NATIONAL SCIENCE FOUNDATION

MATCHMAKER PROGRAM

TECHNOLOGY PROSPECTUS

FY 2000-07

SMALL BUSINESS INNOVATION RESEARCH (SBIR)

SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM

SBIR@nsf.gov
www.nsf.gov/eng/iip/sbir

I am pleased to offer all potential investors our portfolio companies for your consideration. These small businesses are conducting leading edge research in advanced technology areas including biotechnology, electronics, information technology, advanced materials, manufacturing, and chemical processes. Abstracts of research along with contact information are grouped by technology areas. I sincerely believe you will find in this portfolio, high quality researchers pursuing excellent business opportunities.

We at NSF are offering you a service to match your interest with those small businesses that have expressed interest in seeking investors and strategic partners. This is referred to as MatchMaker. Enrollment requires a simple email. Details regarding enrollment appear in the introduction page. Meanwhile, you are welcome to contact them directly if you wish.

I hope you will take advantage of this opportunity to get to know small businesses supported by NSF with exciting technologies with potential for commercial use.

Dr. Kesh S. Narayanan
Director Industrial Innovation & Partnerships
National Science Foundation

MATCHMAKER PROGRAM PROSPECTUS BOOKLET

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Introduction

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program stimulates technology innovation in the private sector by transforming the federally supported research into commercial application leading to wealth creation and societal benefit. NSF is one of ten federal agencies supporting the SBIR/STTR Program. NSF manages over 400 research grants annually to small business firms with an annual R&D investment of over $110 million each year. These grants are competitively selected for their high-risk technological challenges and high potential for commercial applications. In all, less than 20% of all applicants are selected for research towards commercialization.

The research areas of the SBIR/STTR Program cover a broad range of topics in

- Biotechnology,
- Electronics,
- Information-Based Technology,
- Advanced Materials, Manufacturing and Chemical Processes.

To achieve a robust ROI on federal investment, NSF has launched an initiative called the MatchMaker Program. The primary intent is to create a win-win opportunity for investors/strategic partners and NSF funded small business firms. It is intended to help potential investors and strategic partners identify these companies whom they wish to invest in or partner with based on the technology being pursued. Typically, NSF has managed research conducted by each small business firm for at least 3 years. Therefore, NSF is in a strong position to identify the small business firms that best match the interest of investors and strategic partners.

This MatchMaker Program Technology Prospectus catalogues over 800 emerging technology projects NSF has invested in through the SBIR/STTR Program in fiscal years covering 2000 through 2007. In addition, the name of the company and principal investigator performing the research is included for ease of contact.

The NSF SBIR Program is presenting a unique investment opportunity by introducing you to pre-selected, high technology emerging businesses in our portfolio that have each secured nearly $1 million dollars to develop and advance their early-stage, cutting edge research.

We welcome active participation from Venture Capital Firms, Angel Investors and Strategic Industrial Partners and encourage you to sign up in the MatchMaker Program to take advantage of this unique investment and partnering opportunity.

MatchMaker Enrollment

To participate, please send us an email at SBIRmatch@nsf.gov with the following information about your organization:

- Organization Name
- Organization Contact Person
- Phone Number, Email and Mailing Address
- Web-Site Address
- Technology Preference
- Regional Preference
- Range of Typical Investment
- Stage of Typical Investment

For additional information, please contact

T. James Rudd, Program Director (Expert), Industrial Innovation and Partnerships at 703-292-4759 or via email tjrudd@nsf.gov

Kesh Narayanan, Director, Industrial Innovation at 703-292-7076 or via email knarayan@nsf.gov.

Agricultural Biotechnology

Title: SBIR Phase II: Disease Block - Genetically Engineered Plants with Disease Resistance

Award Number: 0111331
Program Manager: Om Sahai

Start Date: September 1, 2001
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Chandrika Ramadugu, ramadugu@ipgenetics.com
Company: Integrated Plant Genetics
12085 Research Drive
Alachua, FL 32615
Phone: (386)462-0880

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to produce transgenic citrus and rice plants carrying novel gene fusions for the purpose of controlling citrus canker and rice blight disease. The fusions consist mainly of peptide aptamers and single chain variable region fragments from monoclonal antibodies (SCFVs) that bind to and interfere with bacterial pathogenicity (Pth) proteins that must be injected by the pathogens into host cells to cause disease. Fusions will be selected that show improved binding at physiologically appropriate pH and temperature ranges by BIAcore analyses. Binding affinities of aptamer SCFV fusions over a range of pH and temperatures will be determined.

The Phase II project will lead to a new, cost-effective genetic method to control a variety of important plant diseases caused by bacterial plant pathogens. Commercial potential would be to the agricultural and forest industries.

Title: SBIR Phase II: Device for In-ovo Targeting and Delivery to the Early Chicken Embryo

Award Number: 0522040
Program Manager: George B. Vermont

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $494,265
Investigator: Phillip Rybarczyk, prybarczyk@embrex.com
Company: EMBREX, INC.
1040 Swabia Ct
Durham NC, 27703
Phone: (919)941-5185

Abstract:

This Small Business Innovation Research (SBIR) Phase II project integrates the imaging system developed in Phase I with a smart-sensor injection system that can inject or sample from the cavity underlying the early chicken embryo with high levels of accuracy accompanied with improved hatch when compared to manual methods. The Phase I work showed that it was possible to image and detect the blastoderm in the presence of a biological membrane with high levels of accuracy (94%). The Phase II project will focus on the technology required to build an injection system using smart sensors that can detect and then move to the fluid cavity to inject (or to sample). The system will thus provide a totally automated solution to early embryo detection and manipulation, with movement in all three dimensions, while still sustaining hatchability of the developing chicken. This research would advance the state of the art for the production of chimeric chickens with superior traits or for producing transgenic chickens for the avian pharmaceutical industry.

The commercial application of this technology is in two large, important industries. In the commercial poultry industry, chimeric chickens could be created in a high-throughput system that possess desired traits like disease resistance (for example, to diseases such as Marek's, Newcastle and Coccidiosis), increased tolerance to stress, and the ability to digest certain feed compounds such as phosphates. Secondly, in the avian pharmaceutical industry, therapeutic proteins used for manufacturing drugs could be created much more cheaply by using a transgenic chicken that can produce transgenic proteins in its eggs. Many therapeutics for diseases like cancer and leukemia are manufactured in mammalian or bacterial systems that face bottlenecks in supply and are extremely expensive to produce. The proposed device advances the state-of-the-art in early embryo injection beyond the limits of the manual method so as to allow a faster, more accurate way of producing transgenic chickens and proteins

Title: SBIR Phase II: Quantitative Detection of Bacterial Pathogens in Seeds by Use of a Novel Enrichment Technique Coupled with Automated Real-Time PCR

Award Number: 0450649
Program Manager: George B. Vermont

Start Date: May 1, 2005
Expires: April 30, 2007
Total Amount: $500,000

Investigator: Parm Randhawa, randhawa@calspl.com
Company: California Seed and Plant Lab., Inc.
7877 Pleasant Grove Road
Elverta CA, 95626
Phone: (916)655-1581

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a highly sensitive PCR-based diagnostic kit for the detection of pathogens in crop seeds. Seed health testing is important in order to identify infected lots that should be excluded from seed sales. Because only a few seeds in a seed lot are usually infected, highly sensitive test methods are needed. The standard method consists of extracting the pathogen into a buffer followed by plating on selective media to isolate the pathogen or identification by PCR. A major limitation of this method is that only a small sample (0.1 ml) can be tested on an agar plate, which gives a maximum sensitivity of only 10 cells per ml. In this project, a novel device called Ampli-disk, has been developed, that allows testing of a 4 ml sample. Further, this Ampli-disk can be stored and used, as needed, unlike agar plates that require fresh preparation for each use. Prior Phase I research has shown that pathogens from seed extracts can be successfully detected and quantified by using Ampli-disk coupled with real-time PCR. In the Phase II project, the objective is to develop Ampli-disks and real-time PCR primers and probes into diagnostic kits for ten most important bacterial pathogens of vegetable crops.

The commercial application of this project will be in agriculture. The proposed technology will be useful to the seed industry and in other bacterial disease diagnostics

Title: SBIR Phase II: Developing Crop Plants with Wide-Spectrum Disease Resistance

Award Number:	0450162
Program Manager:	George B. Vermont
Start Date:	September 1, 2005
Expires:	August 31, 2007
Total Amount:	$462,138

Investigator: Karen Century, kcentury@MendelBio.COM
Company: Mendel Biotechnology Incorporated
21375 Cabot Boulevard
Hayward CA, 94545
Phone: (510)264-0280

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on developing genetically engineered, broad -spectrum disease resistance in plants. An Aribdopsis transcription factor, TDR1, has been identified that causes resistance to three pathogens when overexpressed in transgenic plants. However, constitutive expression of TDR1 or any of three related genes causes growth retardation. Phase I research demonstrated that using tissue specific or inducible promoters to drive the TDR1 genes confers resistance with reduced side-effects. The research objectives of the Phase II project are to test the limits of TDR technology by assaying a broad range of pathogens, optimize the TDR phenotype by mutagenesis, demonstrate TDR function in a crop plant (tomato), and use microarray analysis to correlate gene expression patterns with specific pathogen resistance spectra in Arabidopsis. The results will establish the commercial utility of TDR technology.

The commercial application of this research will be to engineer wide-spectrum disease resistance in crops such as soybean and maize. Chemically based disease management is expensive, harmful to people and the environment, and not always effective. Breeding has long been used for developing resistant cultivars, but the gene pool is limited by reproductive barriers, the technique is slow, and the resistance is generally narrow in scope and often not durable. There clearly is a market for genetically-engineered, durable disease resistance. The main societal benefit of this project is expected to be a decrease in the use of toxic fungicides, which will positively impact the environment and human health.

Title: SBIR Phase II: Implementation of Sex Pheromone-Based Systems to Suppress Populations of Soybean Aphids

Award Number: 0450032
Program Manager: Michael R. Ambrose

Start Date: January 15, 2005
Expires: December 31, 2006
Total Amount: $499,223
Investigator: Junwei Zhu, jwzhu@iastate.edu
Company: MSTRS Technologies Inc.
2501 North Loop Drive
Ames IA, 50010
Phone: (515)294-5930

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop sex pheromone-based techniques for monitoring, mass trapping, and mating disruption of the soybean aphid. Since its first appearance in North America, infestations of the newly invasive soybean aphid, Aphis glycines Matsumura, have continued to cause a significant soybean yield loss due to either direct feeding damage or the vectoring of plant viruses by the aphid. In 2003, the total acreage with soybean aphid infestation was estimated at over 8 million, with yield loss ranging from 32% - 45% in the three biggest soybean growing states in the U.S. (Illinois, Iowa and Minnesota). This project will investigate novel suppression strategies to reduce populations of this pest, thereby reducing the size of the subsequent populations feeding on soybeans.

The commercial application of this project will be to manage aphids in the soybean crop. The research aims to increase knowledge of the chemical ecology of aphids, as well as provide a new understanding of how to use these novel aphid sex pheromone-based control strategies most effectively. This will help growers in the U.S., the world's largest soybean exporting country, to improve crop quality and yield at a minimal cost for soybean aphid management, thereby increasing their competitiveness in the world market.

Title: SBIR Phase II: Microbial Enhancement of Soybeans for Salmonid Diets

Award Number: 0449453
Program Manager: Michael R. Ambrose

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $499,400

Investigator: Clifford Bradley, cbradley@montana.com
Company: Montana Microbial Products
1830 Ronald Ave
Missoula MT, 59801
Phone: (406)544-1176

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a process for enhancing the nutritional value of soybeans to replace fishmeal as the primary ingredient in farmed trout and salmon feed. Fishmeal creates environmental and economic constraints for the aquaculture industry. Plant-derived proteins are a good alternate feed source, but do not meet the nutritional requirements of many farmed fish species including trout and salmon. Prior Phase I work demonstrated that a combination of a selected fungal strain with innovations in solid substrate culture (SSC) would increase the protein content, eliminate the non-digestible carbohydrates and reduce anti-nutritional factors in soybeans. This Phase II project will test pilot-scale SSC technology to determine engineering design and economics for a commercial process to manufacture the bio-enhanced soy protein, and to demonstrate the feed value of this protein in trout feeding trials.

The commercial application of this project will be in the aquaculture industry. The use of fishmeal creates economic, market and water pollution issues for fish farmers, and consumer concerns regarding environmental impacts (for example, there are reports of PCBs, dioxins, and other pesticides detected at higher levels in farmed salmon that have been fed fishmeal based diets). Replacing fishmeal with plant based proteins will promote health through increased fish consumption and will alleviate environmental and economic constraints facing the aquaculture industry.

Title: SBIR Phase II: A Gene Targeting System for Plants

Award Number: 0422159
Program Manager: Om P. Sahai

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,999
Investigator: David Wright, wright@phytodyne-inc.com
Company: Phytodyne, Inc.
2711 South Loop Drive
Ames, IA 50010
Phone: (515) 296-5513

Abstract

This Small Business Innovation Research Phase II project will develop a non-transgenic approach for genetic improvement of crops by using a zinc-finger nuclease strategy for homologous recombination in plants and a strategy for selection of non-selectable phenotypes. The commercial application of this project will be to enable the production of new crop varieties, including those that better withstand pests, have enhanced food value, and produce compounds of industrial importance.

The proposed approach is expected to produce genetically modified (GM) plants requiring less regulatory oversight than existing technologies for plant genetic engineering, facilitating faster and less expensive marketing of GM plants.

Title: SBIR Phase II: Nematode Intestinal Proteins as Anthelmintic Targets

Award Number: 0349756
Program Manager: Om P. Sahai

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $461,021
Investigator: Michelle Hresko, hresko@divergence.com
Company: Divergence, LLC
893 North Warson Road
St. Louis, MO 63141
Phone: (314)812-8024

Abstract

This Small Business Innovation Research Phase II project proposes to develop transgenic roots that are resistant to nematode infection, through expression of small proteins, protein domains or peptides which when ingested by the nematode interfere with the function of essential proteins of the nematode intestine. The longer term goal of the project is to develop transgenic crops (soybeans, corn and cotton), that are resistant to parasitic nematodes. In Phase I research, essential proteins exposed in the nematode intestinal lumen were identified as outstanding targets for anti-nematode agents produced by plants. These proteins are accessible to the environment since the lumenal membrane of the intestine is the surface through which nutrients are absorbed by the nematode. This Phase II project is expected to show that transgenic expression of nematode intestine-toxic peptides at the site of infection would create inhospital host plants for plant parasitic nematodes and would result in resistant crops which do not require application of toxic chemicals for nematode control.

The commercial impact of this project will be on nematode control in major crops. Plant parasitic nematodes are reported to cause $80 billion in crop yield damage annually. The current chemical solutions are limited, environmentally damaging, and toxic to the applicators. Transgenic resistance to nematodes will provide an economically competitive and environmentally safe alternative.

Title: SBIR Phase II: Engineering Broad-Spectrum Disease Resistance in Crop Plants

Award Number: 0349577
Program Manager: Om P. Sahai

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $498,460
Investigator: Teresa Reuber, lreuber@mendelbio.com
Company: Mendel Biotechnology Incorporated
21375 Cabot Boulevard
Hayward, CA 94545
Phone: (510)264-0280

Abstract

This Small Business Innovation Research (SBIR)Phase II project proposes to further optimize the techniques for engineering broad-spectrum disease resistance in crop plants. Protection of crops against pathogens is one of the most significant unmet needs in agriculture. Despite billions of dollars spent on fungicides and other crop protection chemicals, significant economic losses continue to occur every year. Prior Phase I work has established that overexpression of the transcription factor AtERF1 confers resistance against several fungal pathogens in Arabidopsis thaliana. The objectives of the Phase II project are to characterize AtERF1 crop homologs, to demonstrate AtERF1 function in the tomato crop, to optimize the technology by targeting expression to different tissues, to broaden the spectrum of resistance through combinatorial expression with other transcription factors, to optimize AtERF1 function by creating derivatives with enhanced activity, and to improve understanding of AtERF1 function by characterization of targets in Arabidopsis and tomato.

The commercial impact of this project will be significant as there is clearly a market need for conferring broad spectrum disease resistance in economically important crop plants.

Title: SBIR Phase II: Increased Freezing Tolerance in Plants

Award Number: 9983311
Program Manager: Om P. Sahai

Start Date: June 1, 2000
Expires: May 31, 2004
Total Amount: $752,000

Investigator: James Zhang, jzhang@mendelbio.com
Company: Mendel Biotechnology Incorporated
21375 Cabot Boulevard
Hayward, CA 94545
Phone: (510)264-0280

Abstract

This Small Business Innovation Research Phase II project will establish the feasibility of improving the freezing tolerance of canola and wheat plants. Phase I research has demonstrated that Arabidopsis plants show dramatic improvements in freezing tolerance when expressing the CBF gene. However, constitutive expression of the CBF gene was found to be detrimental to plant growth. This Phase II research will determine whether inducible promoters provide freezing tolerance with normal plant growth. Our Phase I and other published work has indicated this approach is very promising. The project goal is to produce enhanced freezing tolerant canola plants, with commercially efficacious growth levels, and provide the molecular biology tools to similarly engineer wheat plants. Canola with improved winter hardiness would be a new high value crop for the US with a value of at least $300 M, as this amount of canola oil is imported annually, and provide a new winter crop rotation system. The project results will also lead to improved winter hardiness in wheat that would improve wheat yields by $940 M. Applications in additional crops such as corn (1995 frost losses of more than $1 Billion), barley, soy, strawberries, and eucalyptus will likely follow once demonstrated in canola. Mendel has targeted canola and winter wheat for the initial applications of the WeatherGard TM enhanced freezing tolerance technology. Spring canola with increased winter hardiness will be a new winter crop suitable for the southern US. Existing spring canola varieties don't survive the winters well enough. WeatherGard TM winter canola will have increased winter hardiness that will allow it to be grown in the midwest. Existing winter canola varieties don't survive midwestern winters very well. One estimate of the value of the trait is that up to 50% of the winter wheat acres or 24 M acres would switch to canola due to its higher profitability and the advantages of crop rotation. Currently wheat is the only widely grown winter crop, so farmers would rotate it with winter canola. The higher oil and protein content of canola creates a higher per bushel value than wheat, translating to a $30/acre increase in value when growing canola. On 24 M acres this higher value crop would create $720 M of new value for farmers. Additional value will be derived from the increased productivity from better crop rotations and the double cropping potential of canola harvested in May. These latter values are hard to estimate in advance but clearly are very large. At a minimum valuation, the US imports $300 M of canola oil annually, so the US canola crop should create at least that much value. Additionally canola is an important crop worldwide (rapeseed) so export opportunities exist as well.

The expected economic benefits of winter wheat are to be in excess of $940 M dollars of extra yield for the US farm economy annually. This assumes that the northern portion of the midwest, particularly North Dakota and South Dakota, that currently can only grow spring wheat, could grow the new variety as a winter wheat with an known 25% yield advantage which represents $500 M dollars of added value. The remaining 80% of the US wheat market should also benefit from increased winter hardiness as sudden frosts after warm spells, very cold freezing temperatures and winter desiccation (essentially drought) are all common problems experienced to various amounts every winter. Improved winter hardiness is estimated to improve winter wheat yields by 10% for an increase in value of $440 M. Thus the combined canola and wheat projects could add over $1.2 to $1.6 billion annually to the US farm economy.

Title: SBIR Phase II: Multispecies Ecological Valuation and Landscape Management

Award Number: 9983279
Program Manager: Om P. Sahai

Start Date: April 1, 2000
Expires: March 31, 2002
Total Amount: $400,000

Investigator: Karen Root, kvroot@bgnet.bgsu.edu
Company: Applied Biomathematics Inc
100 North Country Road
Setauket, NY 11733
Phone: (631)751-4350

Abstract

This Small Business Innovation Research (SBIR) Phase II project will refine, validate, and extend new methods developed in Phase I to compute the community-level risk of extinction or demographic threat for individual sites or landscapes and assign a multispecies conservation value. The objective of such methods is to provide a statistically valid approach to ecological valuation and landscape management. This research will provide an independent measure of the value of a particular site based on its ecological components, i.e., species, and the threats facing it. The new methods will estimate a multispecies conservation value as a spatially explicit weighting of species-specific habitat suitability maps by their respective species-specific extinction risks. This research will also develop a multivariate generalization of recently described exact methods for computing risk of extinction for species of which little is known.

Two potential areas of commercial applications of this project include software sales and case studies. The final product of the proposed research will be part of RAMAS Library of Ecological Software, and will be made available to potential users in overnmental agencies and industrial companies.

Title: SBIR Phase II: Expression Pattern Screening for Agriculture Genomics

Award Number: 0110472
Program Manager: Om Sahai

Start Date: August 1, 2001
Expires: July 31, 2003
Total Amount: $500,000

Investigator: Richard M. Kris, richardkris@earthlink.net
Company: NeoGen, LLC
PO Box 64326
Tucson, AZ 85718
Phone: (520)906-2002

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will use a novel high throughput platform comprising of many, small gene arrays, contained within the wells of microliter plates. This platform, termed Multi-Array Plate Screening (MAPS), allows simultaneous testing of the expression of a specific group of genes of interest and appropriate controls using RNA derived from 96 separate samples, within each well of a 96-well plate. MAPS provides the endpoint assay for a high throughput screen, in which investigators can evaluate how different chemical compounds, applied to cells, tissues, or organisms in vivo, affect the expression pattern for the genes of interest.

This technology will address an unmet need of the agricultural industry to make efficient use of novel genomics information in a manner that does not require distribution of genetically modified organisms (GMOs) in the form of transgenic plants. The plants are grown in each well of a 96 well plate to facilitate high-throughput screening. The platform allows facile and efficient testing of gene targets including newly identified genes, and also provides important information about selectivity and specificity. The commercial potential from this project is in the agricultural market.

Title: SBIR Phase II: Atlantic Cod Nodavirus Vaccine

Award Number: 0724041
Program Manager: F.C. Thomas Allnutt

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $499,393
Investigator: Eric Anderson, mainebiotek@hotmail.com
Company: Maine BioTek
259 Main Street
Winterport, ME 04496
Phone: (207)223-4662

Abstract:

This Small Business Innovation Research (SBIR) Phase II project of develops a recombinant vaccine for the prevention of nodavirus disease of cultured Atlantic cod, fisheries of growing importanct to New England and Atlantic Canada. The recombinant technology used to build the vaccine is economical, safe and results in a potent and efficacious product that improves cod health. The research addresses recombinant antigen synthesis, formulation, safety, potency and efficacy. After translational development, manufacturing and regulatory approval, the vaccine will be available to cod producers for the prevention of nodavirus disease.

The broader impacts of this research will be to enable more facile development of the nascent cod aquaculture industry in respect to methods of viral disease control through vaccination. This is in concert with the desire of the nation to increase aquacultural production significantly by 2020 without impacting the ocean environment negatively.

Biochips/Biosensors

Title: SBIR Phase II: Microfabricated Silicon Devices for Low Cost Microarray

Award Number: 0321601
Program Manager: Om Sahai

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $498,714
Investigator: Robert C. Haushalter, bob@parallel-synthesis.com
Company: Parallel Synthesis Technologies, Inc
333 Ravenswood Ave.
Menlo Park, CA 94025
Phone: (650)859-2112

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a new, commercially viable micromachined silicon technology platform for the printing of DNA microarrays that offer significant advantages over current steel pin technology in cost and in quality. The Phase I effort demonstrated very clearly that a silicon pin reliably imbibed DNA printing solution and deposited spots with a size variance better than that of commercial steel printing pins. Phase II work will focus on the development of a new micromachining protocol based on a combination of wet and dry etching that will allow sculpting of the print tip in all three dimensions. This, in turn, will permit the size, shape and fluid delivery characteristics of the tip to be finely tuned. Printing tip sizes (range: 125 microns x 125 microns to 25 microns x 25 microns) and uptake volumes (range: 0 to 100nL) will allow the pins to precisely take up and deliver any volume or spot size/shape desired. Combined with a much denser packing of pins into a newly designed, all-silicon holder, these attributes will allow DNA microarrays to be fabricated at a cost, speed and quality previously unobtainable.

The commercial application of this project is in the area of DNA microarrays. Due to the weaknesses in the current manually machined steel pins used for printing DNA microarrays (such as extremely high manufacturing costs and low yield, poor pin-to- pin uniformity, the limited range of spot sizes deposited, waste of valuable DNA in uptake and delivery dead volumes, and deposit variability with time due to rapid tip wear), there is an urgent need for an improved printing technology. The new micromachined silicon-printing product to be developed in this project will largely eliminate these drawbacks, and they will be well positioned for market entry as a replacement for existing products by virtue of its lower cost, superior accuracy and speed.

Title: SBIR Phase II: Sensor for Real-Time pH Measurements in Gases

Award Number: 0522325
Program Manager: Michael R. Ambrose

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $500,000
Investigator: Jeffery Schipper, jeff@sierramedical.com
Company: Sierra Medical Technology Inc.
13670 Danielson Street
Poway CA, 92064
Phone: (858)679-2300

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop and market the trademarked Dx-1 pH Measurement System. This medical device integrates the breath pH sensor studied in the Phase I research with an ambulatory, telemetry based data recorder, and data analysis software to provide a non-invasive pH diagnostic tool required by physicians. This pH sensor actively condenses a moisture film on the sensor surface, creating a conduction path across its sensing electrodes. During Phase II, the company plans to complete all technical and regulatory activities in order to gain FDA clearance for product introduction.

The commercial application of this project is in the area of medical devices. The proposed sensor technology will offer a new tool for clinicians to more effectively diagnose and treat respiratory diseases, particularly for children and infants who cannot readily undergo alternative diagnostic procedures.

Title: SBIR Phase II: Ultra-High Sensitivity Surface Plasmon Resonance (SPR) Sensor for Real-Time Botulinum Detection

Award Number: 0522014
Program Manager: George B. Vermont

Start Date: August 15, 2005
Expires: July 31, 2007
Total Amount: $499,800

Investigator: Paul Melman, melmanp@newtonphotonics.com
Company: Newton Photonics
104 Manet Rd
Chestnut Hill MA, 02467
Phone: (617)928-1221

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a prototype botulinum toxin detector based on a novel ultra-sensitive Surface Plasmon Resonance (SPR) technology. The botulinum toxin will be detected by means of the specific cleavage of a peptide substrate attached to the sensor surface. The system will provide results in a fraction of the time and at a much lower cost compared to currently available methods. The feasibility of this technology was successfully demonstrated in Phase I. The research in Phase II will include assay optimization for detection of botulinum types A and B, development of a toxin extraction protocol from complex solutions, and construction of an instrument for multiplexed detection of botulinum toxins. The developed instrument will have the capability for ultrasensitive detection of Botulinum A and B (comparable to the sensitivity of the mouse LD50 assay) on a single chip.

The principal commercial application of this project will be in the detection of biothreat agents. The proposed work, though initially aimed at rapid detection of botulism in individuals and in foods, will be extendable to other biothreat agents such as anthrax and mycotoxins. Additional applications are expected in drug discovery and biomedical research, and for potency testing of botulinum products in medical and cosmetic applications.

Title: SBIR Phase II: ELISA Biosensor for Rapid Bioterrorism Related Agent Diagnosis

Award Number: 0450635
Program Manager: Michael R. Ambrose

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $468,453
Investigator: Winston Ho, winstonho@maxwellsensors.com
Company: Maxwell Sensors Inc.
10020 Pioneer Blvd., Suite 103
Santa Fe Springs CA, 90670
Phone: (562)801-2088

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a self-contained enzyme-linked immunosorbent assay (ELISA) biochip for rapid and confirmatory clinical diagnosis of multiple bio-threat pathogens such as antigens, antibodies, toxins, and viruses. The ELISA chip utilizes microfluidic technology to automate and simplify the assay process on a small chip platform. The plastic chip (reagent pre-loaded) will be affordable and ready for use, and will eliminate the need for a network of tubing connected to bulky external reservoirs and pump systems used in current large clinical laboratory systems. Prior Phase I work successfully developed the microfluidic chip platform and the reader system, and performed assays with anthrax toxin protective antigen (PA) and Francisella tularensis. The Phase II project will focus on system optimization, integration and panel tests, and will result in a prototype to be refined into a commercial product in Phase III.

The commercial application of this project will be in the area of homeland security, for detecting biological warfare agents (BWA) and in managing BWA suspected patients. The ELISA based biochip has the potential to be used as a rapid testing standard to quickly yield preliminary data in advance of microbiology tests. The system, with its extreme sensitivity and specificity, also offers commercial opportunities in the field of clinical diagnostics

Title: SBIR Phase II: Novel Bioaerosol Concentrator/Sampler for Enhanced Biosensor Performance

Award Number: 0450612
Program Manager: George B. Vermont

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $469,973
Investigator: Steve Wright, wright@novafilter.com
Company: Innovatech Inc
6320 Angus Dr Suite C
Raleigh NC, 27617
Phone: (919)881-2197

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a robust, generic, front-end, bio-sampler that when combined with either a wet or dry biological detector, will result in more accurate and rapid detection of hazardous airborne biological agents. While most current systems require samples to be delivered in a fluid for analysis, emerging dry detection technologies facilitate near-real time detection, reduce sampling errors and allow for unattended operation. The prototype bio-sampler developed in Phase I demonstrated very high efficiency in the dry collection mode. This Phase II project has the following objectives: (a) to optimize sampling performance for particles at the low end of the range (<2 micron), (b) to maintain high bio-viability of collected organisms, (c) to function efficiently in the wet or the dry mode, (d) to demonstrate self-cleaning / decontamination features, (e) to evaluate scalability to larger air volumes and, finally, (f) to demonstrate enhanced overall performance in an integrated biological detection system.

The commercial application of this project will be in the area of homeland security and public safety. The proposed technology will enhance the performance of both the detection systems that are presently deployed and that of the advanced biological detectors that are currently under development. Additional applications will be in the monitoring of the environment and of industrial air quality.

Title: SBIR Phase II: X-ray Microscope for In-Vivo Biological Imaging

Award Number: 0450518
Program Manager: George B. Vermont

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $494,620
Investigator: Charles Gary, cgary@adelphitech.com
Company: Adelphi Technology, Inc
981B Industrial Rd
San Carlos CA, 94070
Phone: (650)598-9800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a sub-micron x-ray tomography scanner capable of providing in-vivo and high resolution images of specimens from mice to bacteria. In this era of molecular medicine, where disease and developmental disorders are being re-defined by their peculiar molecular, genetic or cellular profiles, there exists a significant disparity between the type of information gleaned from histological methods and that obtained from conventional non-invasive imaging modalities. With a resolution that is better than these imaging modalities and more than ten times higher than that of current x-ray imaging systems, the proposed device will generate images of development and disease not possible by current methods. The Phase II research will concentrate on the development of the x-ray optical system, including beam conditioning, tomographic imaging capability, and the imaging x-ray lens, and will result in a table-top commercial prototype computerized tomographic imager with 400 nm resolution.

The commercial application of this project will be in the area of medical research. When compared to existing in-vivo imaging technologies, the higher resolution of the proposed x-ray imager will translate to improved sensitivity and specificity of morphologic changes associated with growth and disease. Researchers will be able to use this tool for investigations of a number of medical conditions, including tumor angiogenesis, atherosclerosis, osteoporosis and arthritis

Title: SBIR Phase II: Electronic DNA Biosensor

Award Number: 0450472
Program Manager: Michael R. Ambrose

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $499,715
Investigator: Richard Murante, rmurante@integratednano.com
Company: Integrated Nano-Technologies LLC
999 Lehigh Station Rd
Henrietta NY, 14467
Phone: (585)334-0170

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a portable, rapid, fully - automated, non-Polymerase Chain Reaction (PCR) based, electronic DNA identification device for field use that is capable of accurately detecting low concentrations of biological agents in a broad range of samples. Prior Phase I work demonstrated the feasibility of using palladium-catalyzed nickel to form conductive DNA wires for use in constructing this device. The Phase II project will further advance the DNA detection technology by refining the metallization protocol and integrating the technology into an automated, easy to use format.

The commercial application of this project will be for use by the military and / or for homeland security. The proposed biosensor system is expected to be readily incorporated into existing nuclear, biological and chemical (NBC) detection and reporting systems, enhancing total force protection by enabling the rapid identification, containment and neutralization of biological agents

Title: SBIR Phase II: Kits for the Detection of Bioterror Pathogens

Award Number: 0450469
Program Manager: George B. Vermont

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $499,257

Investigator: Brenda Spangler, brenda.spangler@sensopath.com
Company: Sensopatch Technolgoies, Inc.
2100 Fairview Drive
Bozeman MT, 59715
Phone: (406)585-8192

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop field deployable kits for the detection of bio-terror pathogens. These kits would consist of fluorescent-labeled antibodies directed against protein toxins expressed by bio-terror pathogens, relying for detection on strong antibody-antigen interactions and fast chromatographic discrimination using simple chromatography strips supplied with inexpensive pre-measured reagents. In Phase I project, new water soluble blue-emitting reporter fluorophores were synthesized that were extremely photo-stable and could be easily visualized under any type of light conditions. These fluorophores were conjugated to an antibody against Bacillus anthracis as the initial proof-of-concept, and methodology was developed to attach these reporter fluorophores to monoclonal, polyclonal or recombinant antibodies. The objectives of Phase II project are to optimize reagents and chromatography, to synthesize new fluorophores for multiplexed pathogen detection, to design and assemble prototype kits, and to test and validate the kits.

The commercial application of this project will be in the area of homeland security. The proposed kits are expected to be inexpensive, versatile, and easy to use by relatively untrained first responders (such as police, firefighters, paramedics, hazmat personnel, other emergency response teams).

Title: SBIR Phase II: Rapid Detection of Bacterial Contaminants Using Micro-Fluidic Biochips

Award Number: 0422150
Program Manager: Michael R. Ambrose

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $417,574

Investigator: Laila Razouk, laila.razouk@biovitesse.com
Company: Biovitesse, Inc.
1608 Crow Court
Sunnyvale CA, 94087
Phone: (408)738-4655

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a microfluidic based system for the detection of viable pathogens using dielectric concentration of bacteria as an intermediate step. This system would use a first-stage concentrator, followed by dielectrophoretic concentration, and finally by culturing in media with integrated impedance measurements to detect culture growth.

The commercial application of this project will be on the detection of waterborne microorganisms in biopharmaceutical manufacturing operations. The proposed method would electronically detect the viability of microorganisms in water samples in less than 3 hours, unlike the current technology that takes 2-7 days to yield results.

Title: SBIR Phase II: Nanoelectronic Capnography Sensors

Award Number: 0421966
Program Manager: Om P. Sahai

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $498,969
Investigator: Alexander Star, astar@nano.com
Company: Nanomix, Inc.
5980 Horton St.
Emeryville, CA 94608
Phone: (510)428-5302

Abstract

This Small Business Innovation Research (SBIR) Phase II project will develop a carbon dioxide sensor, using polymer modified carbon nanotudes, for patients receiving anesthesia. The sensor technology relies on two important areas of expertise : the nanotube transducer platform and gas analyte recognition layers. The Phase II project objectives will include optimizing the platform and recognition chemistries that were developed in Phase I. Once a technically suitable recipe is known, sensor chips will be fabricated at the wafer level for large scale testing. The capnography sensors will be packaged and embedded in disposable adapters that fits directly into the patient airway. Hardware and software systems will be designed and integrated with the adapter to deliver sensor information to the end user. At the culmination of Phase II, the capnography sensor system will be validated in a clinical environment and positioned for FDA approval and subsequent market introduction.

The commercial application of this project will be in the area of healthcare. The proposed sensor will have the attributes of low power, small size and low cost.

Title: SBIR Phase II: A Biochip for DNA Detection

Award Number: 0422246
Program Manager: Om P. Sahai

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $499,989
Investigator: Kristian Scaboo, kscaboo@genorx.com
Company: GenoRx, Inc
3916 Trust Way
Hayward, CA 94545
Phone: (510)732-9100

Abstract

This Small Business Innovation Research Phase II project proposes to develop an inexpensive, automated, highly sensitive biosensor chip that would detect small quantities of nucleic acids directly without the need for either a reporter molecule reaction or a PCR expansion reaction. It is expected that the proposed molecular detection platform will provide unparalleled specificity and sensitivity while decreasing sample preparation time by a factor of twenty five, capital costs by a factor of twenty, and the cost of disposables, including the chip, by a factor of five.

The commercial application of this project will be in a number of markets, including biological and biomedical research, diagnostics and forensics.

Title: STTR Phase II: Novel Lipid Deposition for Biosensor Surfaces

Award Number: 0422010
Program Manager: Om P. Sahai

Start Date: September 1, 2004
Expires: August 31, 2006
Total Amount: $460,789
Investigator: Roger Van Tassell, vantassellr@lunainnovations.com
Company: Luna Innovations, Incorporated
PO Box 11704
Blacksburg, VA 24062
Phone: (540)552-5128

Abstract

This Small Business Technology Transfer Research (STTR) Phase II project will use the LPG (Long Period Grating) technology to interrogate the interactions between drugs and G-Protein coupled receptors (GPCRs). To effectively study these interactions, one has to stabilize the GPCRs by immobilizing them to lipid layers. This Phase II project will focus on optimizing the lipid selection, composition, and attachment to the GPRCs and to the surface of the sensor. The development of stabilized lipid based GPCR coating for the LPG biosensor will provide a valuable tool in the area of drug discovery.

The commercial application of this project will be in the area of new high throughput proteomics instrumentation to aid in the development of new therapeutic products.

Title: SBIR Phase II: Portable BioDetection Platform for Rapid Identification of Multiple Biological Agents

Award Number: 0422085
Program Manager: Om P. Sahai

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,911
Investigator: Ihab Abdel-Hamid, iabdel-hamid@mesosystems.com
Company: MesoSystems Technology, Inc.
1001 Menaul Blvd.
Albuquerque, NM 87107
Phone: (509)222-2000

Abstract

This Small Business Innovation Research Phase II project will develop a portable automated biosensor for detection of proteins, viruses and/or pathogens in liquid and air samples. This technology is based on the integration of highly-specific immunodiagnostics with ultra-sensitive electrochemical sensors in a multiplexed microfluidic format that allows the measurement of up to three proteins, two viruses and two bacteria simultaneously. The biosensor is expected to have low detection limits (that is, of less than 0.5 ng/ml for proteins, 1000 PFU/ml for viruses and 700 CFU/ml for bacteria), with an overall assay time of less than 30 minutes. This system will be tested for detection of potential biological threat agents such as Staphylococcal Enterotoxin B (protein/toxin), Influenza (virus) and Bacillus anthracis (bacteria).

The commercial application of this project will be in the areas of homeland security, clinical diagnostics, food quality control and general environmental monitoring.

Title: SBIR Phase II: A Microfluidic-Based Biosensor for Food Pathogen Detection

Award Number: 0422088
Program Manager: Om P. Sahai

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $488,054

Investigator: Xiao-Li Su, xsu@virtual-incubation.com
Company: BioDetection Instruments, Inc.
21 West Mountain
Fayetteville, AR 72701
Phone: (479)571-2592

Abstract

This Small Business Innovation Research (SBIR) Phase II project will develop a portable, rapid and specific capillary channel based immuno-sensing system for food pathogens. The tests will be able to detect concentrations of <10 cfu/ml of various microorganisms (Salmonella, Listeria, Escherichia Coli) in less than 1 hour in contrast to current methods that typically require 24 to 48 hours for preliminary data to become available and typically 3-7 days for definitive results. The capability of the proposed instrument to achieve this significant leap forward in performance was demonstrated by the Phase I results. The Phase II objective is to further refine the instrument with the high performance, ease of use, and low per sample cost needed by the food processing industry.

The commercial application of this project will be in the areas of food safety and bio-defense. Microbial contamination of food products by pathogenic bacteria is a major concern of our society. Contaminated food is estimated to cause 76 million illnesses, 325,000 serious illnesses resulting in hospitalization, and 5,000 deaths in the United States each year. The economic impact of food-borne illnesses has been estimated as high as $10 billion annually. Recent events have also made it clear that the threat from pathogens intentionally introduced into the nation's food supply can be real, with significant economic implications.

Title: SBIR Phase II: Continuously Operating Sensor for Detection of Nerve Agent Contamination in Aqueous Solutions

Award Number: 0422090
Program Manager: Om P. Sahai

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $487,768

Investigator: Markus Erbeldinger, markus@agentase.com
Company: Agentase LLC
3636 Blvd of the Allies
Pittsburgh, PA 15213
Phone: (412)209-7298

Abstract

This Small Business Innovation Research (SBIR) Phase II project is to develop a continuously operating water monitoring device for the detection of chemical warfare agents and hazardous chemicals. Prior Phase I work demonstrated the feasibility of this method and resulted in the construction of a bench-top model that could respond rapidly to contamination, that was resistant to environmental and chemical interference, and that could operate for extended periods of time without user intervention. In Phase II, this model will be modified into a small, self-contained, inexpensive prototype. Several optimized prototypes will be constructed for field trials under operational conditions.

The commercial application of this project will be in the area of bioterrorism.

Title: SBIR Phase II: Anthrax Detector for Mail Sorting Systems

Award Number: 0349687
Program Manager: Om P. Sahai

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $505,985
Investigator: Stuart Farquharson, stu@rta.biz
Company: Real-Time Analyzers
87 Church Street
East Hartford, CT 06108
Phone: (860)528-9806

Abstract

This Small Business Innovation Research Phase II project will develop two prototype anthrax detector systems designed to screen mail entering a postal facility and/or to identify and to stop distribution of anthrax containing mail as it passes through a sorter. These systems will be able to detect 2 micrograms of spores captured from a letter containing as little as 100 micrograms, as well as similar concentrations on contaminated surfaces. The Phase I project demonstrated feasibility by successfully developing a vacuum/filter collection system that captured Bacillus cereus spores from an envelope passing through a mail sorter, which were detected by Raman spectroscopy. Some 23 micrograms of B. cereus spores were measured in 9 seconds using 1064 nm excitation, with an estimated limit of detection of 10 micrograms or 1 million spores in 10 seconds.

The Phase II project will complete the design of the anthrax detector system, with improved sensitivity nd selectivity. The broader impact of this project will be on the safety and security of mail handling and delivery across the United States.

Title: SBIR Phase II: Nanostructured Optical Fiber Breathing Sensors

Award Number: 0349441
Program Manager: Om P. Sahai

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $500,000
Investigator: Jeffrey Mecham, jmecham@nanosonic.com
Company: Nanosonic Incorporated
P.O. Box 618
Christiansburg, VA 24068
Phone: (540)953-1785

Abstract

This Small Business Innovation Research Phase II project will develop and commercialize optical fiber sensors for the quantitative measurement of humidity and air flow for breathing diagnostics. Prior Phase I work has demonstrated that these physically small and mechanically robust sensors respond over a wide range of relative humidities with a response time of microseconds, and are orders of magnitude faster than commercially available devices. The Phase II project will develop sensor thin film chemistries with improved response time, design and fabricate an optical fiber sensor optoelectronic support instrumentation system, and beta-test the sensors and systems with clinicians and physicians. The primary commercial impact of this project will be on home health care and clinical research. Additional applications will be in the industrial gas flow, automotive and transportation areas.

Title: SBIR Phase II: DNA Binding Proteins as Biosensors

Award Number: 0321520
Program Manager: Om P. Sahai

Start Date: December 1, 2003
Expires: November 30, 2005
Total Amount: $498,375
Investigator: Ewa Heyduk, heyduke@slu.edu
Company: Mediomics, LLC
815 Wenneker Drive
Saint Louis, MO 63124
Phone: (314)997-5918

Abstract

This Small Business Innovation Research (SBIR) Phase II project will complete the development of biosensors for detection of heavy metals and acyl-CoA using sequence-specific DNA binding proteins. The presence of the target molecule will be reported by the biosensor as a change in fluorescence signal that could be read using a hand-held battery-operated reader.

The commercial application of this project is in the area of biosensors for markets that include basic and applied research, clinical diagnosis, environmental monitoring, drug screening, and process control in manufacturing operations.

Title: SBIR Phase II: Urea Sensing Biocatalytic Polymers

Award Number: 0321504
Program Manager: Om P. Sahai

Start Date: December 1, 2003
Expires: November 30, 2005
Total Amount: $505,952
Investigator: Markus Erbeldinger, markus@agentase.com
Company: Agentase LLC
3636 Blvd of the Allies
Pittsburgh, PA 15213
Phone: (412)209-7298

Abstract

This Small Business Innovation Research Phase II project proposes to develop prototype urine-detecting products based on enzyme-polymerization and chemical sensing technologies for use in nursing homes, daycare establishments and healthcare facilities. These products will include hand-held sensors, sponge wipes, and bedding fabric pads that change color upon exposure to urine. The strict specificity of the enzymes used in sensor formulation will provide the sensing devices with rapid response times and great precision, thus limiting false positive and negative signals. Having shown the proof of concept in Phase I , the sensor optimization work in this Phase II project will focus on signal enhancement, the development of multi-component sensors for quantitative analysis, and improvements in the usability and the operational shelf life of the proposed sensing products.

The commercial application of this project will be for a broad range of public facilities, including hospitals, nursing homes, daycare centers and food / hospitality establishments.

Title: SBIR Phase II: Biosensor for Label-Free, Real-Time Monitoring of Environmental Pathogens

Award Number: 0321646
Program Manager: Om P. Sahai

Start Date: November 15, 2003
Expires: October 31, 2005
Total Amount: $510,295
Investigator: Salvador Fernandez, fernandez@ciencia.com
Company: Ciencia Inc
111 Roberts Street, Suite K
East Hartford, CT 06108
Phone: (860)528-9737

Abstract

This Small Business Innovation Research Phase II project will develop a portable system for real-time, simultaneous detection and identification of multiple environmental microbes and toxins from aqueous or aerosol samples, on site, with high sensitivity and specificity and with minimal false positives or negative events. The system consists of a disposable biosensor chip and an optical reader device. The detection is based on a proprietary optical transduction technology known as grating-coupled surface plasmon resonance imaging (GCSPRI). Prior Phase I work has demonstrated the feasibility of the GCSPR microarray technology for multiplexed detection with high sensitivity. The goal of the Phase II project is to develop a laboratory prototype of a detection/identification sensor and a prototype chip for multiplexed detection of a model set of three analytes including a bacterium, a virus and a toxin. Non-pathogenic organisms will be used as model systems. Multi-epitope detection methods will be explored for reducing the probability of false alarms. The end result of the Phase II effort will be a demonstration with the laboratory prototype using manual sample introduction. This will provide the logical and critical milestone to transition into commercial development of a portable detection system interfaced to an aerosol collector for field testing and evaluation. The commercial application of this project is in the detection of biological agents for Homeland Defense. The capability for near real-time, multiplexed measurements with a low false alarm rate will be valuable whenever rapid assessment of a contaminated environment is needed.

The potential applications would include hospitals, where nosocomial infections may arise; large buildings, where accidental contamination with mold spores, Legionella and other pathogens may create health hazards; recreational water and drinking water supplies, where waterborne pathogens are a great concern; and the food industry, where there is a need for sensitive methods for on-line and real-time detection of pathogens.

Title: STTR Phase II: Early Detection and Identification of Individual Pathogenic Microorganisms in Food with a Flow Cytometer

Award Number: 0080956
Program Manager: Om P. Sahai

Start Date: June 15, 2000
Expires: June 30, 2003
Total Amount: $449,988
Investigator(s): Richard Shorthill, shorth@me.utah.edu
Company: SoftRay Incorporated
519 South Fifth Street
Laramie, WY 82070
Phone: (307)766-6267

Abstract

This Small Business Technology Transfer Phase II Project will demonstrate the real-time detection of single foodborne pathogenic bacteria in a real-world operating environment. SoftRay demonstrated an innovative technique to detect pathogenic microorganisms in Phase I, based on laser-induced fluorescence coupled with flow cytometry. The Phase I research showed conclusively that this approach is feasible, and that the technique has key advantages over current alternatives including it is: (1) capable of detecting single microorganisms (techniques other than immunofluorescent flow cytometry or immunofluorescent microscopic imaging require in excess of 104 microorganisms; (2) able to completely examine a large volume of food or water in real time; (3) intrinsically automatic; and, (4) sensitive only to the selected bacteria or viruses. In Phase II, SoftRay will demonstrate a lost-cost, self-contained prototype system for the detection of pathogenic microorganisms in food or water, including E. coli O157:H7 on beef. This innovative technique is based on laser-induced fluorescence in which a stream of solution containing the microorganisms is labeled with fluorescent probes and is then illuminated with a laser diode (commonly called flow cytometry). The resulting fluorescence is detected with a CCD imager using a novel time-integration scheme. The proposed device will use a simple optical configuration and a laser diode to provide a low-cost, rugged, small, lightweight package that can be used to detect specific, individual bacteria in real time. Key technology objective is to develop a pathogenic bacteria detection technique that can analyze 1 ml of fluid for selected pathogens in less than 1 minute, to a sensitivity of less than 10 pathogenic microorganisms per ml.

The results of the Phase I and II project will be the demonstration of a prototype sensor capable of individual microorganism detection of unprecedented sensitivity, selectivity, and speed. This will enable rapid detection of individual specific pathogenic microorganisms in a wide array of applications, including: food processing inspection, clinical applications (such as detection of tuberculosis in sputum), biological warfare defense, and many other situations where single microorganism detection is required. The technique can also be used to detect small numbers of molecules, including explosives and groundwater contaminates.

Title: STTR Phase II: Cell-Mimic Optical Waveguide Sensor for Real-Time In-Line Biological Pathogen Detection

Award Number: 0080598
Program Manager: Om P. Sahai

Start Date: August 15, 2000
Expires: January 31, 2003
Total Amount: $449,998

Investigator: Allan Wang, awong@intopsys.com
Company: Intelligent Optical Systems Inc
2520 W. 237th Street
Torrance, CA 90505
Phone: (310)530-7130

Abstract

This Small Business Technology Transfer Research (STTR) Phase II project will develop a cell-mimic optical-based biosensor for the real-time detection of foodborne biological pathogen. Five million analytical tests are performed on food annually in the U.S.; unfortunately, current microbiological test methods are time consuming and labor intensive. Intelligent Optical Systems, in collaboration with the Scripps Research Institute, proposes to develop an optical biosensor that mimics a cell membrane that has undergone biological pathogen attack. The response of the cell-mimic biochromatic membrane to the foodborne toxins is sensitive, specific, and instantaneous. During Phase I, the team developed "highly stable" cell-mimic membranes and demonstrated them in two laboratory systems: (1) a cell-mimic optical waveguide sensor (COWS) for "in-line" monitoring, and (2) a cell-mimic optical bead sensor (COBS) for "on-site point detection". These laboratory systems were used to detect foodborne toxins (E. coli-enterotoxin and cholera toxin) with excellent speed (< 1 minute), sensitivity (500 - 1 ng/ml), specificity (molecular receptor), and simplicity (one step).

Phase II will focus on optimizing the cell-mimic biochromatic polymers, engineering and field-testing a portable COBS prototype, and extending the tests to other foodborne toxins.

Title: STTR Phase II: A Microsensor for Rapid Detection of Airborne Endotoxin

Award Number: 0080569
Program Manager: Om P. Sahai

Start Date: December 1, 2000
Expires: November 30, 2002
Total Amount: $449,929
Investigator: Russell Mileham, rmileham@midwestmicro-tek.com
Company: Microconversion Technologies Co
1322 4th St
Brookings, SD 57006
Phone: (605)688-4618

Abstract

This Small Business Technology Transfer (STTR) Phase II project is expected to result in a biosensor based instrument that can reliably and economically capture and measure airborne endotoxin in-situ with better specificity than existing assay methods. Airborne endotoxin has been identified as a major health hazard to both humans and animals in many agricultural and industrial settings. Endotoxins in the environment primarily enter the body through the lung and are difficult to clear. This contributes to the development of respiratory disorders. Regulation of human endotoxin exposure has not been possible to this point since no quick, reliable system exists to measure airborne endotoxin in the field. Current methods of measuring airborne endotoxin involve collecting dust samples in a sterile filter and sending them to a laboratory for analysis. The results of the analysis take weeks to receive and have poor specificity to endotoxin. The proposed instrument is expected to provide a more accurate, specific, rapid, and reliable alternative to existing assays for detecting airborne endotoxin in the range of 0.01 mg/m 3 to 20 mg/m 3. Measuring endotoxin levels and subsequent modification of airflow will minimize human endotoxin exposure, and lead to improvement in the respiratory health of workers.

A biosensor to detect airborne endotoxin will have commercial applications to protect human health in areas such as livestock confinement and processing facilities, produce storage and processing facilities, cotton processing facilities, waste management facilities, and air quality monitoring of office buildings. Since endotoxin also represents a threat to the health of livestock, particularly swine and poultry, the animal/veterinary sciences market is also expected to be significant.

Title: STTR Phase II: Optic Fiber Sensors for the Detection of Pathogenic Microorganisms

Award Number: 0080372
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2000
Expires: July 31, 2002
Total Amount: $449,464

Investigator(s) Roger Van Tassell, vantassellr@lunainnovations.com
Company: Luna Innovations, Incorporated
PO Box 11704
Blacksburg, VA 24062
Phone: (540)552-5128

Abstract

This Small Business Technology Transfer Research (STTR) Phase II project addresses the need for rapid, reliable instrumentation for the detection of pathogenic microorganisms in food and environmental screening. The proposed system is based on MEMS-based, optical fiber, extrinsic Fabry-Perot (EFPI) biosensors. During Phase I, Luna Innovations (formerly F&S, Inc.) optimized the EFPI sensing platform for refractive index measurements, applied affinity films to measure kinetic binding with specific antibodies and non-hazardous proteins, and integrated the sensors with an inexpensive signal conditioning system for a complete detection combination. The newly developed system is capable of cost effective, robust, operationally simple detection. It is easily adapted to incorporate microfluidics or other sampling system interfaces thereby offering improvements in refractive index measurements, as well as biosensing capabilities. During Phase II, this sensing system will be incorporated with microfluidic sampling systems and used to demonstrate simple detection of proteinacious targets of Escherichi coli and Vibrio cholerae, and will later be expanded for other high priority pathogens found in raw and processed food products, contaminated water and soil, and biological warfare agents.

The prototype system has already generated tremendous interest from many companies involved in refractive index measurements for process control, target screening within the food industry, and other biological research applications. The EFPI as a refractometer has found applications within the beverage industry for milk processing, and the petroleum and chemical industry for distillation processes and concentration monitoring. As a biosensor, the EFPI will find widespread application in multibillion dollar annual markets in food, environmental, medical, and industrial applications.

Title: SBIR Phase II: Fish Freshness Quality Sensor

Award Number: 9983412
Program Manager: Winslow L. Sargeant

Start Date: July 1, 2000
Expires: June 30, 2002
Total Amount: $393,796

Investigator: Dean Smith, dsmith@srdcorp.com
Company: Sensor Research and Development Corp
17 Godfrey Drive
Orono, ME 04473
Phone: (207)866-0100

Abstract

This Small Business Innovation Research (SBIR) Phase II project will further the design, development, construction, and evaluation of a prototype fish freshness sensor based on the successful Phase I feasibility demonstration of using an array of semiconducting metal oxide chemiresistive sensors for quantitative fish freshness quality determination. The advantages of this approach to fish freshness monitoring is that the array data will provide information about the complex gases emitted by fish during degradation and will provide a basis for signal processing techniques to quantify the fish freshness.

The Phase II research is directed towards extending the Phase I demonstration of determining the freshness of Atlantic salmon to other species of fish and to a wider variety of fish handling procedures. The fish freshness sensor data will be compared with results from a gas chromatograph mass spectrometer and a sensory evaluation panel of trained individuals. A field-deployable prototype will be tested on location at fish processing plants to non-destructively determine the degree of degradation of fresh marine fin fish.

Title: SBIR Phase II: Continuous On-Line Monitor to Detect and Quantify Inorganic Contaminants in Water

Award Number: 9983370
Program Manager: Om P. Sahai

Start Date: July 1, 2000
Expires: June 30, 2002
Total Amount: $356,400

Investigator: Rex M. Harper, brimsness@ceemaine.org
Company: BRIMS NESS Corporation
3 Adams Street
South Portland, ME 04106
Phone: (207)767-4302

Abstract

This Small Business Innovation Research (SBIR) Phase II project will advance the resin/quartz crystal microbalance sensor technology demonstrated in Phase I. The device revolutionizes current water monitoring methods by allowing continuous monitoring where only periodic sampling can now be performed. In the Phase II project, ultra-pure water (UPW) monitors will be fabricated and analyzed at a university test facility as well as at a nuclear power plant and semiconductor facility. The monitor will be calibrated and a computerized model characterizing the device's performance in a UPW environment will be developed. The technology consists of applying ion exchange resins to a quartz crystal microbalance sensor device. Once manufacturing repeatability is achieved, the suite of detected contaminants will be broadened to include a wide range of toxic substances of interest to the federal government.

Ultimately we expect to increase the monitor's capability to include all heavy metals set forth in the Clean Water and the Safe Drinking Water Acts. Applications include the development of industrial process control monitors for ultra pure water applications such as semiconductor manufacturing, fail-safe devices to insure the continued effectiveness of drinking water filters, and continuous monitors to detect contaminants in EPA-regulated monitoring sites such as municipal water utilities and wastewater treatment plants.

Title: SBIR Phase II: Rubbed Protein Substrates for Low Cost Biochips Based on Liquid Crystals

Award Number: 0239240
Program Manager: Om Sahai

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000

Investigator: Barbara Israel, bisrael@platypustech.com
Company: Platypus Technologies llc
505 South Rosa Road
Madison, WI 53719-1257
Phone: (608)441-2789

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop an entirely new class of biochips, with a particular focus on biochips designed to track the expression, activation and post-translational modification of proteins involved in cell signaling processes. The technology is based on the use of liquid crystals to image biomolecular interactions at structured surfaces. The goal of this Phase II Project is to demonstrate the substrates for liquid crystal-based biochips that detect activated states of proteins and that can be prepared from mechanically rubbed films of protein (that are) covalently attached to glass substrates. Important issues of non-specific binding, binding of activated states of specific target proteins, sample delivery, sensitivity and quantization will be addressed. These results, when combined with the results of the Phase I research, will make possible the determination of the extent to which cell signaling proteins are activated within biological samples (e.g. in cell lysates).

The commercial applications of this project will be in the areas of proteomics and in vitro diagnostics. The development of the proposed technology will allow for rapid, inexpensive, multi-target, high-throughput analysis of proteins and their modification states.

Title: SBIR Phase II: Biosensor for Rapid Whole Blood Assays using Magnetic Labels and Giant Magnetoresistive Sensors

Award Number: 0548638
Program Manager: Errol Arkilic

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $466,710
Investigator: Curt Bilby, curt.bilby@seahawkbio.com
Company: Seahawk Biosystems
3000 Bryker Drive
Austin, TX 78703
Phone: (512)459-7063

Abstract:

This Small Business Innovation Research (SBIR) Phase II project advances the general state of diagnostics research in the veterinary and security/defense markets using whole-blood assays. This Phase II project will develop (1) an automated Open Assay Development Platform for rapid assay prototyping; (2) whole blood assays for canine immunity assessment and canine thyroid test (T4); and, (3) multiplexed, canine whole blood assays. The approach uses magnetic beads to label biomolecules captured onto a receptor-patterned microchip that contains an embedded array of magnetic microsensors. The magnetic microsensors are wire-like structures that display giant magnetoresistance (GMR). When coupled with controlled fluidic force discrimination - an innovation that greatly reduces unwanted background signal - rapid identification of biomolecules with high sensitivity and specificity is achieved. A prototype system has been developed for both immunoassays and nucleic acid assays, with immunoassays (1 ng/mL) saturating in less than 10 minutes and unmodified DNA detected at 10fm in less than 20 minutes.
Seahawk is responding to the clinical and financial challenges veterinarians face by developing a multi-use, multiplexed instrument and associated disposable cartridges.

This technology platform offers veterinarians superior performance (faster, more accurate, easier to use) and greater profitability than existing products. Initially, the platform will include cartridges for two applications: (1) individualized immunity assessment and (2) disease diagnostics, both specifically for dogs and cats. The system provides an in-clinic, quick turnaround, cost-effective and accurate test of an animal's immune system to determine what, if any, vaccine boosters need to be administered at that time. This provides the veterinarians with three key benefits: (1) improving the quality of care - providing revaccinations only when needed and tailored to each animal; (2) generating additional or replacement revenue due to changes in revaccination protocols; and, (3) replacing annual revaccinations as the impetus for customer compliance with scheduling office visits for physical exams.

Title: SBIR Phase II: Toxic Mold Sniffer

Award Number: 0548727
Program Manager: Ali Andalibi

Start Date: September 21, 2006
Expires: September 30, 2008
Total Amount: $471,421
Investigator: Debra Mlsna, dmlsna@seacoastscience.com
Company: Seacoast
2151 Las Palmas Drive
Carlsbad, CA 92009
Phone: (760)268-0083

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will develop a small, battery-powered sensor for the detection of toxic chemicals produced by molds responsible for "sick building syndrome," and for the detection of such toxic molds in infested buildings. The company's MEMS chemicapacitor technology utilizes an array of surface-micromachined capacitors coated with chemo-selective materials. The proposed device will detect toxic compounds produced by indoor molds, as well as associated volatile organic compounds.

The detection and isolation of suspect molds is a major indoor environmental concern. The sensor technology proposed for use in the company's sensor system can be packaged for single-use home detection kits, or can be incorporated into reusable detection units for surveillance by commercial interests.

Title: SBIR Phase II: Microchip Assay for Glycosylated Hemoglobin

Award Number: 0548744
Program Manager: F.C. Thomas Allnutt

Start Date: March 1, 2006
Expires: February 29, 2008
Total Amount: $480,024
Investigator: Dale Willard, dale.willard@colostate.edu
Company: Advanced MicroLabs LLC
527 Matthew St
Fort Collins, CO 80524
Phone: (970)491-4064

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at developing the next generation of diabetic monitoring devices that will allow the measurement of multiple markers of disease regulation and progression using an innovative lab-on-a-chip technology. The project will develop the first integrated microchip CE device for measurement of an important maker of diabetes.

This technology will impact patient monitoring for disease progression and therapeutic efficacy by following biomarker more efficiently as well as being used at the point of care. This eliminates the time and cost currently required to perform follow up laboratory tests. The technology approaches the chemistry of biomarkers from a non-traditional sensor mechanism and shows great promise for the detection and use of biomarkers for specific diseases.

Title: STTR Phase II: Microfluidic CD Biochips for Enzyme-Linked Immunosorbent Assays

Award Number: 0548716
Program Manager: Ali Andalibi

Start Date: December 15, 2006
Expires: November 30, 2008
Total Amount: $500,000
Investigator: Wei-Cho Huang, wchuang@bioloc.net
Company: BioLOC LLC
1381 Kinnear Road #100
Columbus, OH 43212
Phone: (614)481-9135

Abstract:

The Small Business Technology Transfer (STTR) Phase II project will develop a low-cost and mass-producible lab-on-a-chip platform for molecular and biological analyses. The platform is a microfluidic CD for Enzyme-Linked Immunosorbent Assays (ELISA) that reduces cost, accelerates results, and improves reliability of analyses for food borne contaminants, cancer diagnoses and environmental contamination.

The CD-ELISA technology platform merges two scientific areas - polymer microfabrication and biotechnology - and can substantially reduce manufacturing costs, improve device performance, and enable the production of low-cost and high-efficiency devices. Moreover, as such a device would be more affordable it will enable point-of-use results for a broader spectrum of molecular and biological testing.

Title: SBIR Phase II: Immunological Tools for Trimetasphere Fullerenes

Award Number: 0724380
Program Manager: F.C. Thomas Allnutt

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,955
Investigator: Roger VanTassell, vantassellr@lunainnovations.com
Company: Luna Innovations, Inc.
1703 South Jefferson Street, SW
Roanoke, VA 24016
Phone: (540)769-8400

Abstract:

This Small Business Innovation Research (SBIR) Phase II research develops antibodies and immunoassays for studying therapeutics based on carbon-based nanomaterials. This research will expand the immunological tools developed in Phase I to focus on detailed characterization of anti-fullerene antibodies and validate and down-select immunoassays and reagents for validated commercial formats. Commercial formats will include enzyme-linked, immunosorbant assays (ELISAs) for medical and environmental applications, neutralization schemes for mitigating potential toxicity of fullerene/nanotubes and biosensors platform for long-term monitoring systems. Biosensor platforms based on fullerene antibodies as affinity ligands will include the quartz crystal microbalance and surface acoustic waveguide.

The broader impacts will be to provide a full spectrum of immunological tools for studying the medically-related nanomaterials and monitoring nanowaste by-products during manufacturing processes. These will be new to the marketplace and enable monitoring of the use of products based on these nanomaterials to asssure their safe application.

Bioinformatics

Title: SBIR Phase II: Development of Integrated Fluid/Solid/Bio-Kinetic Simulation Software for the Characterization of Microsphere-based Bio-analytic Systems

Award Number: 0216507
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amt: $499,948
Investigator: Shivshankar Sundaram, jls@cfdrc.com
Company: CFD Research Corporation
215 Wynn Drive, 5th Floor
Huntsville, AL 35805
Phone: (256)726-4800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and customize advanced simulation software for the design and optimization of microsphere and cell-based assays. Current assay design by trial and error is slow, unreliable, expensive, and a bottleneck for multiplexed, high-throughput analysis. Prior Phase I research has successfully established a first-ever, truly integrated (buffer flow, resolved microsphere motion and surface biochemistry) assay design and analysis tool. The objective of the Phase II effort is to further develop the initial models demonstrated in the Phase I effort into a comprehensive, generalized design environment. A suite of bead-surface biochemistry models (enzyme kinetics, multi-step reactions) and including user specifiable surface reaction mechanisms will be developed and fully integrated. In seeking to expand the application to cell-based assays, models for the motion and capture of deformable cells will be created, and detailed flow visualization experiments tracking bead and cell motion as well as assay endpoints in microfluidic channels will be conducted to guide and validate these models. The value of the developed simulation tool will be demonstrated in the proof-of-concept design of a novel microfluidic, cell-based H-filter assay for red-blood cell based aminothiols.

The commercial applications of this project will be in the biotechnology and bioassay design markets. Miniaturized, multiplexed, high-throughput, fast, efficient and sensitive assays are a pre-requisite to translating the wealth of data from the human genome and combinatorial libraries into effective therapeutics. The developed software product will enable rational, computer-based design of these bioassays.

Title: SBIR Phase II: Bioinformatic Data Mining for AIDS Resistance Genes

Award Number: 0450627
Program Manager: George B. Vermont

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $499,961
Investigator: Walter Messier, wmessier@evolgen.com
Company: Evolutionary Genomics, LLC
6840 N. Broadway
Denver CO, 80221
Phone: (303)429-5800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the use of novel evolution-based data mining software to discover targets for the development of human therapeutics for currently intractable diseases. Phase I demonstrated that the evolution-based data-mining software was useful for dramatically narrowing the search for proteins that make chimpanzees resistant to the progression of AIDS after infection by HIV-1. In Phase II, the impact on in-vitro HIV-1 infectivity of a human cell line transfected with the gene encoding one of the adapted chimpanzee proteins will be assessed. Screening of other chimpanzee homologs of genes differentially regulated in human cells upon HIV-1 infection will continue to ensure that all potential AIDS resistance proteins have been identified. The adapted chimpanzee genes/proteins will be compared to those from humans in which HIV-1 infection has not progressed to AIDS for at least 10 years to see if there are any commonalities.

The commercial application of this technology is in the battle against AIDS disease. The identification of proteins that have undergone adaptive evolution should lead to drugs to mediate the progression of HIV-1 infection. This same approach may have broader impact against several other intractable diseases for which non-human primates are less susceptible than humans. This includes hepatitis-C, sepsis, type-1 diabetes, and certain cancers

Title: SBIR Phase II: A Bioinformatics System for GCxGC-MS (Comprehensive Two-Dimensional Gas Chromography)

Award Number: 0450540
Program Manager: George B. Vermont

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $493,692

Investigator: Qingping Tao, qtao@cse.unl.edu
Company: GC Imaging
216 N 11th St, Ste 302
Lincoln NE, 68508
Phone: (402)310-4503

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to use bioinformatics to transform complex data produced by comprehensive two-dimensional gas chromatography with mass spectrometry (GCxGC-MS) to usable chemical information. GCxGC-MS is an emerging technology for chemical separations that provides an order-of-magnitude increase in separation capacity over traditional GC. Results from Phase I demonstrated the feasibility of using bioinformatics to automatically identify chemical components in complex matrices analyzed by GCxGC-MS. Phase II will carry out further theoretical and experimental research to develop solutions that will enable broader use of GCxGC-MS system. The key project objectives include (a) developing a hybrid method that combines three approaches for chemical identification from GCxGC-MS data, (b) establishing the mathematical foundation and practical algorithms for co-elution analysis in GCxGC-MS, and (3) developing new XML technologies for shared and distributed GCxGC-MS data, metadata, and information.

The commercial impact of this project will be to develop information technologies for a new generation of analytical instruments. GCxGC-MS system is likely to capture a significant share of the existing gas chromatography market, currently in excess of $ 1 billion per year, and to open new markets in applications requiring superior separations. These applications with important societal benefits, would include environmental monitoring of air, water, and soil; development and processing of foods, flavors, fragrances, and essential oils; processing of petroleum and industrial chemicals; health-care assays of blood, urine, milk, and breath samples; and analysis and discovery of drugs and medicinal herbs.

Title: SBIR Phase II: Comprehensive Database Resource on Protein Localization

Award Number: 0239206
Program Manager: Om Sahai

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,407
Investigator: Christopher N. Larsen, clarsen@cognia.com
Company: Cognia
117 East 55th Street
New York, NY 10022-3502
Phone: (212)331-7841

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to develop the database and associated software to enable analysis of protein trafficking and localization. The system will be designed to enable drug discovery researchers to identify, elucidate, eliminate and design leads and targets, while facilitating the general training of researchers. During the Phase I work, proteins involved in trafficking and diseases related to mislocalization were identified, and a relational database to house information on protein trafficking was constructed. Curation interface applications were created to allow remote data entry, and graphical user interfaces designed to maximize the utility of the information. The objective of this Phase II Project is to exhaustively populate the database from the primary journal literature. Selection of proteins involved in protein trafficking will be guided by relevant human diseases and corresponding drug discovery efforts.

The commercial application of this project is in the area of biological informatics. The potential users of the biological database to be developed in this project would include pharmaceutical and drug discovery companies.

Title: SBIR Phase II: Hypertension Treatment Responder Prediction

Award Number: 0220661
Program Manager: Om Sahai

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Albert K. Man, aman@burnham.org
Company: Predict
4540 Georgia St.
San Diego, CA 92116-2636
Phone: (619)255-8730

Abstract:

This Small Business Innovation Research Phase II project will develop a clinical predictive algorithm for hypertension medication response based upon patient genetic and medical information. The development of effective treatment for hypertension is critical to controlling costs of this disease, which has the largest negative impact on the U.S. economy in loss of productive years. Anti-hypertensive drugs have a large window of therapeutic options, including significant variation in dosages, medications, and combinations of therapies used. The objective of the Phase II project is to continue development of the software platform, GeneRx, which incorporates pharmacogenetics and nonlinear adaptive algorithms toward optimizing anti-hypertension therapy on a patient specific basis. Genetic data for each patient will be acquired by genotyping DNA from the blood samples, and scored as single nucleotide polymorphisms (SNPs) present or absent in key hypertension-related genes. GeneRx will take a patient's individual genetic, demographic, and environmental variables and predict likely efficacy of a hypertension medication. In Phase I, the basic feasibility of a predictive algorithm for predicting patient response for the ACE inhibitor class of hypertension drugs was established. The Phase II project will use patient information and blood samples from both archival and ongoing hypertension studies to predict the effectiveness of other classes of hypertension medications, including calcium channel blockers, diuretics, and beta-blockers.

The commercial application of this project is in the area of hypertension therapy.

Title: SBIR Phase II: Physiologic High Throughput Screening of Bioengineered Tissues

Award Number: 0724445
Program Manager: F.C. Thomas Allnutt

Start Date: August 15, 2007
Expires: July 31, 2009
Total Amount: $499,956

Investigator: Herman Vandenburgh, hvandenburgh@myomics.com
Company: Myomics
4 Richmond Square, STE 500
Providence, RI 2906
Phone: (401)861-9770

Abstract:

This Small Business Innovation Research (SBIR) Phase II research develops an innovative high-throughput/high content drug screening platform that utilizes three-dimensional human skeletal muscle tissue constructs that mimic in vivo skeletal muscle to quantify muscle force generation. Significant demands exist for new drugs to treat contractility disorders involving skeletal muscle. Myomics' proposed drug testing platform will contribute to significant reductions in time and costs associated with bringing new drugs to market by discovering drug candidates and eliminating ineffective compounds earlier than currently possible. Unlike existing systems, this approach incorporates biomechanics into drug discovery using mechanical sensors to detect contraction of multiple identical tissue samples over extended time periods. Significant socioeconomic and quality-of-life impacts will result for patients with contractility disorders (sarcopenia, atrophy, or Duchennes muscular dystrophy). While most drug screening protocols test one protein pathway at a time, this platform provides a unique physiological screening system and protocol which quantifies contraction as the result of multiple protein pathways interacting over time.

The broader impacts of this research will be to enhance muscle contractility disorder/disease research and provide new tools to the pharmaceutical and biotechnology industries for drug discovery. Upon successful development, the sensing mechanism will potentially be used to develop treatments for several contractile tissues relevant to a range of important human contractile disorders and diseases contributing to improved outcomes for these diseases.

Biomaterials

Title: SBIR Phase II: Suction Retention Smart Variable Geometry Sockets (SVGS) for Transtibial Prostheses

Award Number: 0091513
Program Manager: Om Sahai

Start Date: June 1, 2001
Expires: May 31, 2004
Total Amount: $499,992
Investigator: Richard M. Greenwald, rgreenwald@simbex.com
Company: SIMBEX
Lebanon, NH 03766
Phone: (634)482-367

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will complete development of a production Smart Variable Geometry Socket (SVGS) for transtibial amputees (TTAs) and will test it with a clinical study. This non-electrical system is a simple means for ensuring and maintaining a good socket fit, with security and stability increased over the state of the art. Poorly fitting sockets, which cause pain and skin lesions, are responsible for a significant portion of TTAs rejecting prosthesis. The SVGS/TT utilizes suction retention, which provides an important benefit, particularly to diabetics, by increasing blood circulation in the residual limb.

The unique SVGS system consists of multiple, liquid-filled bladders placed by the prosthetist during socket fitting and a control for maintaining appropriate pressures on the residual limb at selected locations, all contained within the dimensions of a conventional prosthesis. The SVGS can be applied by the prosthetist with existing equipment and conventional art, thereby minimizing implementation cost. This attribute will enhance market acceptance. Phase I demonstrated feasibility; Phase II will measure efficacy and acceptance by TTAs. Phase II results will be the catalyst for successful commercialization.

Title: SBIR Phase II: All Natural Biobased High Performance Composites for Industrial Applications

Award Number: 0518940
Program Manager: George B. Vermont

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $450,117
Investigator: N Hecht, bhecht@acrtucson.com
Company: Advanced Ceramics Research, Inc
3292 E Hemisphere Loop
Tucson AZ, 85706
Phone: (520)573-6300

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to optimize and commercialize the manufacturing of all natural biobased composites from renewable resources. Phase I research demonstrated the technical feasibility of fabricating soybean oil based composites using a selected fiber/resin polymer composite combination. The Phase II project will focus on optimization and scale-up of the fabrication approach and process to improve the performance of the biobased composites. Further, with the help of commercial partners, Phase II work will develop a number of full scale prototype products with the following features: (1) the products contain 80% or more natural fibers and resins; (2) the products rely on economical and environmentally friendly tooling and manufacturing processing; and (3) the products comply with performance, safety, durability, and cost requirements set by end-users.

The commercial applications of this project will be in a number of areas, including low cost building materials for industrial and household furniture, packaging materials, piping for remote areas and aquaculture systems. The proposed biobased composites are expected to have higher value-in-use industrial applications than their petroleum counter-parts (that is, to be available at a lower cost while offering the same functionality).

Title: SBIR Phase II: Advanced Controlled-Impedance Transfemoral Knee/Ankle Prosthesis

Award Number: 0450632
Program Manager: Michael R. Ambrose

Start Date: January 15, 2005
Expires: December 31, 2006
Total Amount: $500,000
Investigator: Edwin Iversen, ed@utaharm.com
Company: Motion Control, Inc.
2401 S 1070 W # B
Salt Lake City UT, 84119
Phone: (801)978-2622

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a transfemoral prosthesis which will allow wearers to walk and run more smoothly, with greater stability and less effort. Typically, transfemoral amputees have difficulty achieving a natural gait, thus causing discomfort and greater energy expenditure. It is expected that the development of this advanced prosthesis will greatly enhance the function and comfort of amputees and bring new technology to the prosthetic industry. In Phase I research, a unique engineering model of the knee and the ankle was developed, implementing the pneumatic compliance (spring) and electrically-controlled hydraulic damping. In Phase II, complete prototypes of the microprocessor-controlled knee/ankle prosthesis will be developed, with the following features: (a) compliant (elastic, rather than stiff) knee flexion during stance phase, which will return energy to the wearer and improve comfort, (b) co-ordination of knee and ankle impedance to match desired walking cadence, and minimal energy expenditure by tuning the spring rate to the natural frequency; and (c) myoelectric control of knee impedance. In addition, high-performance features will be integrated into the prosthetic device, including adaptive swing phase knee impedance, and automatic control of stance phase impedance.

The commercial application of this project will be in the area of prosthetic devices for use by people with knee and foot (transfemoral) amputation. The proposed product will allow the amputees to wear their prosthesis for a longer time period, with less effort and more safety, and to walk on more rugged and uneven terrain. Estimates of revenues resulting from this project show gross sales starting at $750,000 per year, growing rapidly after 5 years to over $8,000,000

Title: SBIR Phase II: Tissue Engineered Cartilage for Drug Discovery

Award Number: 0422194
Program Manager: Om P. Sahai

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $498,843
Investigator: Brian Pfister, bpfister@articular.com
Company: Articular Engineering, LLC
1818 Skokie Blvd. Suite 158
Northbrook, IL 60062
Phone: (847)498-9634

Abstract

This Small Business Innovation Research Phase II project is to develop scale-up production technology to produce engineered cartilage for drug discovery using a proprietary Alginate Recovered Chondrocyte (ARC) method. This method stimulates adult human cartilage cells to form a cartilaginous tissue with proper compositional and functional properties. ARC cartilage tissue is expected to offer a cost-effective alternative to current culture systems and expensive animal studies while utilizing human tissue.

The commercial application of this project will be in the area of drug discovery for cartilage-related problems such as rheumatoid arthritis.

Title: SBIR Phase II: Scalable Synthesis and Processing of Nanocrystalline Hydroxyapatite

Award Number: 0349884
Program Manager: Om P. Sahai

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,999
Investigator: Edward Ahn, eahn@angstrommedica.com
Company: Angstrom Medica, Incorporated
150 California Street
Newton, MA 02458
Phone: (617)454-3620

Abstract

This Small Business Innovation Research Phase II Project proposes to use a newly developed synthetic nanocrystalline hydroxyapatite (HAP) bone material to produce high-strength, resorbable synthetic bone implants for anterior cruciate ligament surgeries. This material solves the problem of current orthopedic implants (made of polymer and/or metal) which either permanently reside as foreign material in the body or quickly degrade into a formless mass of non-ossified, non-load bearing tissue. The objectives of the Phase II work are to concurrently scale up manufacturing processes for HAP to near-commercial levels while developing an anterior cruciate ligament (ACL) prototype product for testing in vivo.

The commercial impact of this project will be in the area of orthopedics. The proposed technology will help decrease the time of healing in surgeries requiring implants (fractiures, ACL) and will minimize the need for second surgeries to remove the screws and/or to correct for morbidities.

Title: SBIR Phase II: A New Vibration Mixer for Bone Cement

Award Number: 0079484
Program Manager: Om P. Sahai

Start Date: September 15, 2000
Expires: August 31, 2002
Total Amount: $399,892

Investigator: Pamela Saha, pssaha@prodigy.net
Company: Clinical and Industrial Technology Co
1570 Woodbury Road
Seneca, SC 29672
Phone: (864)653-6472

Abstract

This SBIR Phase II project is aimed at developing a novel vibration mixer for the mixing of surgical grade bone cement. Self-curing polymethylmethacrylate (PMMA) or acrylic bone cement is used extensively in total joint replacements, in the repair of bony defects and in the fixation of pathological fractures. For surgical use, the methylmethacrylate polymer and the liquid monomer are hand mixed. This hand-mixing entraps air bubbles making the cement porous. Presence of these bubbles adversely affects the mechanical properties of bone cement, making it much weaker under load and may contribute to early failure of cemented artificial joints. Results of the Phase I study indicate that ultrasonic vibration during cement mixing significantly reduced its porosity and increased the fatigue life and mechanical strength of bone cement, compared to hand-mixed cement. Recently, it was shown that combining sonication and vacuum mixing reduced the porosity and further improved the fatigue life, compared to either mixing methods alone. During the Phase II study, the frequency and amplitude of sonication and the vacuum pressure to obtain the best mechanical properties of the cement will be optimized. Subsequently, a new cement mixer will be designed and built incorporating these mixing features.

It is expected that the improved mechanical properties of vibrated bone cement will reduce the incidence of cement fracture and this will improve the success rate of total joint replacements. Considering that cement mixers are used in several thousand hospitals in the United States alone, we expect this new cement mixer to be adopted by a large number of Orthopaedic surgeons in these hospitals.

Title: STTR Phase II: Cold Gas Dynamic Spray Processing of Bioactive Nano-hydroxyapatite/Titanium Nanocomposite Coatings

Award Number: 0110323
Program Manager: Cheryl F. Albus

Start Date: September 1, 2001
Expires: February 29, 2004
Total Amountt: $500,000
Investigator: Larry E. McCandlish, mccandlish@ceramare.com
Company: Ceramare Corporation
12-D Jules Lane
New Brunswick, NJ 08901
Phone: (732)937-8260

Abstract:

This Small Business Technology Transfer (STTR) Phase II Project will develop a fully integrated process for applying a well-bonded, bioactive coating to the stem of an orthopedic hip implant by a novel Cold Gas Dynamic Spray (CGDS), or Hyperkinetic Deposition process. The new process is a potential major advance in the state-of-the-art for surface modification of medical implants. The medical community hitherto has relied primarily on plasma spraying to activate implant surfaces. Plasma spraying is a cost-effective means of applying the coating material but is far from ideal. In particular, the high temperatures experienced by the hydroxyapatite feed powder during plasma spraying can seriously degrade its compositional integrity and thus its bioactive properties. The cold spray process eliminates this problem, and enables, for the first time, high-surface-area nanostructured hydroxyapatite powder to be incorporated into the implant surface without sacrificing its intrinsic bioactivity. As an added benefit the implant surface is left in a state of compression, which should extend the service life of the implant by eliminating the possibility of surface cracking caused by low-cycle fatigue.

The commercial applications for this project will be to improve the life of implants.

Title: STTR Phase II: Variable Diameter Fiber Reinforced Biopolymers for Minimally Invasive Orthopedic Implants

Award Number: 0548663
Program Manager: Rathindra Dasgupta

Start Date: September 20, 2006
Expires: September 30, 2008
Total Amount: $499,849
Investigator: James Mason, grangeng@comcast.net
Company: Granger Eng
PO Box 845
Granger, IN 46530
Phone: (574)272-0552

Abstract:

The Small Business Technology Transfer Research (STTR) Phase II project will develop a new ceramic fiber technology for reinforcing injectable bioplastics used in orthopaedic applications. The main goal of this research project is to achieve a significant increase in strength and stability of the proposed product over current injectable polymer based biomaterials through a combination of variable diameter fibers and new cements.

The proposed product would result in the enablement of new surgical techniques. In addition, the research might be applicable to injection molding of mass produced plastics which could significantly strengthen many products.

Title: SBIR Phase II: Novel Titanium Tantalum Materials for Improved Biomedical Implants and Medical Devices

Award Number: 0724433
Program Manager: Cheryl F. Albus

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $500,000

Investigator: Harvey Fisher, hfisher@dynamettechnology.com
Company: Dynamet Technology, Inc
Eight A St
Burlington, MA 01803
Phone: (617)272-5967

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will use Titanium-Tantalum (Ti-TA) alloys, with the objective that these materials will become commercial alloys used in orthopaedic and stinting devices. Ti-30Ta has potential as a highly biocompatible implant alloy with a modulus closer to that of bone (thus mitigating bone shielding), and is potentially less notch-sensitive than standard titanium implant alloys. This project will also demonstrate that advanced powder metallurgy can produce novel titanium alloys that are extremely difficult and prohibitively expensive to produce by other means. Critical material property data of these alloys will be generated that will lead medical device manufacturers to incorporate these alloys into specific devices and to conduct the necessary testing and clinical trials for commercial product release.

The broader impacts from the use of Ti-Ta alloys will enable the development of improved medical devices that will last longer; are less invasive, promote faster patient recovery times and minimize the risk of adverse reactions. Advances in orthopedic and cardiovascular products will also significantly reduce short-term and long-term health care costs associated with such medical conditions and surgical procedures. Ti-Ta materials will also offer advantages for non-biomedical applications, in regard to mechanical properties as well as to shape memory and superelastic properties. For example, such materials can be expected to also offer improved properties such as resistance to corrosion, oxidation and high temperatures. Thus, availability of these alloys will be applicable to a wide variety of industrial, consumer and aerospace products in addition to biomedical applications, resulting in significant commercial potential.

Biomedical Devices and Instrumentation

Title: SBIR Phase II: Three-Dimensional Atom Probe Imaging for Nano-Biotechnology

Award Number: 0216620
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,850
Investigator: Steven L. Goodman, sgoodman@imagoscientific.com
Company: Imago
6300 Enterprise Lane
Madison, WI 53719-1193
Phone: (608)274-6880

Abstract:

This Small Business Innovation Research Phase II project will develop the Local Electrode Atom Probe (LEAP) to rapidly provide three-dimensional atomic-scale imaging and elemental identification of nano-biotechnology devices. Structural characterization of nano-biotechnology devices is currently problematic because available microscopy and analytical techniques have substantial limitations in quantitative imaging at the atomic-scale. Moreover, current microscopy techniques cannot adequately resolve three-dimensional biomacromolecules, which are intrinsic to nano-biotechnology devices. Until better analytical instrumentation is developed, researchers will "fly blind" as they develop more complex nano-biotechnology devices. The overall goal of this Phase II project is to rapidly analyze the three-dimensional atomic-scale structure and elemental composition of biological and organic molecules on nano-biotechnology devices. The focus will be on developing technologies to analyze commercial specimens using LEAP technology, and to initiate commercialization and marketing of this technology to academic and industrial researchers. The commercial application of this project will be in the area of bioanalytical instrumentation and nano-biotechnology devices.

Title: SBIR Phase II: Novel Nanosized Magnets for Highly Sensitive Multiplexing Bio-Molecular Detection

Award Number: 0450641
Program Manager: George B. Vermont

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $497,185
Investigator: Ted Sun, ted@ls-tek.com
Company: LS Technologies
44160 Old Warm Springs Blvd
Fremont CA, 94538
Phone: (510)651-1329

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop and validate highly sensitive contrasting agents in-vivo, for magnetic resonance imaging (MRI) diagnosis, based on a series of novel nano-sized ferromagnets. Prior Phase I work used combinatorial chemistry to synthesize magnetic nanoparticles with significantly enhanced magnetic resonance signal and sensitivity than currently available paramagnetic contrasting agents. The specific objectives of Phase II research are to further optimize the nano-magnet cores with combinatorial chemistry , to functionalize their surfaces for in-vitro imaging of cells, to validate the newly developed contrasting agents in comparative animal MRI studies against products in use, and to evaluate their toxicity effects.

The commercial application of this project will be in the area of whole-body imaging techniques. The proposed technology will enable superior medical images to be taken at significantly higher throughput and sensitivity, and at a lower cost. Further, it may allow for new medical diagnosis-imaging applications using magnetic resonance (for example, in the early detection and prevention of cardiovascular disease).

Title: SBIR Phase II: Hybrid Inorganic/Organic Ion Exchange Material for the 227Ac/223Ra Generator

Award Number: 0450581
Program Manager: George B. Vermont

Start Date: April 15, 2005
Expires: March 31, 2007
Total Amount: $452,553
Investigator: Hariprasad Gali, hari.gali@lynntech.com
Company: Lynntech, Inc
7607 Eeastmark Dr Ste 102
College Station TX, 77840
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a generator to produce pure radium-223 for use in cancer therapy. The alpha-emitter Ra-223 has a longer half-life than the other alpha-emitting radioisotopes (213 Bi, 212Bi and 211At) that are currently being evaluated for use in radio-immunotherapy (RIT), and has been shown to have higher bone uptake than the commercially available beta-active bone seekers. This makes it very attractive for Ra-223 to be developed further for radiopharmaceutical applications and for use as a pain palliation agent. However, the research and clinical application of this isotope are hindered by the limited availability of pure Ra-223. A simple technique to produce the isotope is a generator where a suitable parent, in this case Ac-227, is immobilized on an ion exchanger column and Ra-223 is eluted when required. Current separation methods frequently use organic resins, which tend to degrade under ionizing radiation and thus the product may contain impurities. Prior Phase I work developed new hybrid inorganic/organic ion exchange materials with high affinity for actinium, but low affinity for radium and good resistance against radiation. The Phase II project will optimize the exchanger performance and fabricate a prototype of the Ra-223 generator.

The commercial application of this project will be in the area of cancer therapy. It is expected that the easy - to - use generator, which poses a smaller radiation hazard to personnel, will be used at medical research centers, radio - pharmacies and hospitals to produce pure radium - 223 to treat patients with bone metastases and other small solid tumors.

Title: SBIR Phase II: Detection and Identification Instrument for Single Molecule Analysis

Award Number: 0450539
Program Manager: George B. Vermont

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $500,000
Investigator: Arieh Karger, AKarger@RMDInc.com
Company: Radiation Monitoring Devices Inc
44 Hunt Street
Watertown MA, 2472
Phone: (617)668-6801

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a novel, low cost laboratory instrument for genetic analysis and single molecule studies. The technology is suitable for the detection and identification of DNA and RNA through fluorescent hybridization probes without the need for Polymerase Chain Reaction (PCR) amplification, or for proteins and small molecules through fluorescence immunoassays. The general scheme is based on single molecule detection (SMD) and utilizes the two-color cross-correlation spectroscopy (TC-FCCS) technique with coincident detection analysis scheme to simultaneously probe ten focal regions of a microfluidic assay. High efficiency single photon detectivity Geiger mode microavalanche photodiode (uAPD) arrays will function as detection elements.

The commercial application of this project will be on biological and medical research, and on the drug development process. Examples of potential applications range from the study of conformational dynamics and interactions of macromolecules to biochemical kinetics of single molecules.

Title: SBIR Phase II: Catheters with Anticoagulation and Fibrinolytic Properties

Award Number: 0422181
Program Manager: Michael R. Ambrose

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $510,774

Investigator: Jun Du, Ydu@spirecorp.com
Company: Spire Corporation
1 Patriots Park
Bedford MA, 01730
Phone: (781)275-6000

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop blood-compatible biomaterials for end-stage renal dialysis (ESRD) catheters through an integrated biological coating (IBC) that combines protein passivation, anticoagulation, and fibrinolytic mechanisms on the surface. Phase II work will build on the Phase I demonstration that internal and external surfaces of BaSO4-loaded polyurethane catheters were activated by an electron cyclotron resonance (ECR) process that promoted uniform deposition of an IBC coating. In the Phase II project, the coating process will be optimized and deposition equipment will be upgraded to enhance reliability and repeatability. Finished catheters will be produced and evaluated for blood compatibility through in vitro human blood testing and ex vivo sheep shunt model experiments. Finished IBC catheters will also undergo rigorous mechanical, biocompatibility, and toxicity testing to show compliance with FDA standards.

The principal commercial application of this project will be on the catheter industry. The proposed technology will also find applications in coatings for other blood-contacting devices such as grafts, polymeric stents , valves and by-pass systems

Title: SBIR Phase II: Robotic Scrub Technician

Award Number: 0422114
Program Manager: George B. Vermont

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $491,500
Investigator: Michael Treat, mt23@columbia.edu
Company: Robotic Surgical Tech, Inc.
5141 Broadway
New York NY, 10034
Phone: (212)932-4520

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a robotic scrub technician that anticipates a surgeon's request for an instrument during surgery using robotics technology. Phase II research will build upon the success achieved in Phase I work , and will implement cognitive architecture over the current physical and sensory system of the robot. To validate the cognitive architecture, the robot will assist surgeons while performing operations on a physical simulator and in experimental animals. In this way, errors both robotic and human will come into play. The robot's actions will be judged using criteria for speed and clinical appropriateness, and the cognitive architecture will be modified to eliminate undesired behaviors.   It is expected that the robot will perform in a clinically acceptable way.

The commercial impact of this project will be in the area of healthcare. The proposed work addresses the issue of critical shortage of nurse technicians, and could reduce personnel costs in hospitals. Furthermore, the use of robots for this environment may free up human technicians to do more critical tasks

Title: SBIR Phase II: Three-Dimensional (3D) Laparoscope

Award Number: 0422102
Program Manager: George B. Vermont

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $428,918
Investigator: Kurtis Keller, kurtis@inneroptic.com
Company: Inneroptic Technology Incorporated
106A N. Churton St.
Hillsborough NC, 27278
Phone: (919)962-1746

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to develop a fully functional prototype 3-D laparoscope, which will be superior to the 2-D laparoscopes currently used in surgeries, based on laser illuminated miniaturized projector for computer generated light patterns and two cameras for acquisition of color and depth.

The commercial application of this project will be in surgical operations. This device will have the capacity to provide depth and computer enhanced view of the surgical domain more akin to open surgery. This would allow for more precision in surgical procedures, thereby eliminating hand-eye coordination issues and reducing mistakes and accidents

Title: SBIR Phase II: MicroElectroMechanical Systems (MEMS) Wavefront Correction Device for Ophthalmic Adaptive Optics

Award Number: 0421965
Program Manager: Om P. Sahai

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $492,983

Investigator: Steven Rodgers, steve.rodgers@memx.com
Company: MEMX, Inc.
2620 Augustine Drive
Santa Clara, CA 95054
Phone: (408)764-0185

Abstract

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a MEMS wavefront correction device for ophthalmic adaptive optics. The use of adaptive optics in ophthalmics shows great promise, but the lack of suitable cost-effective solutions has hindered the advance of research and the development of associated commercial markets. The proposed work will leverage the most sophisticated surface micromachining technology available to design and deliver, for the first time, a MEMS wavefront correction chip that addresses all of the requirements specified by the vision science community. The commercial application of this project will be in the area of ophthalmology. Ophthalmic equipment suppliers need low cost wavefront correction devices for use in next generation phoropters and autorefractors, LASIK preview systems, and high resolution fundus imaging systems.

The ophthalmic market for low cost wavefront correction devices, once such devices are available, is projected to be at least $20 million per year. Such devices may also have utility outside of ophthalmics. Optical coherence tomography, confocal microscopy, portable military imaging systems, free space optical communication systems, and semiconductor lithography are other potential application areas for wavefront correction devices.

Title: SBIR Phase II: Multipass Second Harmonic Generation

Award Number: 0421974
Program Manager: Om P. Sahai

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $492,690
Investigator: Guido Knippels, gknippels@picarro.com
Company: Picarro, Inc.
480 Oakmead Parkway
Sunnyvale, CA 94085
Phone: (408)962-3919
Abstract

This Small Business Innovation Research (SBIR) Phase II project is to develop low-cost, 20-50 mW blue and green lasers for bioinstrumentation applications. The Phase II program objectives are to : (1) design, assemble and test 20 mW 505 nm laser prototypes; (2) to validate laser performance in a commercial bio-instrumentation application; and, (3) to assemble, test, and validate 50 mW blue-green laser prototypes using a higher efficiency second harmonic generation (SHG) architecture.

The commercial application of this project will be the availability of inexpensive laser light sources for researchers in cellular biology and DNA sequencing.

Title: SBIR Phase II: Automated Monitoring and Alarming for Elder Care

Award Number: 0422154
Program Manager: Om P. Sahai

Start Date: September 1, 2004
Expires: August 31, 2006
Total Amount: $481,203

Investigator: Rajeev Sharma, rsharma@advancedinterfaces.com
Company: Advanced Interfaces, Inc.
403 South Allen Street
State College, PA 16801
Phone: (814)867-8977

Abstract

This Small Business Innovation Research (SBIR) Phase II project will develop an automated monitoring system for residents living in elder care facilities. This system will enable the facility staff to quickly respond to any event or behavior requiring intervention, such as an accidental fall, using computer vision for tracking and behavior analysis. Prior Phase I research demonstrated the feasibility of this approach for fall detection and behavior analysis with the help of a laboratory prototype. This work also highlighted several challenges, such as dealing with changing lighting conditions and complex behaviors. Phase II research will focus on addressing these challenges and creating twelve beta sites in actual elder care facilities to further develop and test the algorithms.

The commercial application of this project will be on institutions linked to the care of the elderly. With over 50% of the growing population of seniors staying in independent / assistive living facilities or nursing homes, injuries and deaths resulting from unattended falls represent a serious societal and economical problem. Over 1.8 million seniors fall each year, with each fall costing an average of $9,400 in hospitalization. The proposed work could lead to a solution that provides a way for quickly responding to falls, saving hospitalization costs up to 26% and more importantly, reducing the likelihood of death by as much as 82%. It would also help in generating a feeling of security for the elders and their care givers, without a substantial increase in healthcare costs.

Title: SBIR Phase II: Novel Breath Diagnostic Instrument for Detection of Disease

Award Number: 0349782
Program Manager: Om P. Sahai

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $490,293

Investigator: Douglas Baer, d.baer@lgrinc.com
Company: Los Gatos Research
67 East Evelyn Avenue, Suite 3
Mountain View, CA 94041
Phone: (415)965-7772

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a carbon isotope ratio analyzer based on Off-Axis Integrated Cavity Output Spectroscopy to measure the ratio of the isotopic abundances of 13C to 12C in exhaled breath. The compact analyzer will serve as a medical diagnostic instrument and will operate in a point-of-care setting. The instrument combines robust telecommunications-grade diode lasers with Off-Axis ICOS, an innovative technology that provides extremely long optical paths (several kilometers typical) for ultrahigh sensitivity. The instrument will be inexpensive, portable and easy to use and report measurements of 13CO2/12CO2 with sufficient sensitivity and precision to replace mass spectrometry in 13C-labeled breath tests for diagnosis of several diseases. Prior Phase I work has successfully demonstrated a laboratory instrument with a precision of 0.24 per mil (0.024%) in less than 6 minutes. In Phase II, a prototype instrument capable of autonomous operation, will be developed and tested in on-going clinical trials.

The commercial impact of the project will be significant, as the proposed instrument will aid in quick diagnosis of gastrointestinal diseases at the doctor's office, thereby enhancing rates of patients' compliance with treatment regimens.

Title: SBIR Phase II: Mouthrinse Generator for Plaque and Halitosis Control

Award Number: 0349689
Program Manager: Om P. Sahai

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $492,100
Investigator: Charles Tennakoon, charles.tennakoon@lynntech.com
Company: Lynntech, Inc
7607 Eastmark Drive, Suite 102
College Station, TX 77840
Phone: (979)693-0017
Abstract

This Small Business Innovation Research (SBIR) Phase II will develop and commercialize electrochemically operated devices that will revolutionize the oral hygiene industry by providing an on-demand generation of mouthwash in a portable device and in an irrigator. The mouthwash generated in these devices will be effective in controlling halitosis and dental plaque and will also provide tooth whitening. In the Phase I study, all of the proposed objectives and specified criteria of success were accomplished to amply establish the proof of concept and feasibility of the project. In Phase II, further optimization of the parameters will be followed by the design and fabrication of prototypes in conjunction with a prominent company dealing with turnkey manufacturing, and the testing of 100 portable units in a clinical setting.

The commercial impact of this project will be in the area of oral hygiene products. It is broadly estimated that up to 85 million Americans have halitosis, and over 35 million suffer from periodontal disease. Thus, the cost effective devices to be developed in this project are expected to have a large market potential in the $ 4.7 billion oral care industry.

Title: SBIR Phase II: Polymer Imaging Guide For Endoscopic Applications

Award Number: 0321408
Program Manager: Om P. Sahai

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $511,692
Investigator: Dave Welker, welker@paradigmoptics.com
Company: Paradigm Optics Inc.
14615 NE 13th Court Ste B106
Vancouver, WA 98685
Phone: (360)573-6500

Abstract

This Small Business Innovation Research (SBIR) Phase II project aims to develop high quality, inexpensive polymer-based (plastic) optical fiber imaging guides and other new and unique endoscopic devices through the use of innovative polymer processing techniques. Polymer imaging guides have several distinct advantages over their glass counterparts, including reduced cost, smaller bend radius, and increased ruggedness. Additional benefits include the ability to dope the polymer matrix with molecules that can be used as environmental probes, scintillating material, or indicators ; the ability to tailor the guide for highly specific applications, and the ability to impart diverse functionality into a single imaging guide. The Phase II project is expected to result in a truly disposable endoscope.

The commercial application of this project is in the area of biomedical devices and instrumentation. It is expected that the polymer imaging guide developed in this project will be used as a direct replacement for glass guides in all types of fiber optic endoscopes currently manufactured. The resulting benefits would be lower costs, less patient discomfort, higher reliability, earlier detection of abnormal conditions, and an increase in the number of procedures that could be performed with endoscopes in an outpatient setting.

Title: SBIR Phase II: Advanced Optical Instruments for Monitoring Asthma

Award Number: 0321447
Program Manager: Om P. Sahai

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000
Investigator: Khosrow Namjou, knamjou@ekipstech.com
Company: Ekips Technologies, Inc.
710 Asp Ave., Suite 500
Norman, OK 73069
Phone: (405)307-8803

Abstract

This Small Business Innovation Research Phase II project will develop a laser based breathmeter for detecting and monitoring asthma in children and adults. The Phase I work proved the feasibility of constructing a machine, based on infrared laser absorption spectroscopy, that is capable of measuring exhaled nitric oxide (eNO) and exhaled carbon dioxide (eCO2) levels to evaluate airway inflammation for indications of asthma and to monitor treatment compliance. In the Phase II project, a dedicated hardware design for electronics and data processing plus user-friendly custom written software will be integrated into a compact system that is cost effective, highly sensitive, real-time, and reliable for monitoring airway inflammation.

The commercial application of this project is in the area of biomedical devices and instrumentation.

Title: SBIR Phase II: Micromachined Ultrasonic-on-a-Chip for Medical High-Resolution Imaging

Award Number: 0321576
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $499,993

Investigator: Eli Wiener-Avnear, leeoat@worldnet.att.net
Company: LEEOAT Company
2631 Colibri Lane
Carlsbad, CA 92009
Phone: (760)438-1439

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will optimize and finalize the design and the simulation of the ultrasound-on-a-chip (UOC) probe, and itegrate it into a portable ultrasound medical imager with high spatial resolution and enhanced picture definition for noninvasive clinical diagnosis of the internal lumens. The UOC probe architecture is based on patented ultraprecision micromachining technology. The objective is to fabricate and test the UOC probe and integrate it into a portable cost-effective medical imaging prototype system for noninvasive real-time high-definition volumetric medical imaging.

The realization of the merits of the ultrasound-on-a-chip based portable medical imager will open a wide window of commercialization opportunities for medical and nonmedical applications.

Title: SBIR Phase II: Neural Inverse Control for Ventilators

Award Number: 9983474
Program Manager: Sara B. Nerlove

Start Date: July 15, 2000
Expires: September 30, 2003
Total Amount: $761,987
Investigator: Neil Euliano, neuliano@nd.com
Company: NeuroDimension Incorporated
3701 NW 40th Terr
Gainesville, FL 32606
Phone: (352)377-5144

Abstract:

This Small Business Innovation Research Phase II project from NeuroDimension Incorporated will develop new, biologically inspired solutions to the problem of ventilator control of human subjects. The problem is difficult because the patient is analogous to a time-varying, nonlinear plant. Adaptive inverse control is powerful enough to adapt to changing conditions while maintaining system stability. In Phase I, NeuroDimension developed a control architecture and development environment for neural inverse control and applied it to controlling a ventilator. This solution outperformed the state-of-art commercial ventilator. The goal is to develop a system that will optimize most of the major settings currently set by clinicians on present-day ICU ventilators. The complexity of these ventilators subject their operators to speculative and empirical interpretation of many ventilatory parameters, leading to potentially hazardous misuse. NeuroDimension proposed system will model and extract relevant physiologic conditions in the patient and use this information to either control the ventilator automatically or to advise the clinician on how to change the settings. The primary technical approach utilizes neural fuzzy hybrid systems, Kohonen self-organizing maps (SOMs)-a SOM clusters the input space and assigns a different model to each cluster--and switching multiple inverse controllers. The firm has assembled a unique team of experts in the fields of neural control and ventilation to accomplish this task.

NeuroDimension proffers technology that has application to a number of possible products including, inverse neural control application software; an ultra-intelligent respiratory monitor; and an easy to use and optimal closed-loop ventilator controller.

Title: SBIR Phase II: IBEX - Restoring Functional Mobility in the Elderly Through In-Bed Exercise

Award Number: 0078585
Program Manager: Om P. Sahai

Start Date: December 1, 2000
Expires: June 30, 2001
Total Amount: $399,659
Investigator: Robert C. Dean, RCD@Synnovations.com
Company: Synergy Innovations, Inc.
10 Water Street, Rm. 405
Lebanon, NH 03766
Phone: (603)448-5454
Abstract:

This Small Business Innovation Research Phase II project completes development of a production In-Bed Exerciser (IBEX) and tests its efficacy. This unique, active exerciser is a portable and efficient means of giving, in bed, physical therapy sufficient to maintain or restore the walking muscles of bedridden people. Geriatrics are especially vulnerable to bed confinement; they can lose ability to walk after 5-10 days. Becoming bedridden is a leading indicator of mortality for the elderly. A growing elderly population, a shortage of Physical Therapists, their inability to provide force levels and intensity of exercise needed, and pressure to constrain medical costs, demand such a machine. The Company has innovated a portable exerciser that attaches to the bed, is computer controlled, provides bilateral, reciprocal or one-leg exercise and records performance. Phase I demonstrated feasibility.

The objective of this SBIR Phase II project is to use scientifically designed clinical trials to prove efficacy. Results are the prelude to successful commercialization according to the enclosed plan. The greatest social benefit will be improved quality of life for the elderly.

Title: SBIR Phase II: Integrated Circuit Design for Biological Data Transmission

Award Number: 0238696
Program Manager: Om Sahai

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,924

Investigator: James C. Morizio, jmorizio@tbsi.biz
Company: Triange Biosystems, Inc.
5114 Huxey Glenn Court
Durham, NC 27703-9293
Phone: (919)596-8069

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to develop, test, market and produce low-power wireless headstage systems for the neural prosthetic market. The wireless neural headstage devices will be able to transmit and to receive sixteen electrodes sourced from a patient. The analog signals will be encoded and transmitted wirelessly to a remote receiver where they will appear on a 16-channel connector. The wireless headstage technology will replace the tethered connections and create a more natural and productive laboratory environment for patient data acquisition. Ultimately, wireless technology will improve the quality of life for anyone using a commercial neural prosthetic device by offering extended freedom of motion, improved product safety and reliability, and less visual distractions.

The primary commercial application of this project is in the wireless neural prosthetic market. Additional applications are expected in the biomonitoring business markets, such as for electrophysiological patient testing and monitoring.

Title: SBIR Phase II: Instrument for Tumor Cell Purging

Award Number: 0091448
Program Manager: Om Sahai

Start Date: February 15, 2001
Expires: January 31, 2003
Total Amount: $499,982
Investigator: Manfred R. Koller, fkoller@oncosis.com
Company: Oncosis
6199 Cornerstone Court
San Diego, CA 92121
Phone: (619)550-1770

Abstract:

This Small Business Innovation Research (SBIR) Phase II project describes a novel laser-based technology for large-scale analysis and processing of living cells. One application of this technology is the detection and elimination of contaminating tumor cells from autologous hematopoietic stem cell (HSC) transplants for cancer patients. Published studies have shown that: contaminating tumor cells contribute to cancer relapse; (2) successful tumor purging provides a clinical benefit; and (3) current purging methods are inadequate. A technology that reliably eliminates tumor cells from transplants, while leaving HSCs undamaged, is needed. A patented innovative approach integrating fluorescence scanning cytometry, real-time image analysis, and specific laser-induced killing of individual cell targets will be used. The Phase II project will complete the clinical-scale prototype instrument, leading into clinical trials. The instrument design will then be configured for successful commercial manufacturing, and further improvements in capabilities will be pursued in order to maintain market leadership and expand into other markets.

The studies conducted in the Phase II project will lead to commercialization of a method to eliminate detectable tumor cells from an HSC transplant with a several hour automated procedure. The resulting instrumentation will also be useful in a number of other clinical and research applications that require cell analysis and purification with high purity, yield and speed.

Title: STTR Phase II: High Speed Instrumentation for Real Time Biological Imaging

Award Number: 0091549
Program Manager: Om Sahai

Start Date: March 15, 2001
Expires: February 28, 2003
Total Amount: $499,999
Investigator: Stephen C. Minne, Steve@nanodevices.com
Company: NanoDevices, Inc
516 E. Gutierrez, Suite E
Santa Barbara, CA 93103-3253
Phone: (805)884-0240

Abstract:

This Small Business Technology Transfer (STTR) Phase II project is to develop a new type of atomic force microscope that can image nanometer scale features, in real time, in the physiological environment. In all of its forms, the microscope is probably the most widely used tool in the investigation of biological structure and function. The introduction of the atomic force microscope (AFM) to biology created much excitement because the AFM fills a gap in the capabilities of the microscopes that are available to biologists. The study of living and moving biological systems, on time scales of seconds, with nanometer scale resolution, is becoming increasingly important in biological research. Self-assembled monolayers, proteins, and cellular processes all fall into this category. Existing AFMs fall short of the requirements for these applications because of speed and sensitivity limitations in fluid operation. The project is based on the AFM, for nanometer scale imaging of biological samples that is orders of magnitude faster than current AFMs. Additionally, the new system will be optimized for fluid operation in order to give researchers active control over imaging dynamics. This composite system will allow researchers to probe nanometer scale biological phenomena at speeds never before accessible.

The technology could dramatically increase biological imaging in two ways: (1) faster imaging and (2) higher resolution in fluid. The increase in speed and resolution will help facilitate projects to provide faster results to researchers.

Title: SBIR Phase II: New Elastomeric Microelectrodes for Improved Neuroprostheses

Award Number: 0216035
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,970
Investigator: Francis L. Keohan, fkeohan@capecod.net
Company: Cape Cod Research
19 Research Road
East Falmouth, MA 02536
Phone: (508)540-4400

Abstract:

This Small Business Innovation Research Phase II project is to develop electrically conductive polymer-silicone composite materials for improving the performance of implantable neural prostheses. Prior Phase I study has demonstrated the feasibility of synthesizing electrically conductive polymer nanocomposites with mechanical properties of silicone elastomers. Polymer-based prototype electrical devices were found to be stable toward simulated physiological conditions and cyclic current pulsing. The Phase II program will extend the benefits of these systems to the fabrication of more complex devices such as multi-poled cuff electrodes for chronic peripheral nerve stimulation and recording. An expanded test plan would include development of advanced device fabrication methods and extensive testing of the prototype neural prostheses for electrical response, tissue compatibility, and durability in chronic implantation applications. The optimized elastomeric electrodes will be characterized for biocompatibility, stability and electrical properties. Methodology will be developed for fabricating prosthetic electrodes for extensive in vitro pulsing studies and acute animal testing. Finally, test protocols for the new electrode products will be established in an effort to obtain FDA approval.

The commercial applications of this project will be in the area of biomedical devices and systems that serve the needs of disabled individuals following stroke or spinal cord injury.

Title: SBIR Phase II: No Preparation, Flexible, Dry Physiological Recording Electrodes

Award Number: 0216284
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $500,000

Investigator: Frederick J. Lisy, lisy@orbitalresearch.com
Company: Orbital Research Inc
673 G Alpha Drive
Cleveland, OH 44143-2140
Phone: (440)449-5785

Abstract:

This Small Business Innovation Research Phase II project is to complete the development of a low-cost, no preparation required, and flexible dry physiological recording electrode. These electrodes have the potential to significantly improve quality of care and reduce total cost of biopotential signal analysis by reducing the time and preparation required to obtain a good signal and reducing the total cost of fabricating high quality electrodes. The Phase I results showed feasibility of fabricating dry electrode structures on rigid substrates onto low-cost flexible substrates. However, further work is necessary to optimize the fabrication processes and to ensure that the lowest cost and highest performing flexible dry electrode systems and fabrication processes are chosen to establish a solid foundation for future use. The key objectives of this Phase II project include parallel development of two particularly promising fabrication techniques, selection of a single fabrication technique for further development, and testing and evaluation of the capabilities of the dry electrodes in clinical environments.

The commercial applications of this project will be in the area of physiological monitoring of patients in a clinical setting. Physiological measurements such as ECG (electrocardiogram), EMG (electromyogram), and EEG (electroencephalogram) are expected to benefit from the use of dry electrodes, in part due to the reduced time and preparation needed to apply the electrodes and in part, due to the elimination of abrasive skin prepping and electrolytic gels in the measurement procedure.

Title: STTR PHASE II: Nuclear-Magnetic Resonance (NMR) Properties of Carbon Nanomaterials for Medical Applications

Award Number: 0321630
Program Manager: T. James Rudd

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,947
Investigator: Steven A. Stevenson, stevensons@lunainnovations.com
Company: Luna Innovations, Inc.
PO Box 11704
Blacksburg, VA 24062-1704
Phone: (540)953-4267

Abstract:

This Small Business Technology Transfer (STTR) Phase II project aims to develop advanced contrast agents for magnetic resonance imaging diagnostics. In Phase I dramatically improved contrast agents based on carbon nanospheres were demonstrated. The researchers discovered this new class of molecules called Trimetaspheres, which involve three Gadolinium metal ions encapsulated in a fullerene molecule. They are more than 50 times better in terms of relaxivity than the currently available contrast agents and safer, because the metal ions cannot escape the carbon cage. In the Phase II project full-scale production of the Gadolinium Trimetaspheres will be accomplished at the kilogram level to satisfy the market demand. These Trimetaspheres will be developed into future high field contrast agents and functionalization will be pursued to make the Trimetaspheres more soluble and biocompatible for various medical applications including cell targeting. Following this, the Trimetaspheres will be characterized and evaluated for R1 MRI contrast agents for both high and low magnetic fields. Subsequently Trimetaspheres will be developed for R2 MRI agents for high magnetic s.

Commercially, Trimetaspheres have proven potential in the $1.5 billion market of MRI contrast agents. Trimetaspheres dramatically improve patient care and lower medical costs by improving existing MRI diagnostics and providing new contrast agents that allow diagnoses in cases where there is no current method. The technology developed in this project has immediate applications in current MRI measurements and satisfies requirements for future high field strength MRI instruments. Improved contrast agents increase the likelihood of accurate diagnosis, and ultimately reduce the treatment cost. There are many instances where a MRI scan is not prescribed because no contrast agent exists. For example within the brain, Trimetaspheres can pass the blood-brain barrier and are small enough to fit inside the smaller regions of blood vessels. In addition, Trimetaspheres will lead to applications in other diagnostic equipment (x-ray, PET), and have advantages as a therapeutic delivering radiation upon targeted biodistribution.

Title: SBIR Phase II: Microelectrochemical Assays for Malaria Parasites

Award Number: 0548742
Program Manager: F.C. Thomas Allnutt

Start Date: February 16, 2006
Expires: February 29, 2008
Total Amount: $518,000
Investigator: Zoraida Aguilar, zoraida.aguilar@vegrandis.com
Company: Vegrandis
535 West Research Blvd
Fayetteville, AR 72701
Phone: (479)571 2592

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an automated, high-throughput, sensitive and specific assay for the micorelectrochemical detection of malaria parasites. The use of microelectrochemical assay will allow for the detection of malarial parasites with a combination of attributes, such as all four species to the level of one parasite per microliter of blood without sample preparation.

This technology will impact the current blood donor screening guidelines that call for the deferral of potential donors for one year following travel to malaria endemic regions. Not only do cases of fatal transfusion-transmitted malaria occasionally occur, but also the availability of the blood supply is reduced. This technology will aid the blood banking industry by providing an inexpensive, high-throughput, low detection limit malaria test as blood donor screening tool.

Title: SBIR Phase II: POINT - Precision Optical Intra-Cellular Near-field Technology

Award Number: 0548768
Program Manager: Ali Andalibi

Start Date: September 25, 2006
Expires: August 31, 2008
Total Amount: $338,122
Investigator: Joanne Ebesu, doconnell@oceanit.com
Company: Oceanit Laboratories
1001 Bishop St Suite 2970
Honolulu, HI 96813
Phone: (808)531-3017

Abstract:
This SBIR Phase II project proposes to develop a novel high-resolution instrument capable of penetrating live cells. Currently there are no methods that allow the inside of a living cell to be imaged down to 50 nm resolution or less. Confocal microscopes, MRI and ultrasound cannot image to this resolution and the use of electron microscopes destroys the cells. The potential to develop nanosensors capable of penetrating a cell without destroying its natural environment may provide new information about the molecular makeup of a cell. The proposed Precision Optical Intra-cellular Near-field Technology (POINT) is an innovative adaptation of Near-Field optical microscopy using solid emersion lens (SIL) technology coupled with a sub-wavelength aperture probe. The goal of the Phase I project was to research the feasibility of developing a near-field probe and solid immersion lens combination that would be useful for biological research by providing nanometer scale resolution and enhanced light throughput to image inside intact cells. A small optical excitation volume is provided by a near-field probe, circumventing the diffraction limit to obtain sub-wavelength spatial resolution. This new capability offers higher sensitivity and resolving power than is presently available in microscopy, and could provide a more detailed understanding of molecular processes underlying mutations that lead to any of a number of diseases such as cancer. Solid immersion lenses were successfully fabricated in house by grinding and polishing commercially available ball lenses and validation experiments were then carried out. It was demonstrated that a tighter focused laser spot and narrower spectral width were achieved when using a SIL. This corresponds to higher light coupling to a probe placed at the bottom of the SIL. Successful probe fabrication was achieved based on optical modeling for optimum light throughput.

In phase II we will develop the platform needed to use this SIL/Probe optical tool in conjunction with a regular microscope. The use of a nanoposition stage for precise alignment and extremely small motion of the probe will be integrated as well as a feedback mechanism that signals when physical contact is achieved, such as the probe penetrating a cell's membrane. Various SIL/Probe designs will be characterized including a custom SIL with phase grating for laser wavelengths in the blue. The work in Phase II is a direct follow-on from what was achieved under the Phase I effort.

Title: SBIR Phase II: Non-Contact Optical Stethoscope for Neonatal Patients

Award Number: 0724449
Program Manager: Muralidharan S. Nair

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $500,000

Investigator: Andrey Vyshedskiy, andrey@stethographics.com
Company: Stethographics
21 Wayside Road
Westborough, MA 01581
Phone: (508)320-2841

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop a non-contact optical stethoscope for use in Neonatal Intensive Care Units (NICU). Premature babies in NICU require monitoring for signs of lung congestion and heart disease. Currently NICU medical personnel use acoustic stethoscopes. The use of acoustic stethoscope has a number of highly undesirable side effects including withdrawal response, flinching, apnea, hypoxemia, change in sleep state, and possibility of contamination. During Phase I a prototype non-contact optical stethoscope, capable of recording good quality heart and lung sounds was developed. The non-contact stethoscope is based on a standard technique of interferometry with a novel fiber optic design. The fiber optic design avoids the use of glass components - mirrors, lenses, splitters, and prisms - and yields a light, rugged and inexpensive interferometer.

The non-contact optical stethoscope based on the fiber optic interferometer could greatly improve the quality of care for neonates, burn victims, immuno-suppressed patients, and in those cases where direct contact should be avoided. A laser interferometer based on a novel fiber optic design has been developed. The interferometer based on fiber optics is light, inexpensive, and rugged as it does not require component alignment. The handheld point-and-listen microphone based on the fiber optic interferometer can be ideally positioned to enter the existing laser interferometry market and to open new markets including medical, preventive maintenance of rotating machinery, military urban and rescue operations, as well as law enforcement surveillance.

Bioprocessing and Industrial Bioproducts

Title: SBIR Phase II: Clinical-Scale Suspension Bioreactor for Primary Hematopoietic Culture

Award Number: 0296135
Program Manager: Om Sahai

Start Date: January 1, 2002
Expires: December 31, 2003
Total Amount: $400,000
Investigator: Todd A. McAdams, lcfarrar@aol.com
Company: Montec Research
1901 South Franklin
Butte, MT 59701
Phone: (406)723-2222

Abstract:

This Small Business Innovation Research Phase II project describes the development of a disposable, highly efficient suspension bioreactor for primary hematopoietic (blood cell-forming) cell culture. The unique challenges (heterogeneous nature, donor variability, and shear-sensitivity) of these cultures render traditional flask or suspension cultures unable to economically and consistently produce large quantities of cells. In Phase I, the feasibility and characteristics of a disposable suspension bioreactor was demonstrated. In Phase II, a scaled-up prototype of a large, agitated disposable bioreactor designed for clinical use (stem cell transplantation) will be constructed, characterized, and tested for reliability and durability. Gas and mass transfer correlations established in Phase I will be verified and extended. The use of medium optical density as a surrogate measure for cell density will be investigated.

The final product will be a system that combines the simple, disposable nature of flask culture with the control and monitoring capabilities of a suspension bioreactor. The resulting system will enable the cost-effective production of large numbers of primary hematopoietic cells and will improve the effectiveness and decrease the cost of medical procedures in the fields of transplantation, immunotherapy, and gene therapy.

Title: SBIR Phase II: Designer Cellulases for Biomass Conversion

Award Number: 0522310
Program Manager: Michael R. Ambrose

Start Date: October 1, 2005
Expires: September 30, 2007
Total Amount: $500,000
Investigator: William Coleman, wcoleman@kairos-scientific.com
Company: Kairos Scientific Inc.
10225 Barnes Canyon Rd., A110
San Diego CA, 92121
Phone: (858)626-8170

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new technology to improve the high-temperature performance of endoglucanase, which can be used to manufacture pulp from wood chips and other biomass. Producing pulp for papermaking via thermomechanical pulping (TMP) of biomass is a highly energy intensive process that is performed at high temperatures. Research is proposed to demonstrate the feasibility of using a directed evolution strategy and high-throughput, solid-phase enzyme library screening to engineer a new endoglucanase variant with significantly improved thermoactivity, thermostability and resistance to inhibitors. This enhanced enzyme will be sold as an additive to manufacturers who produce pulp and paper via the TMP process. Major benefits include energy savings and improvement of paper quality.

The commercial application of this project will be on the pulp and paper industry. New screening technology will be used to engineer an enhanced enzyme that will modify pulp fibers under high-temperature conditions. This enzyme additive will accelerate the pulp refining process and thereby lower production costs by reducing the amount of electricity needed to complete the conversion. Any significant reduction in the energy input will be very economically attractive to the pulp producers. If introducing an effective enzyme treatment could eliminate even a modest 10% of the current energy expenditure, the potential worldwide savings could total nearly US$500 million per year. The enhanced enzyme will be able to create a new market by offering these significant savings to the pulp producers. In addition, the information gained from this study could be applied to other similar enzymes to expand the market for thermostable biocatalysts and broaden the understanding of protein structure-function

Title: SBIR Phase II: New Approaches to Using Renewable Biomass Derived Materials in Epoxy and Vinyl Ester Resin Products to Reduce Styrene and Other Petroleum Based Raw Materials

Award Number: 0521976
Program Manager: George B. Vermont

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,993
Investigator: Earl Wagener, ewagener@bellsouth.net
Company: Tetramer Technologies, L.L.C.
657 S Mechanic Street
Pendleton SC, 29670
Phone: (864)653-4339

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to reduce the levels of styrene in commercial vinyl ester-styrene resin formulations and other polymers by replacing all or a portion of the high VOC (Volatile Organic Compounds) toxic monomer with a biomass-derived material. Prior results have shown that the styrene content can be reduced from 45% to 35% or lower without increase in cost or the loss of polymer physical properties. Phase II work will entail commercial development with three customers, scale-up process engineering to commercial levels and expansion of the technology into the broader thermoset market.

The commercial application for this technology is in polymer and resin markets where styrene and other petroleum based, high VOC monomers are used. These are huge markets, and the products are used in hundreds of applications. Successful introduction of these replacements will reduce our dependence on imported oil, promote the use of domestic, crop-based resources, and reduce the use of high VOC pollutants.

Title: SBIR Phase II: Low Cost, Needleless Drug Injection System

Award Number: 0450559
Program Manager: George B. Vermont

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $483,086
Investigator: James Scherer, jjscherer@novawavetech.com
Company: Novawave Technologies
900 Island Dr Ste 101
Redwood City CA, 94065
Phone: (650)610-0956

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a cheap and novel needleless injector (NI) that uses a ceramic-based electrokinetic pumping mechanism together with suitable nozzle arrays. The Phase II effort will focus on building numerous prototype pump / nozzle systems and determining the ability to achieve performance adequate for subcutaneous and intramuscular injections. Models for predicting the temporal response of the pump / nozzle systems will also be refined and compared to experimental results.

The commercial application of this project will be for delivering therapeutics such as vaccines and drugs for both human and veterinary markets. The ability to precisely control the injection temporal profile with the proposed device will enable injection site pain and trauma to be significantly reduced, thereby increasing effectiveness of NI drug delivery as well as reducing the probability of cross - contamination.

Title: SBIR Phase II: Characterization of the Metabolic Competency of Centrifugal Bioreactors

Award Number: 0421962
Program Manager: Om P. Sahai

Start Date: October 1, 2004
Expires: September 30, 2006
Total Amount: $500,000
Investigator: Heath Herman, hherman@kbi-usa.com
Company: Kinetic Biosystems, Inc.
430 Tenth Street, N.W.
Atlanta, GA 30318
Phone: (404)607-7331

Abstract:

This Small Business Innovation Research Phase II project is to develop a pilot-scale Centrifugal Bioreactor (CBR) for the continuous cultivation of hybridoma cells. The commercial application of this project will be in the biopharmaceutical industry for cell culture production of therapeutic agents. It is expected that the technology will reduce the scale and capital costs of commercial animal cell culture equipment and improve the quality and consistency of the secreted protein product.

Title: SBIR Phase II: A Novel Resonant-Enhanced Crystallization (REC) Process

Award Number: 0349704
Program Manager: Om P. Sahai

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $512,000

Investigator: Fangxiao Yang, fxyang@resodyn.com
Company: Resodyn Corporation
1901 South Franklin
Butte, MT 59701
Phone: (406)723-2222

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a novel Resonant-Enhanced Crystallization (REC) process for pharmaceutical and biotechnology industry applications. REC technology is expected to be superior to the conventional crystallization process that incorporate impeller stirring for crystallization, due to its enhanced mass and heat transfer, lower shear (or reduced crystal breakage), and improved crystal size distribution.

The commercial impact of the project would be on pharmaceutical and biotechnology industries. REC technology will make the crystallization process more attractive to pharmaceutical separation and purification operations.

Title: SBIR Phase II: Development of Novel Enzymatic Antibiofilm Formulations

Award Number: 0321768
Program Manager: Om P. Sahai

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $499,914
Investigator: Nelson Barton, nbarton@diversa.com
Company: Diversa Corporation
4955 Directors Place
San Diego, CA 92121
Phone: (858)526-5000

Abstract:

This Small Business Innovation Research Phase II project will develop a powerful enzyme / biocide formulation for industrial water treatment. The research concept targets enzyme-facilitated diffusion of biocide for maximum biofilm control efficacy and provides a resultant low cost product with lowered environmental load. Proprietary gene evolution technologies will be used to enhance enzyme efficacy and to optimize process stability to provide robust enzyme candidates for formulation with conventional biocides. Optimized enzyme / biocide formulations will be tested against multispecies biofilms grown under simulated industrial process conditions.

The commercial application of this project is in the area of industrial bioproducts. Microbial fouling is a common problem in a variety of industrial, household, personal hygiene, and medical settings. To this end, a critical need exists for improved microbial control methods that are effective, economically beneficial, non-toxic and environmentally friendly. The anti-biofilm enzyme products, such as those targeted in this project, are expected to meet these needs for a market that represents an opportunity value of $995 million.

Title: SBIR Phase II: Cell-Based Microfluidic Platform for Drug Discovery

Award Number: 0321506
Program Manager: Om P. Sahai

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $498,620
Investigator: Brett Schreyer, b.schreyer@bioprocessors.com
Company: BioProcessors Corporation
35C Cabot Rd.
Woburn, MA 01801
Phone: (781)935-1400

Abstract:

This Small Business Innovation Research Phase II project will complete the development of the microscale bioreactor platform as a useful tool for cell culture studies in drug discovery research and development. The Phase II work has three key objectives: (1) to expand the capabilities of the microscale bioreactor to allow for the measurement of pH, dissolved oxygen, and protein titer; (2) to construct a fully automated bioprocessing cluster tool; and (3) to demonstrate the cost and speed advantages of the high-throughput approach to bioreactor production of recombinant protein.

The commercial application of this project is in the area of cell culture bioreactors for drug discovery and development.

Title: SBIR Phase II: Biological Process to Utilize Gases from Livestock Confinement Facilities in Biomass Production

Award Number: 9983163
Program Manager: Om P. Sahai

Start Date: August 1, 2000
Expires: July 31, 2002
Total Amount: $400,000
Investigator: Bruce Schroder, bgschroder@msn.com
Company: Dairilean Inc
P O Box 88647
Sioux Falls, SD 57105
Phone: (605)743-5204

Abstract:

This Small Business Innovation Research Phase II project will build and test a 1/30 scale prototype photo bioreactor system, which converts waste gas emissions from confinement swine facilities into algae (biomass). Large confinement production facilities account for a majority of livestock production and represent a significant source of odor and greenhouse gases as well as large quantities of solid and liquid waste. Phase I research demonstrated the ability to capture waste gases from a confinement swine facility and use it to produce micro-algae using a photo bioreactor. The research demonstrated that the algae in the photo bioreactor removed more than 90 percent of the waste gases and odors. During Phase II a 1/30-scale prototype photo bioreactor system will be built and attached to an existing swine confinement facility. The system will be tested using a variety of media and algae or photo organism species during the Phase II research. If successful a full scale demonstration unit will be built and tested in Phase III with sales of the system following. The system will address a serious environmental problem while reducing operating costs for swine producers by providing a feed supplement, algae biomass, and creating the potential to extract valuable co-products from the micro-algae.

The initial market for the bioair photobioreactor will be large swine operations. Pro Edge, a large swine producer, has agree to purchase the first demonstration unit and plans to purchase an additional 100 to 300 systems if they work as anticipated. While sales of the system will generate revenue, the ultimate goal is to extract high value components from the algae for use in pharmaceuticals, pigments, carbohydrates, and other chemical products. The market for these products is estimated to be approximately $6 billion in 2000.

Title: SBIR Phase II: A Novel Integrated Bioleaching Process for Chalcopyrite: An Alternative to Smelting

Award Number: 0078471
Program Manager: Om P. Sahai

Start Date: October 1, 2000
Expires: September 30, 2002
Total Amount: $322,708

Investigator: Gregory Olson, lbl@rmi.net
Company: Little Bear Laboratories, Inc.
5906 Mcintyre Street, Bldg.#2
Golden, CO 80403
Phone: (406)446-3648

Abstract:

This Small Business Innovation Research Phase II project is developing a novel electrobiochemical leaching (EBL) approach to recover copper from chalcopyrite, providing an alternative to smelting. Chalcopyrite is the most common copper ore, yet it is difficult to process hydrometallurgically because it passivates due to formation of refractory surface layers. The EBL approach in Phase 1 was shown to prevent this passivation and to result in faster and more complete copper extraction than conventional bioleaching approaches. The Phase II research objectives are to: 1) demonstrate the versatility of the process by determining the extent of copper extraction from different sources of chalcopyrite ore; 2) determine the optimum bioreactor configurations for the EBL approach; and 3) make a large laboratory scale (50 to 100 kg) demonstration of the process for determining preliminary process economics. The research will measure the extent of copper extraction and extraction kinetics by EBL, including the determination of metallurgical balances.

The results of the Phase II research will provide the data required to establish preliminary economic feasibility of the process and to convince investors or operators (mining company) to support a pilot scale demonstration. If successful, the EBL approach will provide a new technology in mineral extractions that will open additional reserves of copper in the US and elsewhere and reduce smelting of copper

Title: SBIR Phase II: Low-Frequency Sonochemistry -- A Cutting Edge Industrial Processing Technology

Award Number: 0078350
Program Manager: Rosemarie D. Wesson

Start Date: October 1, 2000
Expires: September 30, 2002
Total Amount: $434,000

Investigator: Johan van Walsem, hjvanwalsem@aol.com
Company: Resodyn Corporation
1901 South Franklin
Butte, MT 59701
Phone: (406)723-2222

Abstract:

This Small Business Innovation Research (sbir) Phase II project will demonstrate use of the novel low-frequence sonic technology for application as an advanced fermentation process. This project objective will establish a fundamental understanding of the low-frequency sonic technology capabilities to increase the productivity and yield of various aerobic fermentation processes, e.g., bacteria, yeast and mycelial. The Phase II program includes the development, design and demonstration of a prototype processing system as an efficient and cost-effective method for advanced fermentation applications. The Phase I objectives were fully achieved and feasibility of the innovative technology was demonstrated to provide extraordinarily high rates of gas mass transport into liquids, at low energy values and at low shear rates. The quality and amount of scientific and engineering data exceeded expectations, providing a solid base for a Phase II success. Post-Phase II experimentation was undertaken, which demonstrated specific commercial applications that have market-pull for use of the innovative fermentation methods. Several potential Phase III commercial fermentation applications have been identified. A commercial partner for Phase II co-funding and Phase III funding has been obtained. The commercial partner has also agreed to purchase equipment from Montec for their newly acquired fermentation business.

Commercial applications for fermentation processes include large quantity drug production for enhancement of both human and animal health, amino acids such as lysine for animal feeds and phenylalanine for production of aspartame, food preservatives such as ascorbic acid (vitamin C), vitamins and a plethora of other commodity compounds. In general, the production of an increasing number of biologically active compounds is shifting from traditional organic synthesis to fermentation. In these areas, the development of a lower cost, higher productivity technology has strong commercial appeal both in new and retrofit situations. Fermentation is the commercial end of the genetic engineering revolution and is virtually used in all of the cutting edge therapeutics.

Title: SBIR Phase II: Clinical-Scale Suspension Bioreactor for Primary Hematopoietic Culture

Award Number: 0078716
Program Manager: George B. Vermont

Start Date: December 1, 2000
Expires: February 28, 2002
Total Amount: $400,000

Investigator: Todd McAdams, lcfarrar@aol.com
Company: Tissue Therapeutics
2143 Sheridan Road
Evanston, IL 60208
Phone: (847)467-4559

Abstract:

This Small Business Innovation Research Phase II project describes the development of a disposable, highly efficient suspension bioreactor for primary hematopoietic (blood cell-forming) cell culture. The unique challenges (heterogeneous nature, donor variability, and shear-sensitivity) of these cultures render traditional flask or suspension cultures unable to economically and consistently produce large quantities of cells. In Phase I, the feasibility and characteristics of a disposable suspension bioreactor was demonstrated. In Phase II, a scaled-up prototype of a large, agitated disposable bioreactor designed for clinical use (stem cell transplantation) will be constructed, characterized, and tested for reliability and durability. Gas and mass transfer correlations established in Phase I will be verified and extended. The use of medium optical density as a surrogate measure for cell density will be investigated.

The final product will be a system that combines the simple, disposable nature of flask culture with the control and monitoring capabilities of a suspension bioreactor. The resulting system will enable the cost-effective production of large numbers of primary hematopoietic cells and will improve the effectiveness and decrease the cost of medical procedures in the fields of transplantation, immunotherapy, and gene therapy.

Title: STTR Phase II: Engineering Geobacter for Enhanced Electricity Production

Award Number: 0548633
Program Manager: F.C. Thomas Allnutt

Start Date: September 25, 2006
Expires: September 30, 2008
Total Amount: $499,665

Investigator: Christophe Schilling, cschilling@genomatica.com
Company: Genomatica Inc.
5405 Morehouse Dr. Suite 210
San Diego, CA 92121
Phone: (858)824-1771

Abstract:

This Small Business Technology Transfer (STTR) Phase II project aims to develop commercially viable bacterial strains (Geobacter sulfurreducens) for use as biocatalysts in microbial fuel cells. The research genetically manipulates these bacteria to enable the utilization of alternative substrates and increase current generation through the expression of an energy consuming futile cycle. The rates will be increased and alternative cheaper substrates utilized during this project.

The broader impact of this research will result in development of novel microbial fuel cells that can convert renewable resources such as biomass and agricultural wastes to electrical energy in an efficient fashion with varied commercial applications.

Additionally, innovative the metabolic engineering strategy that is developed could be applied to other industrially relevant microorganisms. In addition, there are significant societal and educational components of this program. One example would be a microbial fuel cell that harnesses electricity from organic waste can be valuable in electrifying remote rural communities in developing countries by decentralizing power generation while protecting the environment.

Title: STTR Phase II: A New Hyperspectral Imaging Spectrometer

Award Number: 0620581
Program Manager: F.C. Thomas Allnutt

Start Date: August 24, 2006
Expires: October 31, 2008
Total Amount: $479,219
Investigator: Rand Swanson, swanson@resonon.com
Company: Resonon
619 North Church Ave Suite 3
Bozeman, MT 59715
Phone: (406)586 3356

Abstract:

This Small Business Technology Transfer (STTR) Phase II research project develops a macroscopic fluorescent scanner that utilizes hyperspectral imaging with enhanced capability for reading microarrays, multiwell plates, and two dimensional (2D) gels. The system utilizes novel optical design to provide more efficient light gathering and less aberration for better imaging versus conventional hyperspectral optical designs. The anticipated technical benefits include improved signal-to-noise (greater sensitivity) and the better dye multiplexing (enabling the use of multiple dyes to detect of multiple analytes simultaneously). The broader impact of this research will be to enable more rapid advancement of scientific discovery by providing enhanced tools for study of the complexity of biological signaling, metabolic and response networks using non-radioactive optical detection methods to improve safety and reduce waste problems with optical detection.

Title: SBIR Phase II: Dynamic Signal Processing and Information Extraction for E-Noses

Award Number: 0522225
Program Manager: George Vermont

Start Date: November 30, 2005
Expires: November 30, 2007
Total Amount: $506,000
Investigator: Neil Euliano, neil@conveng.com
Company: Convergent Engineering
4817 SW 34th Street, Suite 4
Gainesville, FL 32608
Phone: (352)378 4899

Abstract:

This Small Business Innovation Research SBIR) Phase II project focuses on the development of electronic nose signal processing and dynamic pattern recognition systems specifically tuned to the properties of odors. This advanced e-nose signal processing toolbox should improve current selectivity by an order of magnitude. A prototype exhaled-breath propofol (anesthetic) monitor for use in measuring depth of anesthesia in patients undergoing surgery will be built and demonstrated.
The initial commercial application of this project will be in the medical surgery area where the product should provide more accurate patient dosing during anesthesia. The technology, however, may be broadly applicable to such key areas as medical diagnostics, illicit drug detection, glucose monitoring, etc.

Title: SBIR Phase II: Continuous Spray-Capture Production System

Award Number: 0620389
Program Manager: Rosemarie Wesson

Start Date: September 21, 2006
Expires: September 30, 2008
Total Amount: $467,005
Investigator: Piechocki Piechocki, JPiechocki@ABN-Corp.com
Company: Advanced BioNutrition Corp.
7155-H Columbia Gateway Drive
Columbia, AL 21046
Phone: (410)730 8600

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a technology that allows the stabilization of live probiotic bacteria for incorporation into food products outside the dairy case. ABN proposes a novel microencapsulation solution that involves pumping viscous liquids through a spray nozzle, followed by the capture of the resultant particles in a cross-linking fluid. The Phase II objectives are to complete the commercial acceptability of this novel process by modifying the system to make all processes steps compliant with current Good Manufacturing Processes and by designing and fabricating the final critical drying step for the microencapsulated probiotics. This final step will provide a product that is stable enough to be used by the food and feed industries to allow the use of probiotics in products that do not need to be refrigerated.

The manufacturing technology proposed herein is an enabling technology that will open many new commercial opportunities for a number of industries. Stabilization of the probiotics and incorporation into nutritional bars, beverages, cereals, and other food products that do not require refrigeration will greatly expand the commercial potential, and choices for consumers who will benefit from these gut-friendly bacteria. The same technology could also be used for the stabilization and delivery of enzymes, vaccines, and other small molecules whose oral delivery is limited by gastric digestion.

Title: SBIR Phase II: Development of a BioAcoustic Mixing Platform

Award Number: 0646562
Program Manager: F.C. Thomas Allnutt

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Todd McAdams, lcfarrar@resodyn.com
Company: Resodyn Corporation
130 N Main St Ste 600
Butte, MT 59701
Phone: (406)497-5252

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops a mixer based on sound waves applicable for use in bioreactors for cell culturing and fermentors. Cell culturing and fermentation are large markets where significant growth is forecast over the next several years. This research will establish the optimal design and operating conditions for this non-invasive and non-destructive mixing technology. It is anticipated that performance for many applications can be enhanced by 50% or greater over state-of-the-art technology using this novel agitation technology.

The broader impact will be to reduce the costs of pharmaceutical production, when such production is based on biological feedstocks. Media and process development for biological production of pharmaceuticals is costly and time-intensive and performed using stirred-tank bioreactors due to the limitations of orbital shake-flask and cell culture flasks. A mixing technology that could unify laboratory-scale and pilot-scale experiments would be highly valuable in speeding the pace of process development. Low-frequency acoustic energy will dramatically enhance gas-liquid mass transport without increasing hydrodynamic shear stress. The research project will enhance the scientific understanding of low frequency acoustic mixing processes by quantifying the impact of acoustic frequency on oxygen transfer rates and cellular growth. The significance to society that the successful development is a dramatic increase in the pace of biotechnological process development. This will lead to more rapid commercialization of and lower prices for pharmaceutical products that enhance overall quality of life.

Title: SBIR Phase II: Development of Resonant Waveguide-Grating Elements for High Throughput Screening of Proteins

Award Number: 0724407
Program Manager: Muralidharan S. Nair

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $500,000
Investigator: Debra Wawro, wawro@resonantsensors.com
Company: Resonant Sensors Inc.
202 E. Border Street
Arlington, TX 76010
Phone: (817)300-8297

Abstract:

This Small Business Inovation Research (SBIR) Phase II research project applies a new sensor principle to develop commercial High-Throughput Screening (HTS) systems for drug-development applications. The advantages of the Guided-Mode Resonance (GMR) sensor concept for such applications reside in its inherent physical characteristics including polarization diversity, materials independence, choice of spectral regions, angular-addressing flexibility, and associated compact system configurations. These properties enable tag-free sensor technology with high sensitivity, high accuracy, and multi-parameter detection. A major objective is the development and verification of GMR-sensor HTS commercial system prototypes in standard formats. Integrated analysis software will present data on biomolecular binding events, including background density and molecular accumulation dynamics, to the user. An additional main thrust is the development of attachment chemistry and methods for sensor activation where a set of protocols and processes for example measurands will be optimized to maximize detection sensitivity. Finally, by applying transmission sensor formats with shaped input light beams and integrated detector matrices, the next-generation compact system designs for massively parallel screening of drug compounds will be provided.

This research project will stimulate progress in drug discovery. Guided-mode resonance sensors operate without chemical tags permitting observation and study of unperturbed biochemical processes, as no foreign substance is introduced. Therefore, these sensors provide enhanced understanding of chemical and biomolecular reactions and may lead to advances in chemical process development and drug discovery and design. Moreover, this class of biosensors has other potential applications including medical diagnostics, proteomics, genomics, environmental monitoring, and homeland security. Application of this technology to microfluidics, lab-on-a-chip, and wireless integrated sensors for homeland security and environmental monitoring may provide new tools for accurate and cost-effective detection of biotoxins, explosives, and hazardous materials.

Title: SBIR Phase II: An Innovative Photobioreactor for Commercial Production of Astaxanthin from Genetically Improved Haematococcus Pluvialis Strains

Award Number: 0724411
Program Manager: F.C. Thomas Allnutt

Start Date: July 1, 2007
Expires: June 30, 2009
Total Amount: $499,866

Investigator: Fan Lu, lf1230nc@yahoo.com
Company: Algaen
3488 Bramlet
Clemmons, NC 27012
Phone: (336)577-4354

Abstract:

This Small Business Innovative Research (SBIR) Phase II reserach develops an innovative biotechnology for commercial production of natural astaxanthin using genetically improved microalgal strain(s) grown in a proprietary large-scale photobioreactor, and to demonstrate the effectiveness of the new strains in improving bioavailability of astaxanthin. The proposed R&D efforts aim to overcome the major weakness inherent in the present production of astaxanthin-enriched Haematococcus: poor bioavailability of astaxanthin for humans and animals. The company will use several genetically modified Haematococcus strains with remarkably improved bioavailability of astaxanthin. The major objectives of the Phase II research are to design, construct, and evaluate an innovative large-scale photobioreactor system for sustainable mass culture of these new strains. The improved production system will increase astaxanthin productivity by 1.5- to 2-fold with at least 30% cost reduction.

The broader impacts of this technology will be to overcome two major hurdles for the Haematococcus-based astaxanthin industry. The application of this biotechnology will lead to major increases in astaxanthin sales by 2015. It will also result in job expansion in the Haematococcus-astaxanthin production and related industries (e.g., cosmetic, pharmaceutical, and nutraceutical). Reduction in the production costs will lead to decreasing prices, making astaxanthin more affordable to allow more people to take advantage of astaxanthin as a strong antioxidant for improving health and well-being.

Title: SBIR Phase II: High Performance Cement Additive from an Agricultural Byproduct

Award Number: 0724463
Program Manager: F.C. Thomas Allnutt

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Rajan Vempati, chkgroup@worldnet.att.net
Company: ChK Group, Inc.
11700 Audelia Road
Dallas, TX 75243
Phone: (972)234-6744

Abstract:

This Small Business Innovation Research Phase II project develops the manufacturing process for a cement additive from an agricultural biomass waste to be used in the production of High Performance Concrete (HPC), and blended cement. This additive imparts increased strength and durability to concrete; therefore will mostly be used in high-rise buildings, highway construction, and infrastructures built in severe environmental conditions, e.g. petrochemical plants and marine structures. This project will generate increased revenues to the US farmers by selling their byproduct at a higher price and will create jobs in rural areas. Also, potential exists to license the technology to several emerging economies, where there is an urgent need to build transportation-, energy- and building-infrastructures.

The Broader Impacts of this research will be increased and higher value use of this agricultural waste in high strength cement. Utilization of this improved product will reduce pollution caused by the current alternatives in both air and at landfill sites. This research is intended to provide a profitable alternative to farmers producing this crop and create rural jobs.

Environmental Biotechnology

Title: SBIR Phase II: Development of a Differential Long-Path Spectrophotometer for On-line Measurements of Controlled Halogenated Organic Compounds in Potable Water

Award Number: 0109973
Program Manager: Om Sahai

Start Date: September 1, 2001
Expires: February 29, 2004
Total Amount: $498,274

Investigator: Yogesh C. Agrawal, yogi@sequoiasci.com
Company: Sequoia Scientific, Inc.
2700 Richards Road
Bellevue, WA 98005
Phone: (425)641-0944

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype instrument for measuring harmful bi-products of chlorination in drinking water. These disinfection bi-products are subject to EPA regulations. The Phase I project demonstrated that the concept of differential UV absorption measurement, i.e. absorption before and after chlorination, is suitable for the needed measurement. A pre-production prototype instrument will be constructed during the Phase II project. This device shall employ a multi-pass cell design using our novel dual-ratio technique that eliminates concerns about long term drifts. The overall instrument architecture design and systems design will be carried out prior to assembly of the full microprocessor-controlled recording device. Extensive laboratory and field tests will be used to review design changes before production.

The potential commercial applications of the instrument proposed may be used in the laboratory or in-line at utilities. The market for the proposed product is quite substantial, as EPA regulations will result in the installation of such devices at all utilities and drinking water facilities.

Title: SBIR Phase II: An Automated Water Pathogen Monitoring System

Award Number: 0450613
Program Manager: George B. Vermont

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $512,000

Investigator: Zoraida Aguilar, zoraida.aguilar@vegrandis.com
Company: Vegrandis, LLC
535 W. Research Blvd.
Fayetteville AR, 72701
Phone: (479)571-2592

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop an automated instrument for rapid and specific detection of waterborne pathogens in municipal water supplies using methods combining immunoassay with electrochemistry. Although the disposable cartridges for this instrument could be specified for nearly any pathogen of interest, this project will focus primarily on the detection of Cryptosporidium parvum oocysts. C. parvum is a threat to the nation's water supply, does not respond to common antibiotics and resists water purification treatments.

The commercial application of this project will be on the monitoring of drinking water supplies for pathogens. This would include testing of water at the source, in distribution networks, and at bottling and packaging facilities. The proposed device would eventually be adapted for emergency field use, for home use by safety conscious consumers, and for medical, industrial, recreational and combat purposes.

Title: SBIR Phase II: Field Demonstration of a Novel Biotechnology for In-Situ Bioremediation of Methyl Tert-Butyl Ether (MTBE) in Groundwater

Award Number: 0450486
Program Manager: Michael R. Ambrose

Start Date: May 1, 2005
Expires: April 30, 2007
Total Amount: $499,999

Investigator: Fatemeh Shirazi, fshirazi@microvibiotech.com
Company: Microvi Biotech LLC
11966 W 119TH ST
Shawnee Mission KS, 66213
Phone: (913)696-9934

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a novel process for in-situ bioremediation of methyl tert-butyl ether (MTBE) in groundwater. The Environmental Protection Agency (EPA) considers MTBE a potential human carcinogen. Currently, MTBE's Maximum Contaminant Level (MCL) in drinking water has been set for 18 parts per billion. It is estimated that the cost of cleaning up MTBE contamination nationwide is $29 billion and growing. Bioremediation holds a great promise for destruction of MTBE in groundwater. The key problems with currently used bioremediation methods for MTBE are (1) the inability to establish high densities of MTBE- degrading bacterial, (2) the inability to maintain contact between the degrading bacteria and MTBE, and (3) the upsets and losses of key bacteria. Prior Phase I work has successfully demonstrated the effectiveness of a new technical approach called Biological Permeable Barrier (BPB) that uses encapsulated MTBE-degrading bacteria for removal of MTBE in water. The primary objective for the Phase II project is to assess the long-term performance of a BPB field pilot unit to remove MTBE at Port Hueneme Navy site, and to assess the cost and performance of the BPB / MicroBeads system for longer periods of time under field conditions. The novelties of this technical approach are four folds : (1) the proposed system will deliver high cell density of MTBE-degrading bacteria right to the zone of contamination; (2) the proposed system will create the perfect environment for bacteria with a high degree of degradation and stability; (3) the proposed system will protect the bacteria against environmental stresses; and, (4) the proposed system will prevent wash out of key bacteria. It is anticipated that the proposed BPB pilot scale unit at Port Hueneme will effectively degrade MTBE and other contaminants in groundwater to non-detectable levels.

The immediate commercial application of this project will be on the bioremediation of MTBE in groundwater. However, the proposed technology holds promise for effective, controlled and cost efficient cleanup of groundwater at sites contaminated with other toxic and polluting chemicals as well. Other potential applications include the treatment of industrial wastewater and drinking water.

Title: SBIR Phase II: The Use of Halophytic Plants and Fish for the Bioremediation of Coal Bed Methane Discharge Waters

Award Number: 0422222
Program Manager: Om P. Sahai

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $500,000

Investigator: John Woiwode, woiwodejon@cs.com
Company: AquaMatrix International, Inc.
270 Veronica Lane, Suite D
Jackson, WY 83001
Phone: (307)739-7185

Abstract

This Small Business Innovation Research (SBIR) Phase II project is to develop a process that uses halophytic plants and aquaculture effluent to treat highly saline coal bed methane (CBM) discharge water. Vast volumes of water are a necessary though unwanted byproduct of the gas drilling process. The saline discharge is widely viewed as an environmental liability. Discharges into streams are essentially forbidden, while indiscriminant surface discharge causes soil salination. Prior Phase I work has shown that halophytic plants may be successful in sequestering significant amounts of sodium when irrigated with CBM discharge waters. This Phase II project will confirm Phase I greenhouse data with field trials of plants irrigated with CBM water and fish effluent when compared with controls under otherwise normal farming practices. Soil impacts and tilth will also be examined in great detail.

The commercial application of this project will be to alleviate the negative impact of CBM discharges on the environment in Wyoming, and to open up huge areas of land for responsible CBM exploration and recovery.

Title: SBIR Phase II: Advanced Thermal Treatment Process For Sewage Sludge

Award Number: 9983559
Program Manager: Om P. Sahai

Start Date: April 1, 2000
Expires: March 31, 2002
Total Amount: $400,000
Investigator: Michael Klosky, enertech1@mindspring.com
Company: EnerTech Environmental Incorporated
739 Trabert Avenue, NW
Atlanta, GA 30318
Phone: (404)355-3390

Abstract:

This Small Business Innovation Research Phase II project will demonstrate the technical and economic feasibility of the Slurry Carbonization process in generating an improved fuel product from low grade Municipal Sewage Sludge (MSS). Approximately 7.8 million dry tons of MSS are generated each year in the U.S. as a byproduct of municipal waste water treatment. MSS management is a growing concern due to the increase in generated volumes of sludge, demand for lower pollutant discharges, and rise in disposal costs. Slurry Carbonization is a moderate temperature and pressure treatment, which removes oxygen functional groups from the MSS and produces a homogeneous, carbon-hydrogen enriched char product for co-combustion or reburning in suspension-fired coal boilers. The overall objective of Phase II research is to develop the scientific and engineering data necessary to design, build and operate a demonstration facility in Phase III scale-up. Phase II research will focus on bench-scale optimization using EnerTech's 2.2 gal/hr PDU and pilot-scale engineering studies using HTI's 510 lb/hr PDU. Pilot-scale combustion and reburning experiments then will be conducted in EER's 1.0 MM Btu/hr BSF.

It is anticipated that Phase II research will establish Slurry Carbonization as an economically and environmentally desirable method of MSS utilization. In addition to treatment of MSS, other applications of EnerTech's Slurry Carbonization process technology include clean coal combustion and the production of homogeneous slurry fuels from industrial sludge, pulp and paper mill wastes, Kraft mill black liquor, MSW, RDF, wood wastes and other sources of renewable biomass.

Title: STTR Phase II: Development of a Solar Air Conditioner for Small Cooling Loads

Award Number: 0110570
Program Manager: Om Sahai

Start Date: December 15, 2001
Expires: November 30, 2003
Total Amount: $500,000
Investigator: Hector M. Sanchez, acmech@prtc.net
Company: A/C & Mechanical Serv Co
Box 393
Mayaguez, PR 006810393
Phone: (787)833-8050

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop a reliable prototype of a novel, compact and low cost solar air conditioning system for hot and humid climates. The system will consist of an air-cooled single effect absorption machine driven by an array of high performance flat plate collectors and a thermal storage tank. A microncontroller based control system will allow an optimal system operation. The capacity of the system is projected to be in the range of 3-5 cooling tons.

The marketing, manufacturing, installation, and product development of the proposed technology is envisioned as a partnership of three small businesses dedicated to: installation of A/C systems, marketing and manufacturing of solar collectors, and to research.

Title: SBIR Phase II: Ultraviolet (UV) Water Remediation with Surface Discharge UV Lamps

Award Number: 0237472
Program Manager: Om Sahai

Start Date: March 1, 2003
Expires: February 28, 2005
Total Amount: $488,279

Investigator: Raymond B. Schaefer, rschaefer@phoenixsandt.com
Company: Phoenix Science & Tech Inc
27 Industrial Avenue
Chelmsford, MA 01824
Phone: (978)367-0232

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop an Ultra-Violet (UV) water remediation process using a novel Surface Discharge Pulsed UV lamp (SD lamp) to treat organic contaminants. The objective of the Phase II research is to extend Phase I accomplishments and to develop a prototype Surface Discharge UV water treatment system for subsequent commercialization. For UV water treatment, the SD lamp offers advantages in terms of inherent UV efficiency, spectrum, high intensity and the absence of concerns linked to the use of mercury. Prior Phase I studies have shown that the effectiveness of SD lamps is greater than that of commercial mercury lamps by more than what would be expected based on UV efficiency alone. The proposed NSF Phase II Project will examine the reasons for this high effectiveness and to use this information in order to develop a Phase II prototype SD UV water remediation system. This Phase II work will be carried out in conjunction with a major UV water treatment company.

The commercial application of this project will be in the area of water treatment. The Surface Discharge UV lamp is expected to replace mercury lamps currently used in most UV water treatment systems.

Title: SBIR Phase II: Bioremediation of Chlorinated Solvents in Saturated, Low Permeability Soils

Award Number: 0239859
Program Manager: Om Sahai

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,996

Investigator: Kent S. Sorenson, ksorenson@nwindenv.com
Company: North Wind
P.O. Box 51174
Idaho Falls, ID 83405
Phone: (208)528-8718

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to develop an innovative solution to the problem of chlorinated solvent contamination in variably saturated, low permeability soils. Prior Phase I work has demonstrated that: 1) chitin is an effective electron donor for stimulating biodegradation of chlorinated solvents, 2) that chitin enhances bioavailability of the solvents, 3) that chitin can be incorporated into a proprietary hydraulic fracturing process for low permeability soils, and 4) that the delivery method for chitin is effective in the field on a small scale. The objectives of the Phase II Project are to evaluate biodegradation efficiency and longevity of chitin on a large scale. Current approaches for low permeability soils are very capital-intensive and are seldom totally effective. The proposed approach, in contrast, is low-cost and passive, and applicable "in situ". The method is particularly attractive since chitin is available in abundance as a byproduct from the shellfish industry.

The commercial applications of this project are in the area of soil bioremediation.

Title: SBIR Phase II: Development of a Novel Sensing Material for Waterborne Pathogens

Award Number: 0239587
Program Manager: Om Sahai

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,748
Investigator: Mary Reppy, reppy@absbio.com
Company: ABS Inc
701-4 Cornell Business Park
Wilmington, DE 19801-5782
Phone: (302)654-4492

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to develop a method to detect Cryptosporidium parvum oocyst in water using a novel sensing coating deposited on filters. C. parvum has been responsible for a number of outbreaks of cryptosporidiosis, including the outbreak in Milwaukee in 1993 that affected 400,000 people. Cryptosporidiosis is characterized by abdominal pain and severe diarrhea, and can be fatal to immune-compromised individuals. Currently, there is no easy and reliable test allowing the routine monitoring of drinking water supplies for C. parvum. The approved EPA method for this purpose is slow, expensive, and requires interpretation by highly trained personnel. The innovation inherent in the proposed pathogen detection platform resides in a unique "smart" polymer filter coating that permits pathogen concentration, detection, and signal generation in a single step. The signal is generated from interactions between the target and specific antibodies, resulting in a fluorescent signal. Prior Phase I work has already demonstrated the effectiveness of this approach. The proposed Phase II effort will focus on the optimization of the filter coating and the development of the accompanying hardware and testing protocol needed for commercialization and EPA approval of a complete water-testing product.

The commercial application of this project is in the market for detection of pathogens in drinking water supplies. The testing market for C. parvum, the specific pathogen targeted in this Phase II project, is estimated to be $75 million in the U.S. and $ 100 million worldwide. It is expected that further adaptations of the pathogen detection technology proposed in this project will have added applications in the markets for the testing of foods and beverages, and in medical diagnostics.

Title: SBIR Phase II: In Situ Remediation of Methyl Tert-Butyl Ether (MTBE) Using Bioaugmentation

Award Number: 0091432
Program Manager: Om Sahai

Start Date: February 1, 2001
Expires: June 30, 2003
Total Amount: $495,582

Investigator: Paul B. Hatzinger, hatzinger@envirogen.com
Company: Envirogen, Inc.
4100 Quakerbridge Road
Lawrenceville, NJ 08648-4702
Phone: (609)936-9300

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project is designed to develop and demonstrate a new in situ treatment technology for the destruction of methyl tert-butyl ether (MTBE) in groundwater. The gasoline additive MTBE is the second most prevalent groundwater contaminant in the United States, and there are currently no economical technologies for its removal from the water supply. This technology utilizes a novel bacterium of the species Hydrogenophaga flava (ENV735) for the remediation of MTBE. This bacterium, which was recently isolated by Envirogen scientists, is one of only two bacterial strains discovered that are capable of growth on MTBE. Phase II experiments will be conducted to: (1) assess the movement and distribution of the bacterium in the subsurface; (2) develop an adhesion-deficient strain for improved aquifer distribution; and (3) optimize commercial-scale growth, shipment, and injection of the bacterium for. A field demonstration will be conducted to fully test the technology under in situ conditions.

The bioaugmentation with ENV735 has broad potential as an in situ remediation technology for MTBE-contaminated aquifers. If the results of the field trial are positive, commercialization of the bioaugmentation technology is anticipated in the short term.

Title: STTR Phase II: Development of an Automated Instrument Platform for Facilitating Submitochondrial Particle (SMP) Toxicity Assays

Award Number: 0091595
Program Manager: Om Sahai

Start Date: June 1, 2001
Expires: May 31, 2003
Total Amount: $492,166

Investigator: Karl Gustavson, kgustavson@harvardbioscience.com
Company: Harvard Bioscience, Inc.
84 October Hill Road
Holliston, MA 017461371
Phone: (608)276-9820

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and optimize a novel bioassay tool for routine low-cost biomonitoring of water quality. Submitochondrial particle (SMP) toxicity bioassays, based on the in vitro responses to toxicants of the integrated enzyme functions in oxidative phosphorylation, are good predictors of conventional whole organism tests, yet can be completed in minutes. Phase I research proved the concept that SMP technology could be streamlined and semi-automated, enhancing their convenience and commercial potential. In Phase II, prototypes of two dedicated instruments will be developed to accommodate both the cuvette and 96-well microplate-based formats. Accessory liquid and cuvette handling tools will be developed to increase sample throughput. Features will be added to computer software developed in Phase I for running the tests, including support for other protocols; better error detection; statistical treatments and graphical presentation of data. SMP production methods and quality control procedures will be improved and standardized. The software and instrument prototypes will be tested at four independent laboratories to establish assay variability and to gain additional information on appropriate applications of the tests.

If successful, this project will provide affordable tools that will allow for screening of water quality and wastewater discharges by industry and municipalities.

Title: SBIR Phase II: A Novel, Non-Toxic, General Purpose Oxygen Activated Disinfectant

Award Number: 0216382
Program Manager: Om Sahai

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $500,000

Investigator: G. Duncan Hitchens, hitchens@lynntech.com
Company: Lynntech, Inc
7610 Eastmark Drive, Suite 202
College Station, TX 77840-4024
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to develop a novel method for on-site and on-demand generation of an extremely potent and safe disinfectant. Phase I research has established the basic feasibility of this unique method to generate the disinfectant, as needed, at appropriate concentrations. The overall objective of the Phase II project is to design, demonstrate, and challenge test a fully operational bench-scale device for on-site and on-demand generation of the disinfectant. Additional work will be done to improve the yield of the disinfectant, to examine various additives, and to conduct antimicrobial experiments in accordance with EPA test requirements.

The commercial applications of this project will be in the areas of domestic/personal healthcare, food service and healthcare delivery.

Title: STTR Phase II: Plant Bioreporters for Arsenic

Award Number: 0548751
Program Manager: F.C. Thomas Allnutt

Start Date: September 25, 2006
Expires: September 30, 2008
Total Amount: $500,000
Investigator: Mark Elless, elless@edenspace.com
Company: Edenspace
15100 Entp Ct Suite 100
Chantilly, VA 20151
Phone: (703)961-8700

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop plant bioreporters for arsenic which is widely dispersed in the environment. Detecting and monitoring arsenic in soil and water, particularly in large or remote areas, is often cost-prohibitive due to the expense of sample collection and analysis. This research will lead to an innovative, cost-effective, real-time system to monitor water and soil quality offering high spatial resolution, stand-off reporting, ready scaling to large treatment areas, and continuous in place reporting of bioavailable arsenic. Applications for this technology include detection and investigation of arsenic contamination and risk assessment during remedial activities at contaminated sites.

The broader impact of this technology will be to enable more extensive use of in place environmental cleanup methods such as phytoremediation, assist efforts to monitor and clean the environment, and reduce environmental health hazards posed by arsenic. Improving the ability to accurately assess arsenic contamination will improve awareness of contaminated areas and make affordable arsenic monitoring by homeowners, farmers, and industry. Of particular usefulness would be the ability of farmers and gardeners to detect the potential bioavailability of arsenic to food crops as a result of arsenic in biosolids and pesticides.

Title: SBIR Phase II: Environmental Neurotoxicity Using Zebrafish

Award Number: 0548657
Program Manager: F.C. Thomas Allnutt

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $512,000
Investigator: Catherine Willett, kptnkate@phylonix.com
Company: Phylonix Pharm Inc
100 Inman St Suite 300
Cambridge, MA 02139
Phone: (617)441-6700

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at developing a large-scale quantitative assay procedure for the evaluation and detection of potential developmental neurotoxic environmental pollutants. The assay will use zebrafish as the model to investigate the presence of these potential pollutants and as such, will be a relatively simple, fast and cost effective method to evaluate and prioritize potential chemicals for subsequent testing.

The ability to detect, evaluate and determine levels of potential developmental neurotoxic compounds in ground water and other industrial sites will provide for a more comprehensive understanding of potential hazards that industrial runoff may have. To date, very few chemicals that are being tested have been assayed for their potential neurotoxic effects. This assay will provide such a method for testing and will have an impact on environmental pollution and public health.

Title: SBIR Phase II: Water Purification Technology for Removal of Chemical and Biological Contaminants

Award Number: 0620568
Program Manager: Errol Arkilic

Start Date: August 25, 2006
Expires: July 31, 2008
Total Amount: $499,997

Investigator: Lisa Farmen, farmen@yahoo.com
Company: Crystal Clear Technologies
3933 N.E. Royal Court
Portland, OR 97232
Phone: (503)544-2330

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops a low-cost, water purification technology for removal of biological and chemical contaminants. In combination with research at the University of Oregon and technology licensed from the University of Texas, a proprietary surface-modified mineral adsorbents will sequester high concentrations of chemical contaminants, such as arsenic, lead, mercury, PCE, TCE and MTBE. The current effort will: a) optimize specific bifunctional ligands and mineral substrates capable of removing heavy metals to meet the EPA drinking water standards; b) demonstrate alternative ligand/substrate combinations capable of selective removal of contaminates from a water stream; c) demonstrate qualification to EPA and California drinking water requirements of a CCT water filter and ultra-violet lamp combination; d) field test the solution in an underdeveloped location.

Currently two-thirds of the world's population does not have access to clean water and one-third lack access to a reliable source of water. In certain parts of the world, mostly the underdeveloped world, water is already the most precious necessity. From the executive summary of the World Water Assessment Program sponsored by the United Nations under UNESCO: "In 2000, the estimated mortality rate due to water sanitation hygiene-associated ... diseases.. was 2,213,000." That equates to one person every 15 seconds. In the U.S., an 2001 EPA report estimates that over two million Americans get sick from contaminated water each year. In China, over one billion people lack acceptable water resources. At the completion of the Phase II effort, CCT will have a complete solution, using both passive and active technologies, for a low cost, sustainable water purification module.

Genomics

Title: SBIR Phase II: Genomic Mapping of DNA by Means of GeneEngine(TM) Technology

Award Number: 0320449
Program Manager: Om Sahai

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,998
Investigator: Rudolf Gilmanshin, rgilmanshin@usgenomics.com
Company: U. S. Genomics
6 'H' Gill Street
Woburn, MA 01801-1721
Phone: (781)937-5550

Abstract:

This Small Business Innovation Research Phase II project aims to build a technology for long-range, high-resolution DNA mapping based on the proprietary GeneEngine(TM) platform. This technology will be a unique tool for genomics because of the combination of features: single- molecule sensitivity, ability to analyze very long DNA molecules, high throughput, and potential for automation. The basic feasibility of this technology was shown in Phase I. The Phase II project is aimed at creating efficient procedures for sample preparation and measurement, as well as for developing analysis algorithms and combining them into an automated software package. These procedures and software will be united to form a toolkit for DNA mapping.

The commercial application of this project will be in the area of Genomics. The product resulting from this project will comprise of instruments and consumables (e.g. reagents) for mapping of whole microbial genomes based on long-range, single-molecule DNA mapping. The ability to scan microbial genomic DNA for genetic information at a fraction of the cost and time of that needed currently will be valuable in a number of commercial applications in life science research and the healthcare industry, including the elucidation of complex genetic pathways, identification of target genes for development of novel anti-infective drugs, correlation of genomic information with unique functions and with drug response, as well as for DNA-based molecular diagnostics and prognostics. The principal market for these applications would be the bio-pharmaceutical companies and academic research laboratories, with additional longer-term markets expected in the area of clinical diagnostics.

Title: SBIR Phase II: Software for Micro RNA Detection and Analysis

Award Number: 0522270
Program Manager: George B. Vermont

Start Date: August 15, 2005
Expires: July 31, 2007
Total Amount: $405,905

Investigator: Gary Fogel, gfogel@natural-selection.com
Company: Natural Selection Inc
3333 N Torrey Pines Ct Ste 200
La Jolla CA, 92037
Phone: (858)455-6449

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop machine learning tools for RNA gene detection. Prior Phase I research resulted in the successful development of artificial neural networks for the discrimination of functional RNA (fRNA) coding regions from non-coding regions in four model eukaryotes. The Phase II project will focus on (1) refinement of best evolved neural networks for 10 key eukaryotes capable of discriminating fRNA coding from non-coding sequence information, (2) experimental verification of predicted fRNA coding regions in human and mouse, (3) development of machine learning algorithms capable of discriminating between eukaryotic fRNA subtypes, (4) extension of the approach to include machine learning tools capable of discriminating between fRNA subtypes and to evaluate this potential for additional functionality, and (5) development of a user-friendly graphical user interface (GUI) for the product.

The commercial application of this project will be to identify a new class of targets for drug design and discovery for the pharmaceutical industry. The educational aspects of the proposed work will be to assist in dissemination of knowledge about the importance of fRNAs to the next generation of scientists.

Title: SBIR Phase II: Development of Anticancer Drugs Using Novel Drug Delivery Systems

Award Number: 0521900
Program Manager: George B. Vermont

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $500,000

Investigator: C.J. Yu, yucjyu@aol.com
Company: GlyPort, Inc.
118 S. Berkeley Ave.
Pasadena CA, 91107
Phone: (626)844-7896

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the enhancement of water solubility and efficacy of sparingly soluble anticancer drugs. Many of the clinically accepted anticancer drugs have side effect problems because of the dosages that must be used to overcome low solubility and bioavailability properties. A new delivery vehicle has been developed, which, when attached to known chemotherapeutic agents , increases water solubility and improves the drugs anticancer activity in in-vitro tests. The Phase II goals are to evaluate further enhancement of solubility with modified delivery segments, do in-vivo evaluations in mice with human tumor xenografts, and to do pharmacokinetic studies of the drugs in the rat model.

The commercial application of this technology is in cancer chemotherapy. Increased solubility and bioavailability should reduce the quantity and side effects of the expensive drugs that are currently used. Furthermore, certain drugs that could not be used previously because of poor cellular uptake, might now be made available using this mode of delivery.

Title: SBIR Phase II: Development and Manufacture of High-Density Plate Washer

Award Number: 0450448
Program Manager: Michael R. Ambrose

Start Date: January 15, 2005
Expires: December 31, 2006
Total Amount: $500,000
Investigator: Richard Kris, richardkris@earthlink.net
Company: NeoGen, LLC
2602 E Avenida De Posada
Tucson AZ, 85718
Phone: (520)906-2002

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a plate washer capable of washing very high-density plates, such as 1536 well plates, for ELISA and high-throughput screening assays. Currently, there are automated plate washers for 96 and 384 well plates, but there are none available for plates with ultra-high density. This is because currently available washer technology, employing a nozzle system, cannot be made reliable enough to allow dispense and aspirate nozzles to properly reach within each of the many, very small wells, and because the thin nozzles needed can get easily clogged using many standard buffers. In contrast, the proposed system uses a steady stream or sheet of solution, making the system less likely to clog.

The commercial application of this project will be to allow use of high-throughput screening assays by industrial and academic researchers involved in genomics and drug discovery research. The proposed technology will enable additional use of fluorescent chemical compounds, that typically require a wash step to remove interfering substances, for screening

Title: SBIR Phase II: Development of a Microfluidic Device for Rapid Analysis, Sorting, and Collection of Biological Particles Using Photonic Forces

Award Number: 0422059
Program Manager: Om P. Sahai

Start Date: September 1, 2004
Expires: August 31, 2006
Total Amount: $499,940
Investigator: Jonathan Diver, jdiver@genoptix.com
Company: Genoptix, Inc.
3398 Carmel Mountain Road
San Diego, CA 92121
Phone: (858)523-5003

Abstract

This Small Business Innovation Research (SBIR) Phase II project will develop a fluorescence activated cell sorter (FACS) that uses optical forces to move cells and to sort cell sub-populations. The specific Phase II objectives are : (1) to build an integrated prototype cell sorter with flexibility to configure multiple lasers and detectors, (2) to develop a self contained microfluidic cartridge that can handle 1,000-100,000 cells/sample and sort with purities greater than 95% and total recovery rates greater than 80%, (3) to develop microfluidic flow assays, and (4) to validate that the mechanical and optical stresses do not adversely affect cells.

The proposed work will result in a prototype cell sorter, self-contained microfluidic cartridges, and a panel of assays that demonstrate the broad utility of the instrument. The commercial application of this project will be in the area of cell-based assays for use in biological and biomedical research.

Title: SBIR Phase II: Novel Method for Class Switching IgM Secretors to IgG

Award Number: 0238667
Program Manager: Om Sahai

Start Date: January 1, 2003
Expires: December 31, 2004
Total Amount: $500,000
Investigator: Yevgenya Akselband, yaks@onecell.com
Company: One Cell Systems Inc
100 Inman Street, Suite 200
Cambridge, MA 02139-1206
Phone: (617)868-2399

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a rapid IgSwitch Assay for inducing and isolating IgG class switch variants from IgM hybridomas using in-vitro culture conditions, microencapsulation technology and fluorescence activated cell sorting. The IgSwitch Assay is expected to be a significant improvement over conventional methods used to isolate class switch variants, and will be useful in cell line development and monoclonal antibody production. Prior Phase I research has already demonstrated the feasibility of the proposed method using a model IgM hybridoma. This Phase II project will develop in-vitro culture conditions that promote switching to different IgG subclasses. The Phase II research will also validate reagents for a family of isotype specific IgSwitch Assays.

The commercial application of this project will be in the area of monoclonal antibodies. Use of the targeted IgSwitch Assay in monoclonal antibody production will help to generate new IgG specific antibodies from a largely untapped source of IgM hybridomas, for potential use as research, therapeutic, diagnostic, and imaging reagents.

Title: SBIR Phase II: Thermostable Phage DNA Polymerases: Improved Tools for Genomics Research

Award Number: 0215988
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,928
Investigator: Thomas W. Schoenfeld, tschoenfeld@lucigen.com
Company: Lucigen
2120 W. Greenview Dr.
Middleton, WI 53562-2547
Phone: (608)831-9011

Abstract:

This Small Business Innovation Research Phase II project will develop novel DNA polymerase reagents for use in current and developing DNA diagnostic procedures. The approach is to develop thermophilic phage DNA replicases in place of the currently used DNA repair enzymes. The feasibility of this approach was demonstrated during Phase I research. This follow on Phase II project will extend the methods used in Phase I to isolate additional activities, characterize them and develop them as reagents for various amplification platforms.

The commercial applications of this project will be in a number of markets that use molecular analysis of DNA. They include the areas of biomedical research, medical testing, genetic identity testing, public health and agriculture.

Title: SBIR Phase II: Development of Agents to Promote Cellular Ga-67 (Gallium-67) Uptake

Award Number: 0450618
Program Manager: George B. Vermont

Start Date: October 1, 2005
Expires: September 30, 2007
Total Amount: $499,992

Investigator: Takuji Tsukamoto, taku@chemica.com
Company: Chemica Technologies Inc
325 S.W. Cyber Dr.
Bend OR, 97702
Phone: (541)385-0355

Abstract:

This Small Business Innovation Research Phase II project focuses on the development of new pharmaceutical agents to selectively enhance tumor imaging using gallium 67. A photo-degradation product of nifedipine, nitrosipine, has been found to selectively enhance the uptake of Ga67 by tumor cells. A specific derivative of nitrosipine has an even better selective uptake of the radioactive imaging agent. This project will synthesize and test other nitrosipine derivatives and determine the efficacy of Ga67 uptake in animal models using these complexing agents.the commercial application of this technology is in the area of diagnostic imaging. The use of Ga67 in tumor imaging is currently very limited due to poor selectivity of the agent for tumor cells. Enhanced uptake in tumor cells relative to normal cells would expand the types of tumors that could be effectively imaged and possibly replace the more costly and complex PET scan imaging using radioactive fluorinated sugars

Marine Biotechnology

Title: SBIR Phase II: Applying Transgenic Technology to Improve the Pearl Production Process

Award Number: 0239065
Program Manager: Om Sahai

Start Date: March 1, 2003
Expires: February 28, 2005
Total Amount: $499,979

Investigator: Dale J. Sarver, dalej@aloha.net
Company: Black Pearls Inc
P.O. Box 525
Holualoa, HI 96725-0525
Phone: (808)322-7108

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop the technology to produce faster growing oysters that yield bigger and higher quality pearls than those currently available. Prior Phase I work has already shown the production of the first-ever verifiable transgenic pearl oysters, and the successful isolation of the first nacre gene from Pinctada margaritifera. The proposed work in this Phase II project will demonstrate commercial viability by isolating other potentially important genes from Pinctada, a proven transfection methods, and evaluating nacre quality and deposition rates in transgenic phenotypes. Biosecure land-based grow-out of transgenic oysters, as mantle-tissue donors only, will increase application efficiency and overcome environmental concerns.

The commercial application of this project will be in the black pearl market that is estimated to be of the order of $ 5 billion worldwide. A U.S.-led expansion of this lucrative industry could provide economic benefits to Hawaii and to U.S.-affiliated Pacific Islands, increasing investment, employment opportunities and self-sufficiency in these remote islands, and reducing the economic burden on the U.S. Government.

Title: SBIR Phase II: Use of Inducible Antimicrobial Peptides for Rapid Diagnosis, Prevention, and Management of Disease in Finfish Aquaculture

Award Number: 0349772
Program Manager: Om P. Sahai

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,812
Investigator: James Carlberg, jcarlberg@kentseatech.com
Company: Kent SeaTech Corporation
11125 Flintkoe Avenue Suite J
San Diego, CA 92121
Phone: (858)452-5765
Abstract

This Small Business Innovation Research (SBIR)Phase II Project proposes to develop a new approach for controlling disease in the aquaculture industry. This approach is based on the use of a recently discovered natural antibiotic compound in hybrid striped bass (HSB) called bass-hepcidin. Hepcidin is an antimicrobial peptide (i.e. bactericidal molecules) that is part of the fish's innate immune system. Prior Phase I work has demonstrated that HSB (and probably many finfish) respond to disease challenges by increasing their hepcidin levels. This finding is useful because elevated hepcidin levels indicate that fish are being challenged by disease, and artificially increasing hepcidin levels (by feed additives or other means) may stimulate the fish's immune response to assist in combating disease. This Phase II project will develop an ELISA diagnostic test for hepcidin and conduct follow-on clinical studies with several important aquaculture species. If successful, this research may result in the development of two types of hepcidin-based products that will be of immense value to aquaculturists: 1) hepcidin test strips that provide an instant positive-negative indication of the presence of disease processes, analogous to pregnancy test kits, and 2) feed additives that stimulate the production of hepcidin in finfish, to be used to control disease outbreaks.

The commercial impact of this project will be significant as there is clearly a market need for products to control infectious diseases in fish that cause tremendous economic loss, of the order of $ 3 billion, each year.

Title: SBIR Phase II: Ploidy Induction with Penaeid Shrimp for Protection of Investment in Selective Breeding

Award Number: 0079315
Program Manager: Om P. Sahai

Start Date: July 15, 2000
Expires: June 30, 2002
Total Amount: $399,800

Investigator: Robert Shleser, Shleser@aloha.net
Company: Aquatic Farms
1164 Bishop Street, #124
Honolulu, HI 96813
Phone: (808)259-5042

Abstract:

This Small Business Innovation Research Phase II project focuses on mass production of triploid marine shrimp. Marine shrimp culture experienced exponential growth between 1980 and 1990, increasing from 5% to 28% of total world production. Since then, farmed shrimp production has stagnated due to disease and water quality problems. Disease problems are largely due to dependence on wild caught shrimp broodstock and post larvae, which carry many untreatable viral diseases. A solution to this problem is closed-cycle culture, which also permits genetic selection for improved production performance. To protect a breeder's investment in specific pathogen free (SPF)stock, specific pathogen resistant (SPR) stock, and genetic selection, it is highly desirable to sell only sterile post larvae. Triploidy is a possible solution since triploids of other species are typically sterile and may exhibit superior culture performance. In addition triploidy may allow for the culture of exotic species in environmentally sensitive areas where exclusion of exotics is desirable. Phase II will focus on development of tetraploid breeding stocks that will be crossed with normal diploid stocks to produce triploid progeny.

The successful outcome of our R&D effort will result in significant changes in marine shrimp culture. It will prevent competitors from propagation of shrimp stocks that have been genetically selected for aquaculture performance. It will help stimulate large-scale investment in SPF, SPR, genetic selection and closed-cycle shrimp culture. It will help create opportunities to expand use of exotic shrimp species into environmentally sensitive culture areas. Our company intends to be at the forefront of these opportunities.

Title: SBIR Phase II: Broadband Split-Beam Fish Tracker

Award Number: 0109976
Program Manager: Om Sahai

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $500,000
Investigator: Jae-Byung, Jung jae-byung@scifish.com
Company: Scientific Fishery Systems
PO Box 242065
Anchorage, AK 99524
Phone : (907)345-7347

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will develop a broadband split-beam fisheries sonar system for shallow water applications. As the number of fish in rivers and streams diminishes and becomes threatened, endangered or extinct, there is a need for better fish monitoring tools for such shallow water environments. Through a series of workshops, the leaders in the riverine sonar community have highlighted several deficiencies in the current monitoring systems. This Phase II Project proposes to build a fish tracking and counting system that addresses many of these deficiencies, and that has a ten-fold better range resolution and at least a 6 dB improvement in detection. The broadband sonar system, to be built in the course of this project, will include (a) a unique bizonal shaded transceiver array, (b) a full complement of functions for collection, storage, analysis and display of data, and (c) a multi-hypothesis tracker for tracking fish in low SNR and dense target environments. The sonar system will be validated first in a comprehensive set of pool tests, and then subjected to a rigorous set of evaluation experiments in the Kenai and Copper Rivers of Alaska and in the Rogue River of Oregon.

The commercial applications of this project are in a broad range of markets that require fish counting and tracking equipment. The overall market size for such equipment worldwide is estimated to be on the order of 1.8 billion dollars.

Title: STTR Phase II: Engineering of Non-leaching Antibacterial Non-woven Textiles

Award Number: 0450527
Program Manager: George Vermont

Start Date: October 21, 2005
Expires: October 31, 2007
Total Amount: $505,450

Investigator: Nina Lamba, cclbiomed@verizon.net
Company: CCL Biomedical, Inc.
224 North Washington St.
Havre de Grace, MD 21078
Phone: (410)939-9356

Abstract:

This Small Business Technology Transfer Innovation Research (STTR) Phase II project proposes the development of a unique family of biocidal polymers that have been shown to be non-leaching, and do not require regeneration or refreshment of activity. The Phase I study demonstrated the synthesis of these polymers containing potent broad-spectrum biocides. The polymers were spun into nanofiber webs using electrospinning techniques. The webs were challenged with bacteria and a 99% reduction in bacterial viability in one hour was demonstrated. The Phase II program will continue to explore the electrospinning processing of the polymers. The polymers will be optimized for activity against bacteria, viruses and molds. Microscopic and mechanical tests will be performed on materials to identify structure-property relationships.

The commercial application of this technology will be in textile products where antimicrobial protection is critical, e.g., homeland security (biodefense) garments, first responders emergency clothing, hospital garments and supplies, etc. Current systems are water leachable and use can lead to reduced protection.

Title: SBIR Phase II: Enabling High Output Metabolism in Plant Cells

Award Number: 0548640
Program Manager: F.C. Thomas Allnutt

Start Date: January 11, 2006
Expires: December 31, 2007
Total Amount: $511,937
Investigator: Michele Champagne, kasllc@hawaii.rr.com
Company: Kuehnle Agro Systems
2800 Woodlawn Dr. Suite 281
Honolulu, HI 96822
Phone: (808)753 2693

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop and validate a novel chloroplast transformation vector for protein expression in chloroplasts. The research project will broaden scientific understanding of the parameters of chloroplast transformation by addressing stoichiometric expression of multiple transgenes for effective engineering of pathways such as carotenogenesis, feedback regulation and expression of multimeric proteins.

The commercial impact of this technology will provide an enabling strategy for expression of genes of interest in chloroplasts to potentially increase the production of high value nutraceutical and pharmaceutical compounds. Application of this technology for stable, high output metabolism with regulatory compliance will reduce production cost and increase the reliability for downstream processing and eventual commercialization.

Title: SBIR Phase II: Rapid and Automated Differential Gene Expression Profiling

Award Number: 0548750
Program Manager: Ali Andalibi

Start Date: September 21, 2006
Expires: September 30, 2008
Total Amount: $499,995

Investigator: Jian Tajbakhsh, jtajbakhsh@maxwellsensors.com
Company: Maxwell Sensors Inc.
10020 Pioneer Blvd Suite 103
Santa Fe Springs, CA 90670
Phone: (562)801 2088

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will develop a rapid and automated microarray expression profiling chip and system for gene expression profiling. As part of this project a miniaturized automated system will be developed to integrate key steps in target synthesis, labeling and hybridization.

The use of the integrated system will enhance the reproducibility and cost of running microarray experiments.

Title: SBIR Phase II: Compact genetic assessment using the Infrarray SNAP (Simple Nucleic Acid Profiler)

Award Number: 0724423
Program Manager: Ali Andalibi

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,986

Investigator: Steve Savoy, ssavoy@nanohmics.com
Company: Nanohmics
6201 East Oltorf St.
Austin, TX 78741
Phone: (512)389-9990

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to further develop a microfluidic device for the detection of nucleic acids for a variety of studies where genetic analysis and identification of target sequences are required. The instrument proposed is designed to be compact and capable of reading a disposable cartridge on which sample preparation, amplification, and multiplex detection, with a modest-sized microarray, are performed. The proposed instrument is enabled by direct imaging of a PhotoGenerated Reagent (PGR) microarray, with an image sensor positioned near the face of the microarray. It is also enabled by the use of up-converting phosphors as the label, which are in turn excited by infrared radiation that passes through the silicon microarray.

The development of and inexpensive, fully integrated and automated microfluidic device for use in genetic analysis would give individuals in academic, commercial and defense settings access to affordable microarray analysis. The availability of such a versatile platform would allow the development of arrays for any nucleic acid target, as well as easy multiplexing. With such a platform, production of custom arrays and off-the-shelf ones will be achieved with great facility. Moreover, the integrated platform will reduce the cost and effort associated with microarray analysis.

Title: SBIR Phase II: Novel Labeling Method for Multicolor Fluorescence in situ Hybridization (FISH) Probes

Award Number: 0724876
Program Manager: Ali Andalibi

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Joan Aurich-Costa, joan@onecell.com
Company: One Cell Systems Inc
100 Inman St Ste 200
Cambridge, MA 02139
Phone: (617)868-2399

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to further develop a panel of multicolor oligonucleotide fluorescence in situ hybridization (FISH) probes for performing preimplantation genetic diagnosis (PGD) and detecting aneuploidies in eggs used for in vitro fertilization (IVF) protocols. The use of oligonucleotides offers advantages such as enhanced specificity and sensitivity, shorter hybridization times as well as a reduction in manufacturing cost when compared to currently available genomic DNA derived probes. The panel that the company plans to develop will cover 8 chromosomes known to be particularly susceptible to deletions and rearrangements and would allow simultaneous detection of any abnormalities that may be associated with them.

The development of a panel of probes for the detection of genetic abnormalities in preimplantation embryos will increase the success rate of IVF procedures and thus reduce the financial and emotional cost associated with them. Moreover, use of the proposed labeling method can be useful in a variety of areas outside of PGD, including basic research, clinical diagnostics and cytogenetic testing.

Pharmaceutical Drug Delivery

Title: SBIR/STTR Phase II: Automated Analyzer for Drug Delivery Systems

Award Number: 0216220
Program Manager: Om Sahai

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,378
Investigator: Leah R. Williams, williams@aerodyne.com
Company: Aerodyne Research Inc
45 Manning Road
Billerica, MA 018213934
Phone: (508)663-9500

Abstract:

This Small Business Innovation Research Phase II project will develop a new analytical tool for characterizing drug delivery aerosols and powders. This instrument will be based on a previously developed aerosol mass spectrometer that provides real-time size distribution and chemical composition measurements for aerosol particles. During Phase I research, a new inlet for the aerosol mass spectrometer, allowing detection of particles in the size range relevant to inhalable drug delivery aerosols and powders (2 to 10 mm in diameter), was successfully developed. The key objectives of the Phase II project are (a) to further improve the collection efficiency for particles in the 2 to 10 mm diameter size range; (b) to design and construct a sampling apparatus that conforms to Food and Drug Administration (FDA) and U. S. Pharmacopeia Convention (USP) guidelines for sampling drug delivery aerosols from metered dose inhalers (MDIs) and dry powder inhalers (PDIs); and (c) to develop and to validate an analytical method that meets FDA standards.

The commercial applications of this project will be in the area of drug delivery.

Title: SBIR Phase II: A New Biotherapeutic Approach to Combating Unwanted Bacteria

Award Number: 0421991
Program Manager: Om P. Sahai

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $498,903

Investigator: Hideki Suzuki, hsuzuki@conjugon.com
Company: ConjuGon, Inc.
505 South Rosa Rd, Suite 29
Madison, WI 53719
Phone: (608)441-2890

Abstract:

This Small Business Innovation Research Phase II research project will develop a commercial biotherapeutic using a unique bacterial conjugation technology to deliver cytotoxic genes and their products to bacterial pathogens. The Phase I work successfully demonstrated proof of concept by effectively killing multi drug resistant bacteria in vitro. The Phase II project will optimize the technology further to create a treatment for nosocomial (hospital acquired) urinary tract infections.

The commercial application of this project will be in the area of anti-infective therapy. The proposed work provides a unique therapeutic approach that can compliment standard antibiotic therapies as well as reduce the dire problem of the burgeoning development of antibiotic-resistant bacteria in the clinic.

Title: SBIR Phase II: High-Throughput Specific Cell Loading by Optoinjection

Award Number:	0321740
Program Manager:	Om P. Sahai
Start Date:	November 1, 2003
Expires:	October 31, 2005
Total Amount:	$512,000

Investigator: Glenn Sasaki, gsasaki@oncosis.com
Company: Oncosis
6199 Cornerstone Court
San Diego, CA 92121
Phone: (619)550-1770

Abstract

This SBIR Phase II project proposes to develop a novel technology for laser-enabled analysis and processing (LEAP) of living cells. The ability to load cells with compounds is critical in many areas of research and medicine such as drug discovery and gene therapy. Current methods have limitations with respect to specificity, efficiency, toxicity, and/or throughput. Optoinjection is a novel and versatile procedure for cell loading that has been demonstrated in a few laboratories. Unfortunately, this is a slow, laborious procedure carried out on specialized microscopes. Oncosis has developed the LEAP platform for high-speed cell imaging and purification via lethal laser effects on unwanted cells. Phase I results demonstrated feasibility for using the LEAP platform to implement optoinjection in a high-throughput, cell-specific manner that would enable the commercialization of this novel form of cell loading. Phase II studies are proposed to optimize and implement optoinjection in biologically relevant experimental systems, resulting in data supporting this powerful new tool for the analysis and manipulation of living cells within a physiological environment. The instrument design will then be configured for successful commercial manufacturing, and further improvements in capabilities will be pursued in order to maintain market leadership and to expand into other markets.

The commercial application of this project is in the areas of cell-based life science research and drug discovery. Over $ 2.6 billion was spent during 2001 on research instrumentation in academic life science research and commercial drug discovery, and growth to $ 5.3 billion by 2005 has been forecasted. For the specific application of optoinjection, LEAP provides many advantages over current techniques including simplicity, robustness, efficiency, speed, high viability, and specificity. The commercial opportunity for this platform is therefore significant, as is the scientific enablement of experimentation that is not currently possible.

Title: SBIR Phase II: High Speed Chemical Analysis of Combinatorial Libraries

Award Number: 9983700
Program Manager: T. James Rudd

Start Date: March 1, 2000
Expires: February 28, 2003
Total Amount: $748,739
Investigator: Jack Syage, jsyage@syagen.com
Company: Syagen Technology
1411 Warner Avenue. Suite B&D
Tustin, CA 92780
Phone: (714)258-4400

Abstract:

This Small Business Innovation Research Phase II project will develop a high through-put drug screening technology based on the successful Phase I feasibility demonstration. High throughput methods in parallel and combinatorial organic synthesis are revolutionizing the field of drug discovery and biological screening. However, progress is seriously impeded by lack of reliable methods for conducting high throughput chemical analysis (HTCA) for composition and purity assessment. Current approaches rely on liquid chromatography/mass spectrometry (LC/MS). With a cycle time of about 5 min, an LC/MS instrument can analyze about 300 samples in a 24 hr period. We propose an innovative MS concept that reduces cycle time to about 10 sec, raising the potential analysis rate to >5,000 samples/day. The innovation is based on a novel ionization source that achieves (1) near-universal and efficient ionization of drug compounds, (2) minimal fragmentation molecular ion spectra for accurate analysis, (3) minimal interference from air constituents and commonly used solvents, and (4) suppression of competition-for-charge and ion suppression effects experienced by conventional methods. The proposed technology advances analytical and research capabilities to improve fundamental understanding of drug molecules and to build a knowledge base for implementing more rational approaches to lead drug optimization.

Market research indicates the potential for exponential growth on the basis of quick penetration of the chemical analysis niche of the rapidly growing field of combinatorial and parallel synthesis methods for drug discovery. The proposed high throughput chemical analysis system has the potential to dominate the market for combinatorial library analysis, which is a rapidly growing field of drug discovery. Our real-time, complex mixture analyzers will also be marketed for applications in drug testing, environmental monitoring, and on-line process monitoring.

Title: SBIR Phase II: High-Throughput Purification of Combinatorial Libraries

Award Number: 0321765
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $499,990

Investigator: Jack Syage, jsyage@syagen.com
Company: Syagen Technology
1411 Warner Avenue. Suite B&D
Tustin, CA 92780-6461
Phone: (714)258-4400

Abstract:

This SBIR Phase II project aims to develop a prototype of a highly parallel, mass-selected purification system for large pharmaceutical drug libraries. High-throughput purification is driven by the industry recognition that combinatorial chemistry samples must still be purified even after chemical screening. This project will examine monolithic parallel preparative liquid chromatography configurations. The key enabling technology is low-pressure photoionization mass spectrometry (LPPI MS), which permits accurate molecular detection in mixtures of compounds without the problems of competition-for-charge and ion suppressions that plague conventional ionization methods. A practical purification rate of >1 sample/min (12 parallel purifications in <12 min column cycle time) corresponding to a potential 16-hr daily rate of >960 sample purifications/day is expected. This work will transition into a Phase II prototype involving strategic partners to commercialize the technology.

The proposed high throughput purification system for combinatorial libraries has the potential to dominate an important niche market for molecular analysis and screening for drug discovery. This rapidly growing market will fuel applications in many other directions of drug development. The proposed activity will have a broad and profound impact on society as a whole by providing valuable information that can lead to improved drug therapy and early detection of disease. The practical outcome is to improve health care and reduce costs. This project also has the potential for explosive commercial growth, which will stimulate economic development.

Title: STTR Phase II: Antibacterially-Active Nanoparticles

Award Number: 0620572
Program Manager: F.C. Thomas Allnutt

Start Date: August 3, 2006
Expires: July 31, 2008
Total Amount: $499,977
Investigator: Seyoung Jang, syjang77@hotmail.com
Company: Nanopharma
3802 Spectrum Blvd.
Tampa, FL 33612
Phone: (813)469-7107

Abstract:

This Phase II Small Business Technology Transfer (STTR) research project develops a novel nanoparticle delivery system for treatment of antibiotic-resistant infections. This extends previous findings using antibacterially active polyacrylate nanoparticles to animal infection models. Penicillin containing nanoparticles are the intial focus due to the clinical importance of penicillin in treating bacterial infections and the extreme sensitivity penicillin has to degradation by proteins produced by methicillin-resistant Staphylococcus aureus (MRSA). The research will determine the stabilities of penicillin nanoparticles under various chemical and biological conditions, evaluate potential in vitro and in vivo toxicity of the nanoparticles, examine the biodistribution of the two most active nanoparticles in healthy mice, and assess the effectiveness in treating early stage (skin) and advanced (systemic) MRSA infections in mice. The results from this project will provide both fundamental data to the scientific community on these polyacrylate nanoparticles as a drug delivery platform, as well as animal testing data needed to advance this nanoparticle technology towards IND and FDA approval.

The broader impact of this research will be to demonstrate that nanoparticle technology can be applied to treatment of MRSA infections and provide essential data on the use of polyacrylate nanoparticles as a drug delivery platform. Use of nanoparticles in anti-infectives is essentially unexplored. These novel nanoparticles will enable characterization of the properties for creating FDA guidelines on the use of nanoparticles in medicine. In addition, the training of students at the graduate and undergraduate level in bio-nanotechnology is a central element of this joint project between industry and academia. The precipitous loss in the ability of antibiotics to treat bacterial infections is already having enormous societal implications. The number of deaths and serious illnesses due to clinical complications from drug-resistant infections is staggering. This research will establish a new treatment protocol for these types of infections through use of cutting-edge nanotechnology, both as a drug-delivery platform and as an effective way to recover the therapeutic effectiveness of antibiotics like penicillin. There are currently no existing technologies like this in the anti-infectives area, indication of an unmet health need and a large commercial market.

Title: SBIR Phase II: High-Density Microcapillary Bioplate

Award Number: 0548332
Program Manager: Ali Andalibi

Start Date: February 7, 2006
Expires: February 29, 2008
Total Amount: $500,000

Investigator: Joseph Krans, jak@incomusa.com
Company: Incom Inc
PO Box G
Southbridge, MA 01550
Phone: (508)765-9151

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will aid in the development of high-density glass microcapillary bioplates that will offer complete flexibility in the choice of diameter and thickness of the capillaries. These features are not currently available in an exiting product. Through an innovative low-cost fabrication approach, the disposable bioplate will allow for massive parallel experimentation that is crucial for large-scale high-integrity measurements.

The proposed research will provide for a dramatic and cost effective increase in high-throughput screening programs in all phases of drug discovery and target validation. The ability to accelerate the analysis of targets in a cost effective manner will provide for more effective screening programs.

Title: SBIR Phase II: Device for the Activation of Nanoparticle-Based Cancer Therapies

Award Number: 0548741
Program Manager: F.C. Thomas Allnutt

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $500,000
Investigator: Patrick O’Neal, poneal@nanospectra.com
Company: Nanospectra Bio, Inc.
8285 El Rio St Suite 130
Houston, TX 77054
Phone: (713)842-2720

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at developing a minimally invasive, image-guided cancer therapy for the optimum activation of nanoparticle based, photo-thermal cancer therapies. This will allow for the treatment of deep-seated tumor, irregular shaped tumors as well as regional metastatic spread and tumors situated near or within sensitive tissues.

This technology will impact the current therapies for cancers, especially those of the brain and other sensitive areas. The technology will provide a minimally invasive therapy with a high safety profile that allows treatment of poorly defined tumors margins without damage to surrounding, often sensitive tissues. This would make the treatment not only more effective but will also limit damage to healthy tissue and as such, limit side effects and other organ dysfunction. Additionally, this therapy is compatible with and potentially synergist with existing treatment modalities.

Title: SBIR Phase II: Chiral Polymers for Pharmaceutical Purification

Award Number: 0620587
Program Manager: F.C. Thomas Allnutt

Start Date: August 8, 2006
Expires: July 31, 2008
Total Amount: $496,939
Investigator: Alexander Gorkovenko, agorkovenko@materialmethods.com
Company: Material Methods
30 Hughes, Suite 205
Irvine, CA 92618
Phone: (949)206-0967

Abstract:

This Small Business Innovation Research (SBIR) Phase II project develops new chiral stationary phases for pharmaceutical purification. Drug manufacturers seek new chiral stationary phases with high throughput, extended chiral selectivity, high loading capacity, with the ability to tolerate a wide range of mobile phases. To meet this need, artificial saccharides will be synthesized and polymerized into a 100% stereo specific chiral stationary phase for liquid chromatography of enantiomers. These polymers have remarkable propertie such as stereo specificity, five asymmetric centers, functionality for tailoring phase/ligand recognition, extensive crosslinking capability, and ether bonding. This chemistry was demonstrated in Phase I and in Phase II will lead to a new family of chiral polymers to speed drug discovery and reduce the cost of drug manufacture.

The broader impact of this research will be to provide artificial polysaccharides to provide novel activities versus the natural products currently sold. Polysaccharides have multiple, chiral centers, unparalleled optical integrity; and the highest density of functional groups of all known molecules. Artificial polysaccharides are most readily functionalized and tailored to form desired chiral selectors. This project will molecularly design chiral selectors. The impact of this research extends beyond drug purification to sugar separations, high performance fibers, tissue scaffolds, and nano machinery.

Title: SBIR Phase II: Disposable pL Fluid Transfer/Microarray Printing Device

Award Number: 0646638
Program Manager: F.C. Thomas Allnutt

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $498,437
Investigator: Robert Haushalter, bob@parallel-synthesis.com
Company: Parallel Synthesis Technologies, Inc
3054 Lawerence Expy
Santa Clara, CA 95051
Phone: (408)749-8308

Abstract:

This Small Business Innovation Research (SBIR) Phase II project provides an inexpensive disposable polymer tool that will perform extremely accurate fluid transfer in the picoliter to nanoliter range. Research efforts have already demonstrated that the costs associated with fabricating molds employing a combination of silicon micromachining and electroforming will allow these tools to be disposable. Fabrication processes will be transitioned to injection molding by adapting the micromachined/electroformed molds to the injection process. The research will design the final generations of the printing and fluid transfer pin designs, use silicon micromachining and electroforming to prepare the injection molds for the 96 and 384 pin printheads, design new collimator / printheads for both microarray printing and fluid transfer applications and redesign and scale up the chemical surface treatment process to treat thousands of pins simultaneously. Because the polymer pins can be manufactured so inexpensively compared to current technology, the number of laboratories around the world that can utilize this nanoscale fluid handling will dramatically increase.

The broader impacts of this project will be to provide disposible plastic parts at less than ten percent of the least expensive current technology thereby enabling reductions in costs for high throughput technologies important to drug discovery and diagnostics. This could improve the delivery of healthcare to the nation and reduce its overall cost.

Proteomics

Title: SBIR Phase II: Computer-Directed High Throughput Screening for Improved Enzymatic Activity

Award Number: 0091586
Program Manager: Om Sahai

Start Date: March 15, 2001
Expires: February 28, 2003
Total Amount: $499,986
Investigator: John R. Desjarlais, jrd@xencor.com
Company: Xencor
111 W. Lemon Ave.
Monrovia, CA 91016
Phone: (626)737-8065

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an enabling technology for computer- directed high-throughput screening of proteins with improved properties. Xencor's Protein Design Automation (PDA) predicts all the possible amino acid sequences that will fold into the three-dimensional structure of a protein. There should be molecules among those sequences that have the structure and function of the "parent "protein, together with additional novel properties such as increased thermo-stability or alkaline pH optima. In Phase I the company addressed this possibility using xylanase as a model protein. After targeting the active site of the enzyme for PDA re-design, the company found sequences that were more active than the wild-type protein and one that had a different pH profile. These results were achieved by testing only 260 of a possible 110,592 sequences. In Phase II the company will develop a high-throughput assay system that will allow testing the majority of the predicted sequences. The research will also improve electrostatic functions of the PDA algorithm, and then use this version of the program to re-design the entire xylanase molecule instead of just the active site, thereby finding mutations located away from the active site that effect the protein's characteristics.

The PDA technology improves enzyme efficiency and expands the reactions and process conditions where they can be applied. Major markets include polymer manufacturers, value extraction from waste streams and food processing.

Title: SBIR Phase II: Proteome Epitope Tags-Based Antibody Arrays for High-Throughput, Proteome-Wide Kinase Pathway Profiling

Award Number: 0522303
Program Manager: George B. Vermont

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000
Investigator: Neal Gordon, ngordon@epitomebiosystems.com
Company: Epitome Biosystems, Inc.
100 Beaver Street
Waltham MA, 02453
Phone: (781)209-2369

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a novel antibody microarray for high-throughput, multiplexed profiling of a large number of signaling proteins from multiple pathways by measuring protein phosphorylation. The antibody array will simultaneously measure kinase activities in Ras effector pathways including the Raf-MEK-ERK pathway, the P13K-Akt pathway, the p38 and JNK pathways. Current kinase profiling technologies such as Western blotting of flow cytometry are low throughput, not quantitative and difficult to multiplex and standardize. This novel technology (Proteome Epitope Tag or PET) creates antibodies with pre-defined specificity that can be multiplexed using standardized assays on antibody microarrays for measuring protein phosphorylation. The PET approach will be further developed to construct highly multiplexed antibody arrays for simultaneous measurement of a large number of kinase protein activities from multiple pathways. The ability to measure all signaling proteins from interconnected pathways will provide an unprecedented opportunity to decipher the complexity of cell signaling.

The commercial applications of this technology will be in large scale protein analysis relevant to basic biological research, drug discovery, and clinical medicine. Protein biochips hold great promise for biomarker discovery which is important in all these areas. Large-scale protein biochips capable of standardized and high-throughput protein measurement on differentially perturbed biological systems do not exist today. This is due primarily to the lack of highly specific antibodies for all human proteins predicted by gene sequences. The PET technology addresses this urgent, unmet need by generating antibodies for highly specific peptide tags of defined sequences in a proteome, representing a universal method for producing antibodies and standardized chip-based assays for any protein of interest. PET chips for profiling kinase signaling networks will have enormous utility for drug discovery by better characterizing drug efficacy, side effects and potential toxicity

Title: SBIR Phase II: High Speed Sequencing and Structure Analysis

Award Number: 0450640
Program Manager: George B. Vermont

Start Date: May 15, 2005
Expires: April 30, 2007
Total Amount: $462,352

Investigator: Jack Syage, jsyage@syagen.com
Company: Syagen Technology Inc
1411 Warner Ave Ste D
Tustin CA, 92780
Phone: (714)258-4400

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop new methods for achieving high-speed sequencing and structure analysis of drug and biological molecules . The benefits of high-speed Molecular Sequencing (MSn) will be broadly applicable to end users through compatibility with ion trap MS instruments in general and specifically for the proposed QitTof MS (quadrupole ion - trap, time - of - flight mass spectrometry), which will provide the highest potential analysis speeds. The technical objectives for Phase II research are to (a) to develop high-speed MSn algorithms, (b) to optimize accurate mass neutral loss performance, (c) to develop CE / ESI (capillary electrophoresis / electrospray ionization) interface, and (d) to demonstrate CE / ESI / QitTof MS/MS for high-speed peptide sequencing. The final outcome of this Phase II work will be an instrument that will clearly achieve the highest speeds for peptide sequencing and overall protein identification.

The commercial application of this project will be in the area of proteomics. The proteomics market is forecasted to grow from $ 0.7 billion to $ 5.8 billion over the next 5 years. There is a tremendous need to develop automated methods for the analysis of proteins and peptides linked to specific cells and tissues, in order to better understand global biological function for improved drug therapy and early detection of diseases such as cancer

Title: SBIR Phase II: Membrane Protein Microarrays

Award Number: 0450262
Program Manager: George B. Vermont

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $500,000
Investigator: Athena Guo, athena@memsurface.com
Company: Microsurfacees Inc
4001 Stinson Blvd Suite 430
Minneapolis MN, 55421
Phone: (612)789-0104

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a product platform based on polymer cushion coated glass slides with controlled surface charge density for membrane protein microarray fabrication. The key technical objectives for Phase II research are : (a) to complete quantitative studies on surface charge density in the formation of supported phospholipid bilayer (SPB) from charged lipids , (b) to develop the chemistry for the grafting / adsorption of polymer cushions, (c) to measure the activities of membrane proteins in SPBs, and (d) to fabricate membrane protein microarrays based on surface pre-patterning using soft lithography techniques.

The commercial application of this project will be in the area of protein microarrays for use in disease diagnostics and for drug discovery research. The proposed technology will enable development of therapeutics aimed at membrane protein targets.

Title: SBIR Phase II: Overexpression of Membrane Proteins from Hyperthermophilic Bacteria - Refinement of a Novel Expression System

Award Number: 0349777
Program Manager: Om P. Sahai

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Hiep-Hoa Nguyen, hiephoa@its.caltech.edu
Company: TransMembrane Biosciences
145 N. Sierra Madre Blvd.
Pasadena, CA 91107
Phone: (626)536-0691

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes to continue the development and refinement of a novel membrane protein expression system utilizing a unique group of bacteria capable of synthesizing a vast amount of membrane proteins and supporting extensive internal membrane structures. Membrane proteins are of significant medicinal importance. However, efforts to study membrane proteins are often hampered by their low level of biosynthesis. An efficient membrane protein overexpression system will facilitate their biochemical and biophysical characterization. This will allow for the economical mass production of membrane proteins essential for large-scale structural genomics effort as well as for industrial applications.

The commercial impact of the project will be on drug discovery work by biotechnology and pharmaceutical companies. Additional impact will be in areas of biology and physiology where processes are modulated by membrane proteins (for example, in agriculture).

Title: SBIR Phase II: Innovative Protein Microarrays

Award Number: 0349712
Program Manager: Om P. Sahai

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $499,807
Investigator: Andrzej Drukier, akd@biotraces.com
Company: BioTraces Inc
13455 Sunrise Valley Dr. Ste 200
Herndon, VA 20171
Phone: (703)793-1550

Abstract:

This Small Business Innovation Research Phase II project proposes to develop a novel supersensitive multiphoton detection system for protein chips (P-chip/MPD) for applications in drug discovery and in early detection of prostate cancer and breast cancer. The commercial impact of the proposed work will be in the area of diagnostic proteomics. The diagnostics industry is large, currently estimated at around 10 billion dollars per year. The most profitable and dynamically growing fields are those that permit early detection of cancer and therapy monitoring, or provide toxicity assays for new drugs.

It is expected that the P-Chips/MPD developed in this project will eventually capture a significant share of the diagnostic proteomics market.

Title: SBIR Phase II: Automated 2D Protein Cell Mapping

Award Number: 0321763
Program Manager: Om P. Sahai

Start Date: November 15, 2003
Expires: October 31, 2005
Total Amount: $413,037

Investigator: Jack Syage, jsyage@syagen.com
Company: Syagen Technology
1411 Warner Avenue. Suite B&D
Tustin, CA 92780
Phone: (714)258-4400

Abstract:

This Small Business Innovation Research Phase I project will develop a method for conducting high-throughput, automated analysis of the protein content of cell lines using a novel mass analyzed two-dimensional liquid-phase separation method. The conventional method of two-dimensional poly-acrylamide gel electrophoresis (2D PAGE) has several limitations ; it is labor intensive, time consuming, difficult to automate and often not readily reproducible. In addition, quantitation, especially in differential expression experiments, is often difficult and limited in dynamic range. The proposed technology provides automated, faster, and more accurate 2D protein maps, and can be used to purify specific proteins and enact protein/peptide digest and sequencing information. These capabilities will prove valuable for studying drug-protein interactions for detecting early signs of cancer. Studies of cancer cell lines can reveal signatures of cancerous cells that can serve as markers for actual diagnosis. The proposed system is based on 2D liquid-phase protein separation using chromatofocusing (CF) in one dimension and non-porous silica, reverse-phase, high-performance liquid chromatography (NPS-RP HPLC) in the second dimension. The HPLC eluent is monitored in real-time by on-line electrospray ionization (ESI) mass spectrometry (MS) to provide molecular weight and intensity information.

The commercial application of this project is in the area of proteomics. The proteomics market is forecasted to grow from $ 0.7 billion to $ 5.8 billion over the next 5 years. There is a tremendous need to develop automated methods of protein analysis and peptide analysis of cell lines to better understand global biological function for improved drug therapy and early detection of disease, such as cancer.

Title: SBIR Phase II: New Convergent X-Ray Beam Based System for Protein Crystallography

Award Number: 0321581
Program Manager: Om P. Sahai

Start Date: December 1, 2003
Expires: November 30, 2005
Total Amount: $499,903

Investigator: Huapeng Huang, hhuang@xos.com
Company: X-Ray Optical Systems, Inc.
15 Tech Valley Drive
East Greenbush, NY 12061
Phone: (518)880-1500

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new convergent x-ray beam based crystallography system for measurement of the quality and the structure of protein crystals in an effort to support crystal growth development efforts and as a prescreening tool for very small protein crystals prior to refined, high-resolution structure determination at dedicated synchrotron-based macromolecular structure facilities. Measurements of a broad range of crystal types, sizes, and degrees of perfection will be carried out in an active protein crystal growth and characterization laboratory at the Wadsworth Center of the New York State Health Department. Parallel measurements using the same crystals will be made in this laboratory with a conventional state-of-the-art protein diffraction system in order to examine the potential benefits and limitations of the convergent beam method (CBM). Measurements will also be made in an industrial laboratory to evaluate the potential of CBM as a commercial, compact, high-intensity, low-power, low-cost, protein screening instrumentation.

The commercial application of this project will be in the area of structural proteomics. Development of a compact, high-efficiency, high-sensitivity system for measurement of the quality and preliminary structure of small protein crystals is crucial to implementation of the huge opportunities offered by recent advances in human and non-human genomics, with far-reaching consequences in the areas of disease therapy and drug discovery. Furthermore, such a system could find broad applications in academic, scientific and industrial programs for high- resolution microscopy of structure, texture, and strain in metallurgical, geological, environmental and biological or other materials.

Title: SBIR Phase II: Antigen-Mediated Selection of Hybridomas

Award Number: 0078548
Program Manager: Om P. Sahai

Start Date: October 1, 2000
Expires: September 30, 2003
Total Amount: $510,714
Investigator: Yevgenya Akselband, yaks@onecell.com
Company: One Cell Systems Inc
100 Inman Street, Suite 200
Cambridge, MA 02139
Phone: (617)868-2399

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a rapid, sensitive and highly specific method for monoclonal antibody production and hybridoma cell line development by combining single cell gel microdrop (GMD) encapsulation technology, a novel protein capture format, and fluorescence activated cell sorting. Using insulin as a model antigen, Phase I studies demonstrated that individual cells, which comprised a 1% sub-population of a heterogeneous population, could be rapidly isolated based on both secretion level and antigen specificity of the secreted antibody. Phase II research will optimize the assay format by permitting simultaneous analysis of other antibody properties, including antibody isotype and blocking properties. Using newly fused hybridomas, Phase II research will isolate and enrich productive clones and compare results with conventional methods which require use of time consuming and labor intensive limiting dilution cloning.

Monoclonal antibodies are widely used as research, therapeutic, diagnostic, and imaging reagents, and are increasingly used in the emerging field of proteomics for discovering new drug targets and locating disease specific markers. The GMD method will reduce production time and costs, improve antibody quality and yield, and permit isolation of rare cells.

Detectors/Sensors/Instruments

Title: SBIR Phase II: Integrated Microsensors for Detection of Aqueous and Gas Phase Volatile Organic Compounds

Award Number: 0078726
Program Manager: Winslow L. Sargeant

Start Date: May 1, 2002
Expires: April 30, 2004
Total Amount: $400,000
Investigator: Eugene C. Aquino, arcova@swva.net
Company: American Research Corp of VA
PO Box 3406
Radford, VA 241433406
Phone: (540)731-0655

Abstract:

This Small Business Innovation Research (SBIR) Phase II project involves development of an integrated sensor system that will accurately and rapidly measure small quantities of volatile organic compounds (VOCs) both in air and in aqueous environments. At present, no inexpensive sensor system is sufficiently sensitive and rugged for use in continuously monitoring of VOCs in underground water streams, soil, effluent discharge, fugitive emissions and in spent liquid and vapor streams. To capture this business opportunity, this project involves the development of low-cost continuous organic chemical sensors based on the change of fluorescence of dyes embedded in polymeric and sol-gel thin films. This program is innovative in combining sensitive diode laser-excited fluorescence with total internal reflection methods of analysis to provide a continuous monitor of VOCs. The Phase I research program was successful in demonstrating the feasibility developing several highly sensitive polymer/dye films for use in detection of aqueous and gaseous phase VOCs. Detection limits in the part-per-billion (ppb) range for both aqueous and vapor phase trichloroethylene were achieved using fluorescence detection spectroscopy. The Phase II research and development program will accomplish the feasibility demonstrated in Phase I by developing a turnkey sensor system for multiple chemical analysis.

The Phase II Research Objectives include synthesis of polymer and sol-gel solid matrices with pendant functional groups, development of a fluorescence monitoring array and algorithms for multi-chemical analysis, design and integration of miniaturized total internal reflection fluorescence array instrument, acquisition of families of test data to establish instrument specifications, and demonstration of the total-internal reflection fluorescence instrument at environmental remediation facilities and a water treatment plant.

This sensor platform together with sensitive polymer/dye films is significant in providing rapid on-site identification and quantification of volatile organic compounds and environmental pollutants in groundwater, soil, effluent discharge and fugitive emissions.

Title: SBIR Phase II: Portable Sequential Injection (SI)-High Performance Liquid Chromatography (HPLC) Analyzer

Award Number: 0522319
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000
Investigator: Garth Klein, garth@flowinjection.com
Company: FIAsolutions
14450 NE 29th Place, suite 113
Bellevue WA, 98007
Phone: (425)376-0450

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project is aimed at the development of a portable and fully automated chromatographic based analyzer. This analyzer will integrate several proven technologies to produce an automated instrument that is compact, robust and easily implemented for on-line, at-site, or field-ready use, especially where complex HPLC (High Performance Liquid Chromatography) analyses is needed. Based on both Sequential Injection (SI) protocol and HPLC instrumentation, this device will be fully automated and provide an integrated approach with respect to sample collection, pre-treatment, chemical modification, separation and detection of target analytes. This chemical analyzer will exploit several novel technologies including sequential injection, portable high-pressure syringe pumps and sol-gel HPLC columns in its development.

The proposed SI-HPLC instrument will find applications in on-line process control, at-site environmental monitoring or as a multipurpose field-ready analyzer for medical, law-enforcement and military use. Sequential Injection technologies make this analyzer ideally suited for use by untrained personnel or for remote autonomous analysis since sample handling and preparation can be completely automated. Initial targeted use for the SI-HPLC will be for online bioprocess control (e.g. pharmaceuticals) to provide real-time feedback for Quality Control or optimal product yield.

Title: SBIR Phase II: Oxygen Sensor for Aircraft Fuel Tanks

Award Number: 0522239
Program Manager: Muralidharan S. Nair

Start Date: July 15, 2005
Expires: June 30, 2007
Total Amount: $474,135
Investigator: Travis Martin, tmartin@dakotatechnologies.com
Company: Dakota Technologies Inc
2201 12th St N Ste A
Fargo ND, 58102
Phone: (701)237-4908

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will complete the development of an oxygen sensor that can be deployed inside aircraft fuel tanks. Such a sensor will be needed after the Federal Aviation Agency (FAA) mandates the use of nitrogen-enriched air to prevent explosions like the one that destroyed TWA flight 800. Currently available oxygen sensors cannot withstand the harsh environment and meet the accuracy, longevity, and cost requirements. The technical objectives are to completely characterize and understand the permeation properties of the polymer matrix; examine alternative formulations of the polymer; completely understand the photochemical, leaching, and spectroscopic properties of the phosphorescent dye, examine other candidate dyes, and conduct long-term testing. A flight test of the oxygen sensor is planned.

This research will ultimately benefit society by making air travel safer. It will also serve as a model for the interplay between fundamental science, applied science, and the engineering disciplines during product development. The work will open the door for development of other luminescent sensors that can be deployed in comparably harsh chemical environments, including the measurement of water in fuels and alcohols.

Title: SBIR Phase II: Novel Radial Magnetic Field Actuator for Fully Flexible Electromechanical Valve

Award Number: 0522170
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $462,429

Investigator: David Cope, dcope@engineeringmatters.com
Company: Engineering Matters Inc
375 Elliot St Ste 130K
Newton MA, 02464
Phone: (617)965-8974

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop a novel radial magnetic field actuator for fully flexible electromagnetic automotive engine valves. Electromagnetic valve actuators are rapidly emerging as the technical solution for improved emissions, fuel consumption and greater engine performance. Dramatic improvement in engine performance and reduction in environmental impact is possible with this technology. A fully electronically controlled inlet/exhaust valve actuating system eliminates camshafts and other mechanical components completely, thus (1) allowing optimization of the gas-exchange process across the whole engine speed and load range, and (2) eliminating the packaging restrictions placed upon an engine by conventional camshaft profiling.

The primary application of the actuator is automotive internal combustion engine valves. The ability to alter the lift and timing (opening and closing) of automotive engine valves will create more powerful engines that require less fuel and create fewer emissions. In fuel savings alone, an estimated 15% savings can be achieved, which equates to saving approximately 475 million barrels of oil per year for US consumption worth approximately $21 billion per year. Improving fuel economy is a worthy national goal: it will reduce America's dependence on imported oil, cut the carbon emissions that contribute to global warming, and increase automotive competitiveness.

Title: SBIR Phase II: Assessment of Manufacturing and Fatigue Damage Effects in Titanium Alloys Using Induced Positron Annihilation

Award Number: 0521901
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $446,385

Investigator: Jagoda Urban-Klaehn, klaehn@physics.isu.edu
Company: Positron Systems, Inc.
6151 N Discovery Way
Boise ID, 83713
Phone: (208)672-1923

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop a prototype Induced Positron Manufacturing Damage System (IPMDS) to be used to assess initial component quality, and manufacturing damage effects for Ti-6Al-4V and IN738 components. The IPMDS is based on the Induced Positron Annihilation technologies whose capabilities to assess alpha inclusion and fatigue damage effects have been previously demonstrated. The IPMDS is an innovative damage assessment tool that will be developed with support from Precision Cast Corporation (PCC) as a manufacturing quality control and damage assessment tool to be used to reduce costs in place of current destructive methods, which are expensive and do not provide adequate sensitivity to either manufacturing or operational damage effects. The IPMDS will contribute to extended use component designs, cost savings, and efficient operations for the titanium and nickel super-alloy industries.

Commercial applications of IPMDS will be targeted at the structural and turbine engine industries, which extensively utilize expensive titanium and nickel super-alloy components. The IPMDS has a high potential for becoming a critical and necessary inspection tool in these industries due to its potential for minimizing manufacturing variability, assessing operational damage, optimizing maintenance requirements, reducing costs, and improving safety. The IPMDS capability is expected to extend inspection applications to a wide range of industries where improved knowledge of manufacturing variability, induced damage effects, minimization of inspection and replacement costs, and component life extension are important

Title: SBIR Phase II: A Reversible, Colorimetric Hydrogen Safety Sensor Using Tailored Xerogels

Award Number: 0521760
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,999

Investigator: Kisholoy Goswami, kisholoy.goswami@innosense.us
Company: InnoSense LLC
2531 West 237th St, Ste 127
Torrance CA, 90505
Phone: (310)530-2011

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will optimize performance of an optical safety sensor for integration with the hydrogen economy infrastructures. Feasibility of the sensing approach was demonstrated by developing a sol-gel-titania-based indicator formulation, which showed complete reversibility, and response and recovery time of less than a minute with 4% hydrogen. Safety remains a top priority since leakage of hydrogen in air during production, storage, transfer and distribution creates an explosive atmosphere for concentrations between 4% (v/v) - the lower explosive limit (LEL) and 74.5% (v/v) - the upper explosive limit (UEL) at room temperature and pressure. Being a very small molecule, hydrogen is prone to leakage through seals and micro-cracks. The sensor will be further improved with regard to its dynamic detection range, response and recovery times, sensitivity, accuracy, resolution and reduced interference from temperature fluctuations, and atmospheric gases including humidity.

Hydrogen economy is new; public acceptance of hydrogen fuel would require the integration of a reliable safety sensor. Global energy consumption is projected to increase by 50% over the next 20 years. Failure to develop alternatives to oil would heighten growing reliance on oil imports, raising the risk of political and military conflict and economic disruption. The acceptance of hydrogen by the general public as an alternative fuel requires a safety sensor for mitigating the explosion risks due to hydrogen leakage at unacceptable levels

Title: SBIR Phase II: Ultrasensitive, Real-Time Explosives Sensor

Award Number: 0521652
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $483,725

Investigator: James Scherer, jjscherer@novawavetech.com
Company: Novawave Technologies
900 Island Dr Ste 101
Redwood City CA, 94065
Phone: (650)610-0956

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project seeks to develop a new, ultrasensitive laser based explosives detection system (EDS). The system will be capable of rapidly detecting and discriminating among common explosives materials in a timescale commensurate with that of existing passenger screening systems that are presently used in airports. The proposed EDS technology is based on a combination of a new, rapidly and widely tunable laser system with a novel optical cavity enhanced absorption method. The research effort comprises constructing and testing a bench top version of the system that is suitably configured for use in the middle infrared, where explosives can be detected via their characteristic spectral signatures. If successful, the instrument will be capable of significantly exceeding the sensitivity level of existing commercial EDS sensors, as well as potentially providing an orthogonal sensor platform.

The sensor will be suitable for passenger, baggage, and cargo screening applications, and will be engineered specifically for integration as a plug-in replacement or parallel technology to existing screening systems. In addition to advancing laser technology, the project has the potential to benefit society by assuring safer transportation to the general public. The ability to rapidly scan the middle infrared spectral region with high absorption sensitivity will enable the rapid detection of numerous trace chemical species including toxic industrial chemicals, chemical warfare agents, and industrial pollutants.

Title: SBIR Phase II: Sensor Technology Enabling Large Array Based Sensors

Award Number: 0450583
Program Manager: Muralidharan S. Nair

Start Date: June 1, 2005
Expires: May 31, 2007
Total Amount: $480,705
Investigator: Tony Ragucci, tony.ragucci@lynntech.com
Company: Lynntech, Inc
7607 Eeast Mark Dr. Ste 102
College Station TX, 77840
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project involves an innovative gas sensor (DiskFET) based on a commercially available hard drive mechanism, proprietary polymers for sensing, and a modified Field Effect Transistor (FET). The device as envisioned is small, handheld, lightweight, low power, and applicable to a diverse range of chemical sensing fields. The DiskFET operates by applying an electric field between a polymer coated rotating disk and stationary FET, which is "floating" a fixed distance above the disk surface, the field strength will be affected by the interactions of the analyte with the polymer coating on the disk. This change in field strength is measured by the FET. By combining the signal responses of all of these relatively non-specific sensors, a "fingerprint" for the analyte is constructed. Using Artificial Neural Network analysis, the concentration and identity of the analyte can be recognized based on a database of the sensor response characteristics.

Personal safety and air quality monitoring is on the rise. More and more workers are becoming conscious of the dangers of their work environments and are demanding adequate monitoring technologies as evidenced by the long-term, steady increase in chemical detector sales. This device will be used for the detection of chemicals such as Ammonia and VOC's with detection limits below current OSHA accepted levels

Title: SBIR Phase II: Advanced Phased Array Ultrasound Instrument for Nondestructive Evaluation (NDE)

Award Number: 0450553
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $481,841
Investigator: Vincent Lupien, vincent.lupien@acousticideas.com
Company: Acoustic Ideas Inc.
27 Eaton St
Wakefield MA, 01880
Phone: (781)621-8228

Abstract:

This SBIR Phase II research project strives to develop an Advanced Ultrasonic Beamformer that is unparalleled in its scalability and signal processing features. The ultrasonic beamformer architecture will be unique in its breadth of features. The architecture was developed as the superset of features across several fields including medical imaging, medical therapy, bone density measurement, vascular imaging, and materials characterization. This approach provides each field with an instrument capable of operating outside the normal performance envelope, thereby presenting opportunities for the development of new uses of ultrasound. The benefits of this array include better frame rates, crisper images, and more accurate surgery.

The higher frequencies used in materials characterization, when brought to medical imaging, will allow array transducer to be used where only conventional, single element probes could used in the past, for example in intra-cardiac imaging for surgical instruments, and also for tumor ablation. By design, the proposed architecture encompasses the abilities of many different fields. Each field then enjoys performance capabilities beyond what is normally available, providing a general-purpose tool for research.

Title: SBIR Phase II: Reflectance Sensitive Image Sensor for Illumination-Invariant Visual Perception

Award Number: 0450554
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $499,997

Investigator: Vladimir Brajovic, brajovic@intriguetek.com
Company: Intrigue Technologies, Inc.
513 Harrogate Rd
Pittsburgh PA, 15241
Phone: (412)223-2443

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project proposes to develop an adaptive CMOS image sensor that estimates and largely eliminates illumination variations in sensed optical images thus reporting electronic images that are indicative of the reflectance of the viewed scene. By eliminating illumination-induced variations from the raw optical images the proposed sensor will eradicate the vision system's vulnerability to illumination variations and signal loss due to high dynamic range. The core innovation is in a signal processing technique for estimating the illumination field from sensed images. The technique efficiently implements as a dense on-chip massively parallel analog processor distributed among the photo-detectors to produce a reflectance sensitive image sensor. By compensating for illumination, the proposed image sensor inherently addresses the wide dynamic range problem, that routinely causes conventional cameras to over or under expose producing inadequate images. Even when illumination conditions do not saturate an image sensor, the vision system has to account for object appearance variations caused by illumination.

The proposed research has the potential to broadly impact computer vision performance and reliability. Most present and future vision applications including automotive, biometric, security, and mobile computing applications operate in unconstrained environments and have to cope with unknown and widely varying illumination conditions. Image sensors are rapidly finding their way into people's cars, cell-phones, personal digital assistants, medical and diagnostic equipment, automated drug discovery, cutting edge security, surveillance and biometric systems

Title: SBIR Phase II: Development of an Optical Sensor for Instantaneous Detection of Bioaerosols

Award Number: 0450546
Program Manager: Muralidharan S. Nair

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $512,000
Investigator: Luis Alva, ctt@vitec2.com
Company: Caribbean Thermal Technologies
177 Balboa St.
Mayaguez PR, 681
Phone: (787)834-5700

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project addresses the development of a novel real-time bio-aerosol machine for detecting and identifying harmful bio-aerosols present in the environment. The system will use the time of flight method to determine the aerodynamic size, and the Multiphoton Laser Induced Fluorescence (MLIF) method for the identification of the fluorescence spectrums. The novelty of the detection machine lies in the use of in-line, non-invasive techniques to measure these two important parameters. The system will consist of a compact laser source, a laser diode, a spectrometer, fiber optics couplings, a series of lenses and filters, pumps, flowmeters and pressure transducers. The sensor will be driven by two printed circuit boards and by computer software both uniquely designed for the proposed detector.

The need for the proposed instrument is of high priority in current times due to the extreme concerns about air quality issues and the high probability of terrorist attacks in large urban settings. The initial target markets for this product are "first emergency response" civilian agencies, medium to large size hospitals, and the armed forces

Title: SBIR Phase II: Miniature Mass Spectrometer for Liquids Analysis

Award Number: 0450512
Program Manager: Muralidharan S. Nair

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $458,475
Investigator: John Grossenbacher, grossenbacher@griffinanalytical.com
Company: Griffin Analytical Technologies, Inc.
3000 Kent Ave
West Lafayette IN, 47906
Phone: (765)775-1701

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop novel instrumentation based on electrospray ionization (ESI) coupled with mass spectrometry for identifying and quantifying chemical species in liquid-phase samples in the field. The goal of this project is to employ an existing Minotaur miniature mass spectrometer (MS) to develop a portable, easy-to-operate detector that will provide real-time and highly sensitive detection of a broad range of chemical compounds in liquid samples in the field. The objectives of the research are to construct, integrate, and optimize an innovative miniature ESI source into the instrument to receive liquid samples and introduce the target analytes to the detector, while minimizing interference from background matrix constituents, and to fully develop and qualify the analytical characteristics and ease-of-use of the instrument during field operations.

Commercially this development of the first field portable, miniaturized ESI-mass spectrometer will have commercial applications in several governmental and commercial sectors, and has the potential to impact society broadly by providing improved monitoring of water resources and protection of the public from chemical exposure resulting from hazardous material accidents or acts of terrorism. If successful, this research will lead directly to developments allowing for determination of compounds of biological origin, e.g. biomarkers, which will provide additional dimensions of information as to the content of analytical samples

Title: SBIR Phase II: 2D Transducer Array for 3D High-Resolution Ultrasound Imaging

Award Number: 0450493
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $488,109

Investigator: David Lemmerhirt, dlemmerh@soneticsultrasound.com
Company: Sonetics Ultrasound Inc
4890 Troon Ct
Ann Arbor MI, 48103
Phone: (734)260-4800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop Micro-electro-mechanical systems (MEMS) based, fully populated two-dimensional (2D) ultrasonic transducer array for three dimensional (3D) imaging in real time. Current 2D ultrasound systems employ a linear array of transducers to accumulate images. A planar array is universally acknowledged as the ideal approach for 3D image acquisition; however, multiple challenges must be overcome to make this practical, including: limitations in existing piezoelectric transducer technology, connecting an array with many elements (e.g., > 16,000) to front-end electronics, and processing large amounts of image data in real-time. The highly collaborative Phase II effort will build upon design and simulation results from the The system architecture will provide substantial flexibility in applying digital processing techniques, including adaptive beamforming, synthetic apertures, and phase aberration correction.

The developed technology could bring many new capabilities to medical imaging, including volumetric flow, and real-time 3D imaging for tumor evaluation, image-guided surgery, and fetal echocardiography. Some of these include a breakthrough planar array technology overcomes a key bottleneck in the state-of-the-art in ultrasound, with spillover contributions to non-ultrasound fields (e.g. other MEMS, sonar, other medical imaging, nondestructive testing)

Title: SBIR Phase II: A Device for Measuring Electric Field Strength from Dropsondes and Radiosondes

Award Number: 0450497
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $499,970

Investigator: R. Paul Lawson, plawson@specinc.com
Company: SPEC, Inc.
3022 Sterling Circle
Boulder CO, 80301
Phone: (303)449-1105

Abstract:

This SBIR Phase II research project will provide research-aircraft and weather-balloon flight tests a new, novel device for measuring the electric field strength of thunderstorms and hurricanes. Electric field strength is a significant factor in the development of precipitation and lightning, and may even play a role in influencing the intensity of precipitation from thunderstorms. Research aircraft flights that typically measure electric field strength in thunderstorms and hurricanes are difficult and potentially dangerous because of the hazardous conditions, such as lightning, hail and turbulence. However, the new device, called an electric field module, can be contained in a device called a dropsonde and dropped through thunderstorms from aircraft flying above the storm, or attached to weather balloons called radiosondes that are released from the ground.

Since over 7,000 dropsondes and 400,000 weather balloons are routinely deployed each year, adding electric field measures to these devices represents a substantial commercial market. Measurements using the new E-field modules deployed by the SPEC Learjet research aircraft will be unique and open a new realm for analyzing the structure of electric fields in storms. A more realizable goal is improved aviation safety, by virtue of a better understanding of lightning discharges from clouds associated with thunderstorms, particularly anvil clouds, where commercial aircraft are often struck by lightning

Title: SBIR Phase II: Thick Film Planar Magnetooptic Garnet Faraday Rotators

Award Number: 0450470
Program Manager: Juan E. Figueroa

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $443,775

Investigator: Vincent Fratello, vjfratello@integratedphotonics.com
Company: Integrated Photonics, Inc
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Birmingham AL, 35210
Phone: (908)281-8000

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project addresses the device and market opportunity for thick magnetooptic garnet Faraday rotator films with planar anisotropy to be operated in the near infrared. Magnetic and electromagnetic field sensors could be developed at a variety of near-infrared wavelengths including the 800 nm, 1310 nm and 1550 nm bands. These sensors can be made much less expensively, in much smaller sizes and with much less weight than current technologies such as current transformers. They have a potential for immediate impact in reliability of electric power distribution through failure anticipation and prevention and conservation of electric power through monitoring and control. Planar materials have much higher switching speeds than conventional perpendicular Faraday rotators and as such would permit a magnetooptical approach to packet switching. Such films are an innovative solution to device problems that require high-speed, continuously-varying polarization rotation with applied field. The project will work on improving properties and performance of such thick planar films and incorporate them into devices. Specific materials tasks are directed to improving sensitivity, linearity and temperature range of operation.

If successful these sensors will have applications such as wheel and turbine rotation, electric power distribution, monitoring, metering and control, and battlefield sensors. The electric power application in particular has potential to revolutionize catastrophic failure prevention in the power grid and reduce power costs at a variety of levels by enabling autonomous reconfiguration. The lack of electrical connectors in fiber optic sensors for explosive, flammable and high-voltage environments represent a significant improvement in safety. New photonic devices not currently realizable will be enabled for telecommunications and military applications such as variable optical attenuators, polarization controllers and increased speed magnetooptic switches. Photonic devices include polarization controllers, variable optical attenuators, switches and new innovative devices. Smart ships and buildings would find utility both for conservation and efficiency

Title: SBIR Phase II: Automated Foam Index Test Instrumentation

Award Number: 0450405
Program Manager: T. James Rudd

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $463,748

Investigator: John Stencel, john@triboflow.com
Company: Tribo Flow Separations, LLC
1525 Bull Lea Blvd
Lexington KY, 40511
Phone: (859)259-0011

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a prototype Automated Foam Index Test (AFIT) instrument for measuring foam indices of mineral admixtures used in concrete; and, a prototype AFIT instrument for controlling dosage of air entraining agents into mineral admixtures and concrete. AFIT instruments take advantage of the physical behavior of foams to identify bubble stability and breakup activity. The Phase I project confirmed concepts behind AFIT to measure air entrapment. The Phase II project creates a commercial-ready instrument. The Phase II research objectives are to (1) construct, test and then refine the tabletop AFIT and the automated sampling, control AFIT prototype instruments; (2) confirm correlations between the foam index/air content values from AFIT prototypes and visual/ASTM measurements; (3) install an AFIT at a partner company and verify its efficacy within a industrial setting; and (4) commercialize these instruments for the concrete industry.

Commercially widespread application of AFIT for the concrete industry would promote replacing cement with less expensive mineral admixtures up to specification limits of 30%. On a worldwide view, the potential cost reduction associated with this replacement is greater than $5 billion per year. Significant societal benefits also accrue. First, because cement production is approximately 10 times more energy intensive than the average of all other industrial activities, green house gas emissions worldwide are decreased significantly when cement is replaced by a less energy-intensive substitute. Second, because the primary mineral admixture used is coal combustion ash, and because it is now predominantly landfilled, environmental impacts and land usage issues are ameliorated.

Title: SBIR Phase II: Development of an Automated Ballast Water Exchange Monitoring System Using 'Through-the-Hull' Acoustic Modems

Award Number: 0450355
Program Manager: Muralidharan S. Nair

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $497,767

Investigator: Kushal Talukdar, kushal@harrisacoustic.com
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141 Washington St
East Walpole MA, 02032
Phone: (508)850-3101

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project is aimed at building the first prototype of an automated ballast water exchange (BWE) monitoring and reporting system. The system will use acoustic modems that use ultrasonic acoustic energy through metal structures as the means of communication. Wireless networking based on radio frequencies (RF) is not very effective within enclosed metal structures such as the hulls of ships. The acoustic modems can be used to overcome such limitations and can establish a local wireless network for data transfer among sensors located in various parts of the vessels. The through-the-hull communications technology is at a nascent but proven state. Existing modems transfer data at 20 bits per second. The Phase-I research showed that a data rate of 500 bits per second (or higher) would exceed the data throughput requirement for BWE monitoring.

Ballast water management is a global issue. The foreign micro-organisms not only destroy the bio-diversity in the native coastal eco systems but create problems for regional economies as well. The impact from the introduction of Zebra mussels in great lakes is estimated at over four billion dollars. Therefore developing an effective and inexpensive technology for monitoring the ballast water has a broader impact on the society. It has the potential to save economies that depend on coastal resources and ensure the preservation of the local eco-systems for future generations without placing excessive restrictions on international maritime trade

Title: SBIR Phase II: Multi-Coil Surface NMR Instrumentation and Software for 3-D Groundwater Imaging

Award Number: 0450164
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000

Investigator: David Walsh, davewalsh@vista-clara.com
Company: Vista Clara Inc
8849 47th Pl W
Mukilteo WA, 98275
Phone: (425)353-8494

Abstract:

This SBIR Phase II research proposal aims to develop a commercial multi-Coil Magnetic Resonance Sounding (MRS) system for 3-D groundwater imaging and characterization. The principal innovations are the use of multi-coil arrays and the development of coherent signal processing methods to reconstruct 3-D images. The feasibility of this system concept through computer simulation, analysis, and by acquiring experimental (very low SNR) multi-coil NMR data has been established. It is now proposed to design and assemble a field-scale multi-coil MRS prototype instrument with surface coil diameters on the order of 50-100 meters, and to field test this prototype extensively with the U.S. Geological Survey and a groundwater -consulting firm. This multi-coil MRS system enables a critical performance improvement in the area of spatial resolution (3-D vs. 1-D) and at least an order of magnitude improvement in sensitivity (effective SNR).

Inadequate access to clean, safe, and reliable sources of drinking water is a primary cause of disease in the developing world. Inadequate access to groundwater resources, and inadequate understanding of the long-term effects of groundwater use, pose fundamental limitations on economic and agricultural development in much of the developed world, including the United States. As an inexpensive, low-energy, and non-invasive groundwater exploration method, the proposed technology could have significant positive impacts on world health, natural resource management, and economic development

Title: SBIR Phase II: Infrasonic Avalanche Identification

Award Number:	0449731
Program Manager:	Muralidharan S. Nair
Start Date:	April 1, 2005
Expires:	March 31, 2007
Total Amount:	$500,000

Investigator: Ernest Scott, scotte@imlinc.com
Company: Inter-Mountain Laboratories, Inc
555 Absaraka St
Sheridan WY, 82801
Phone: (307)674-7506

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to produce a working prototype sensor array monitoring system that detects, identifies, and localizes the infrasound generated by snow avalanches. The goal of the project is to bring to commercial form automated monitoring systems that improve the safety and welfare of those impacted by avalanche activity. Avalanche-generated infrasound signals can propagate miles from their origin, and provide a basis for automated monitoring and warning systems. Previously developed single sensor infrasound monitoring systems can detect and identify avalanche-generated infrasound in an automated near real-time manner, but performance suffers when avalanche signal amplitudes are small and/or during high wind noise periods. By advancing and refining array-based signal processing algorithms, sensor array monitoring can provide spatial information that greatly improves avalanche signal identification in varying signal and noise conditions while also providing the geographic location of the avalanche signal origin.

Identification of avalanche occurrences will improve safety in avalanche prone terrain and minimize direct and indirect costs associated with avalanche activity. Automated notification of unexpected avalanche activity will provide a prompt for early response activities. Knowledge garnered through this project will advance the field of applied infrasonic sensor array monitoring, an infant science. Innovative hardware and software components that are designed and proven will be available for other infrasound monitoring applications such as tornadoes, volcanoes, flash floods, ocean storms, calving glaciers, aura borealis, ridgeline winds, explosions, and aircraft

Title: SBIR Phase II: A Novel Clamp-On Self-Powered Flowmeter

Award Number:	0422033
Program Manager:	Muralidharan S. Nair
Start Date:	November 1, 2004
Expires:	October 31, 2006
Total Amount:	$496,929

Investigator: Robert McKillip, Jr., bob@continuum-dynamics.com
Company: Continuum Dynamics, Inc.
34 Lexington Ave
Trenton NJ, 8618
Phone: (609)538-0444

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will produce a prototype low-rate fluid flow instrument for nuclear power plants that incorporates several novel features that permit its use as a clamp-on measurement device having minimal installation costs and complications. By utilizing waste heat on piping lines, and wireless data links, the flow sensor system avoids the requirement for an extended wiring system that interconnects and powers the instrumentation within the containment vessel. Accurate and reliable measurement of critical flow systems will ensure piping thermal stresses remain below design limits, for safe continued generation of electric power.

The broader impact of the proposed flow sensor should significantly enhance nuclear power plant system safety by providing a robust, self-contained, zero-maintenance, zero-power instrument for monitoring in-plant piping systems. In addition, the platform for the flowmeter instrument may serve as a basis for a new family of monitoring systems for nuclear power plants and other environments where instrumentation wire runs are costly or prone to failure.

Title: SBIR Phase II: Composite Structural Damage Self-Sensing via Electrical Resistance Measurement

Award Number: 0422146
Program Manager: Muralidharan S. Nair

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $498,010

Investigator: Jaycee Chung, jayceechung@sbcglobal.net
Company: Global Contour Ltd.
1145 Ridge Road West
Rockwall, TX 75087
Phone: (214)514-4085

Abstract

This Small Business Innovation Research (SBIR) Phase II project is aimed to capitalize on the Phase I success of an innovative self-sensing of composite structural damage utilizing the electrical conductivity of carbon (graphite) composite materials for structural health monitoring (SHM). The Phase II project is intended to provide a full-scale development (FSD) technology for composite a structural self-diagnostic (CSSD) system/technique. The necessary hardware/software and implementation procedures, such as microchip-based nodal electrical conductivity acquisition electronic circuitry, composite structural self-monitoring computer hardware and software will be incorporated in the CSSD device. The CSSD technology should prevent the catastrophic failures of aircraft and rotorcraft by predicting impending failures of flight-critical composite structural components. The system hardware/software will be demonstrated on new commercial passenger jet aircraft and military aircraft. The application of the CSSD technology should reduce the maintenance cost of the aircraft and rotorcraft due to automated structural health monitoring and diagnostic feature.

Title: SBIR Phase II: Development of a Low-Cost Harsh Environment Vibration Sensor

Award Number: 0422069
Program Manager: Muralidharan S. Nair

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $475,190

Investigator: Jonathan Geisheimer, jong@radatec.com
Company: Radatec, Inc.
75 Fifth St NW
Atlanta, GA 30308
Phone: (404)526-6048

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop an inexpensive sensor for measuring mechanical vibration and displacement of rotating machines using 5.8 GHz communications components. Current sensing technologies cannot operate in the high temperature and dirty environments often found inside these machines. Major problems often first develop in these unmonitored areas. By providing a new source of information, failures and degradation can be detected earlier.

The broader impacts of the proposed research result from the ability of engineers and scientists to more accurately characterize the internal workings of large rotating machinery (e.g. hydroelectric generator, power generation gas turbine, and DC motor) within the harshest environments. Designers and machine operators will have data in critical areas where failure modes most often occur, allowing for earlier warning of performance degradation and more accurate machine condition monitoring.

Title: SBIR Phase II: Low-Pressure Microplasma Gas Analyzer

Award Number: 0422076
Program Manager: Muralidharan S. Nair

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $500,000
Investigator: Chris Doughty, cdoughty@verionix.com
Company: Verionix
251 Granville Lane
North Andover, MA 01845
Phone: (617)905-0015
Abstract

This Small Business Innovation Research (SBIR) Phase II research project will develop a miniaturized gas analyzer for use in industrial process control, fault detection and monitoring. The gas analyzer proposed here would be able to identify the chemical components of the gas and quantify their partial pressures down to part-per-million (ppm) levels. It will be sensitive to a range of gas species, and be small, have low power consumption and low cost.

The broader impact of this research project will be to advance the nation's scientific and intellectual knowledge base by developing and demonstrating novel plasma emission sources and their applications. It will advance the nation's economic competitiveness by enhancing industrial productivity and the ability of the US semiconductor capital equipment industry to compete worldwide.

Title: SBIR Phase II: A Sensitive Integrated Multi-Speckle Laser Interferometer for Industrial Applications

Award Number: 0422028
Program Manager: Muralidharan S. Nair

Start Date: July 1, 2004
Expires: June 30, 2006
Total Amount: $499,934
Investigator: Bruno Pouet, bpouet@bossanovatech.com
Company: Bossa Nova Technologies LLC
606 Venice Boulevard
Venice, CA 90291
Phone: (310)577-8113
Abstract

This Small Business Innovation Research Phase II project describes an innovative Approach for development of a high sensitivity laser ultrasonic receiver for Application in industrial environment. A high sensitivity classic reference beam interferometer with the ability to efficiently overcome the limitation caused by the speckle light generated from the reflection from rough surface will be developed. The interferometer should be well suited for demanding industrial applications where low cost, sensitive and rugged receiver is needed. Because the proposed interferometer takes advantage of the high integration level of current state-of-the-art in electronic packaging, the system can be made very compact and will be the key element of an ultrasonic system. The robustness, high sensitivity and lower cost of this ultrasonic receiver is hoped to enable laser based ultrasonic inspection to become a cost effective and reliable solution.

The commercial market for this type of laser ultrasonic receiver is targeted at process control and in-service inspection applications where high reliability and low inspection cost is required. The steel industry has expressed strongly a desire to have a system dedicated to the in-process wall-thickness measurement of seamless tube.

Title: SBIR Phase II: Self-Imaging Transmitters for Remote Sensing

Award Number: 0349771
Program Manager: Muralidharan S. Nair

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $458,011
Investigator: Iain McKinnie, iainm@ctilidar.com
Company: Coherent Technologies, Inc.
135 S. Taylor Ave
Louisville, CO 80027
Phone: (303)604-2000

Abstract:

This SBIR Phase II project will develop and demonstrate self-imaging laser technologies for eyesafe remote sensing applications. Laser based remote sensing applications require a variety of output formats, including amplitude modulated (AM) and frequency modulated (FM) continuous wave (CW) lasers; and pulsed lasers. There are currently no eye safe technologies available with the adaptive waveform capabilities to satisfy these requirements. At eye safe 1.5-micron wavelengths, bulk solid-state lasers are not capable of high average power operation; and conventional fiber laser systems are not capable of handling high peak powers due to optical damage and nonlinear effects. A patent-pending diffraction limited self-imaging waveguide laser technology has been developed that use an adaptive waveform that has the potential to satisfy the average and peak power requirements simultaneously. There are two objectives for the Phase II research- 1) to design a self-imaging laser system with adaptive waveform capability, and 2) to demonstrate an adaptive waveform 1.5-micron laser transmitter. It is anticipated that >20 W of diffraction limited, eye safe average laser power will be achieved with adaptive waveform capability demonstrated. This eye safe self-imaging waveguide laser module is targeted as an enabling technology with broad reaching impact.

The specific markets include remote sensing markets of wind and aerosol detection and 3- D imaging. This technology should have a significant impact because current sensors are complex and costly. Other applications include hazard alerting for windshear, gust front, and turbulence detection; wake vortex detection, tracking, and measurement; and detection and tracking of hazardous bioaerosols.

Title: SBIR Phase II: Improved Magneto-Optical Imaging Films Employing Surface Plasmon Resonance

Award Number: 0349694
Program Manager: Muralidharan S. Nair

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $498,774

Investigator: Jeff Lindemuth, jlindemuth@lakeshore.com
Company: Lake Shore Cryotronics, Inc
575 McCorkle Boulevard
Westerville, OH 43082
Phone: (614)891-2243

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project is to develop an improved magneto-optical (MO) visualizer based on a laser-scanning polarimeter and a MO imaging film (MOIF) utilizing surface plasmon resonance. In Phase I, the feasibility of substantial improvements in spatial and magnetic field resolutions and imaging bandwidth over existing methods were demonstrated. In Phase II, the MO material quality and sensor design will be further optimized. The visualizer will be adapted to maximize the many advantages offered by the improved MOIF material. Software will be developed to provide automatic system control and conversion of the acquired image into the quantitative spatial magnetic field distribution. The capabilities of the prototype systems and sensors will be evaluated in terms of magnetic field resolution, spatial resolution and speed through the imaging of electrical current patterns and data storage devices.

Commercial market needs include sensors, instruments and systems for improved magnetic field imaging. Applications include magnetic character reading, magnetic code reading for security, superconductor research, spin valve and magnetic RAM research and manufacturing, integrated circuit electrical current imaging, structural composite stress imaging using magnetic and magnetostrictive materials, flaw detection in metals, biomedical tagging and identification of cancer and other cells, research and testing of MEMS actuators and devices.

Title: SBIR Phase II: Delta-Sigma All-Digital Magnetometer

Award Number: 0321647
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $499,991

Investigator: James Deak, jdeak@nve.com
Company: NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and prototype a single-chip magnetometer based on an innovative approach to digital magnetic sensors. The traditional approach combines a physical sensor having an analog output with an electronic analog-to-digital converter. In this sensor, the analog-to-digital conversion occurs in the physical mechanism of the sensor itself. With this approach only inexpensive digital electronic circuits are needed to complete the sensor system, resulting in a robust design that can easily be manufactured. The unique properties of sub-micron sized magneto-resistive sensor elements are used. The small size of these elements allows only two magnetic states, i.e. the magnetic state represents a binary digit that is a function of the external magnetic fields. Using concepts borrowed from over-sampling delta-sigma analog-to-digital converters, it is possible to measure the analog magnitude of a magnetic field by repeatedly interrogating the magnetic state of the bit. Using the principles of delta-sigma converters, including noise shaping feedback and high over-sampling ratios, high resolution and an inherently linear response can be achieved.

This single-chip digital magnetometer would be a revolutionary advance in sensor technology since it is based on standard wafer-level integrated circuit processing techniques. It will thus be much smaller and cheaper to fabricate than existing equivalent magnetic sensor systems. The highly integrated nature of this product, low power consumption and the digital output will make it extremely attractive for remote and/or bussed sensor applications. Applications include digital compasses, geomagnetic surveying equipment, vehicle sensors for traffic control, intrusion detection, currency/document validation and portable biomedical assay devices.

Title: SBIR Phase II: Lobster-Eye X-Ray Imaging Sensor

Award Number: 0321674
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount $499994
Investigator: Paul Shnitser, pshnitser@poc.com
Company: Physical Optics Corporation
20600 Gramercy Place, Bldg 100
Torrance, CA 90501
Phone: (310)320-3088

Abstract:

This Small Business Innovation Research Phase II project will develop an innovative Lobster Eye X-ray Imaging Sensor (LEXIS) for the observation of x-ray precipitation during long-term high-altitude balloon flights. The pinhole x-ray cameras currently used in such flights have very limited spatial resolution, and need significantly improved sensitivity. The proposed sensor will have a large-field-of-view x-ray lens fabricated of long metal microchannels. With this lens, the LEXIS will have significantly higher angular resolution and higher sensitivity than pinhole cameras. Phase II efforts will culminate in fabrication and testing of a full-scale LEXIS prototype capable of focusing on both soft and hard x-rays. LEXIS will bring unprecedented resolution to the investigation of boreal sources of x-rays. The proposed research will yield a new kind of x-ray optics that overcomes the limitations and shortcomings of current instruments. The lobster eye optics will dramatically improve the resolution of security screening x-ray equipment. It will enhance the penetration capability of screening equipment, more reliably detecting hazardous or illegal materials within thick metal containers.

The technology to be developed for fabricating lobster eye optics will be applied to the fabrication of antiscatter grids for medical x-ray detector arrays.

Title: SBIR Phase II: Carbon Isotope Ratiometer

Award Number: 0320470
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: Manish Gupta, mglgr@mindspring.com
Company: Los Gatos Research
67 East Evelyn Avenue, Suite 3
Mountain View, CA 94041
Phone: (415)965-7772

Abstract:

This Small Business Innovation Research Phase II project involves the development of a robust, field-portable gas analyzer capable of determining the carbon isotope ratio of carbon dioxide emitting from deep-sea hydrothermal vents. These vents provide access to water that has been trapped under the ocean in a unique, anaerobic environment that is devoid of photosynthesis and emulates the conditions believed to exist under the ice crusts of Europa and Callisto, beneath the surface of Mars, and on primordial Earth. Preliminary carbon isotope studies suggest that biological activity takes place in such an environment and novel instrumentation is sought to provide further evidence. The Phase II analyzer, based upon our proprietary Off-Axis ICOS technology, will determine the isotope ratio in-situ to within 1 angstrom, which is sufficient to discriminate between biogenic and geological carbon sources, and may provide evidence for a Subsurface Lithotrophic Microbiological Ecosystem (SLiME). The proposed instrument, which will interface with the Medusa seafloor sampling system developed by NASA Ames, will operate autonomously and be able to withstand the harsh underwater conditions found near deep-sea vents. The Phase II work will involve scientific development to enhance the prototype's specificity, deep-sea packaging to permit underwater deployment, and testing to demonstrate the analyzer's capabilities.

One of the most promising markets for our novel Off-Axis ICOS technology is in industrial process control (IPC). The Phase II instrument can be directly converted to an IPC analyzer due to its ability to autonomously operate in harsh environments, integration of compact control system, and use of sophisticated chemometric algorithms. Within the $1.67B IPC market, the targeted markets will be those in which current technology is either too expensive or insufficient, such as the niche in the fast analysis of acetylene contamination in ethylene.

Title: SBIR Phase II: Ultra-Sensitive Charge-Coupled Device (CCD) Technology: A Photon Counting Camera

Award Number: 0320531
Program Manager: Winslow L. Sargeant

Start Date; November 15, 2003
Expires: October 31, 2005
Total Amount: $474,174

Investigator: Mark Meisner, mmeisner@titanoptics.com
Company: Titan Optics & Engineering
7830 North Paseo Monserrat
Tucson, AZ 85704
Phone: (520)743-8315

Abstract:

This Small Business Innovation Research Phase II project will result in an innovative, technologically advanced, imaging system--with the potential of capturing and counting individual photons. The imaging system will be a compact avalanche-gain, charge-coupled device digital camera. The technology generated from this research effort will profoundly benefit many detection and discrimination applications. The innovation will offer high-photoresponse from the deep ultraviolet to the near infrared in very Low-Light-Level, as well as photopic light conditions. In addition, the camera system will have solid-state reliability without typical intensifier imaging tube limitations, such as, image burn-in and blooming. In short, the innovation will have significant cost savings over current conventional multi-spectrum imaging systems and will offer enhanced imaging performance.

A possible research, military, law enforcement, or homeland security application for the camera will be black-on-black detection--that is, when faint objects are difficult to discriminate from the background. This far-reaching technology will also be beneficial for many non-military applications: such as, Low-Light-Level physical, deep space and forensic sciences, as well as, photopic (daylight) medical and life sciences. In summary, the imaging system will have the most impact where real-time and lowest possible noise is required.

Title: SBIR Phase II: On-Line Optoelectronic Sensing of Molten Metal Chemistry

Award Number: 0321305
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $511,982

Investigator: Leigh Peritz, lapwte@aol.com
Company: wTe Corporation
7 Alfred Circle
Bedford, MA 01730
Phone: (617)275-6400

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a highly innovative, high-speed optoelectronic sensor system capable of continuously monitoring molten metal alloy compositions during casting and melting operations. The goal is to design and construct a commercially-viable sensor system capable of performing highly-accurate quantitative measurement of molten aluminum alloy compositions in an aggressive industrial setting. Development of this sensor is among the highest priority technology needs identified by both the metal casting industry and the aluminum industry in their industry roadmaps of the future. In order to effectively compete, U.S. metal industries must increase their use of low cost scrap and must also find ways to increase production efficiency. The proposed sensor will acquire critical compositional data thousands of times faster than current commercial methods and will operate on a real-time basis without the need to place the sensor in contact with the molten metal. At these speeds, a melt shop could produce one extra metal production batch ('heat') per day, resulting in a 15% increase in productivity. The incorporation of this innovative optoelectronic sensor system will result in a tremendous increase in production efficiency, providing for a 15% gain in productivity. Thus, the $30 billion aluminum smelting industry could realize a $4.5 billion increase in production output with little or no additional capital investment other than the cost of the sensor system. In fact, the most immediate broader impact of the proposed activity will be to enhance U.S. competitiveness of aluminum casters and smelters because of this productivity improvement. In addition, the proposed technology will have a significant positive effect on process control and quality assurance, thereby providing further competitive advantages.

Broader impact to our society will also be brought about through reduced emissions and energy savings resulting from shorter melting cycles. Similar improvements would be possible for zinc, copper, brass, bronze, iron, ceramic and glass industries that also have need for a similar continuous sensor system to monitor and control composition and quality on a real-time basis.

Title: SBIR Phase II: Ultrasonic Inspection of Internal Bond Strength in Paper Products

Award Number: 0237475
Program Manager: Winslow L. Sargeant

Start Date: April 1, 2004
Expires: March 31, 2006
Total Amount: $499,948

Investigator: Gary Wood, tceltd@earthlink.net
Company: SoniSys, LLC
1734 Cooper Lake Dr.
Smyrna, GA 30080
Phone: (414)226-9925

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an ultrasound technology that measures internal bond strength (IBS) in paper and paperboard materials. IBS is a very important quality control parameter because it provides an assessment of bond strength between wood pulp fibers and between plies in multi-ply grades. Two standardized test methods are widely used throughout the paper industry to evaluate IBS: Z-direction tensile (ZDT) and Scott Plybond. However, these methods are problematic in many ways: they require destructive testing, are technically deficient, are labor and time intensive, and cannot be integrated into automated paper testing equipment in quality control laboratories. Since the propagation of ultrasonic waves in paper is sensitive to bonding between fibers, an ultrasonic IBS method has the potential to address all shortcomings of existing methods. Preliminary results gathered during Phase I confirmed correlations between ultrasonic IBS, ZDT and Scott Plybond. Phase II involves additional work on the ultrasound technology to improve its accuracy, reliability, and universality. Also, it includes the development of an engineering prototype instrument for paper mill quality control testing, a comprehensive statistical study comparing ultrasonic IBS, ZDT, and Scott Plybond, and the drafting of a standardized test method.

The worldwide market of ZDT and Scotty Plybond Instruments is estimated at 400 units, largely in QC labs. Expected sales are $11M. Commercialization of a few hundred units would be considered as a tremendous success in the paper industry. The successful deployment of ultrasonic IBS in the QC lab could support the future development of real-time IBS monitoring during production.

Title: SBIR Phase II: A Trace Contaminant Sensor for Semiconductor Process Gases

Award Number: 9983349
Program Manager: Winslow L. Sargeant

Start Date: July 1, 2000
Expires: December 31, 2002
Total Amount: $400,000

Investigator: David Bomse, dbomse@swsciences.com
Company: Southwest Sciences Inc
1570 Pacheco Street, E-11
Santa Fe, NM 87505
Phone: (505)984-1322

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will test a novel sensor for real-time detection of trace impurities important in micoelectronics manufacturing. Gas feedstock quality is an important measurement for any process control strategy because contamination at the part-per-billion (ppb) level may limit product yield. This project's technique, called wavelength modulated photo-acoustic spectroscopy, has the potential to achieve these detection levels at a significantly lower cost than is possible with current technology. This technology is compatible with both corrosive and non-corrosive gases. The Phase II will construct and field test a prototype trace moisture sensor that is expected to achieve 10-ppb detection limits in corrosive gases such as hydrogen chloride and ammonia.

Potential commercial applications are expected in on-line removal of trace impurities important in micoelectronics manufacturing.

Title: SBIR Phase II: Development of High-Tc Superconducting Quantum Interference Device (SQUID) Magnetometers for Unshielded Operation

Award Number:	9983502
Program Manager:	Winslow L. Sargeant
Start Date:	April 1, 2000
Expires:	March 31, 2002
Total Amount:	$399,974

Investigator(s) Mark DiIorio, markd@magnes.com
Company: Magnesensors, Inc. (MSI)
9717-A Pacific Heights Boulevard
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Phone: (619)458-5752

Abstract:

This Small Business Innovation Research Phase II project is aimed at developing an ultra-sensitive magnetic sensor technology that is capable of operation in an unshielded environment. These compact sensors will be based on superconducting quantum interference devices (SQUIDs) that are fabricated from high temperature (high-Tc) superconducting materials. A collaborative effort between MagneSensors and U.C. Berkeley will employ novel design and materials processing solutions to produce high-Tc SQUIDs operating in ambient fields with an unprecedented level of sensitivity. The program will test the developed sensors on real-world applications at both low and high frequencies to demonstrate operation in the presence of large background magnetic field interference. This new enabling technology seeks to overcome the limitations in sensitivity, bandwidth, size, and spatial resolution, which restrict the more widespread application of present conventional magnetic field sensors. The eventual goal is the development of a low-cost, portable system with much greater sensitivity than is available with any other instrumentation.

This technology will enable the development of an entirely new generation of instrumentation that will find use in a wide variety of applications. Such applications include non-destructive evaluation of cracks and corrosion in aircraft, inspection of integrated circuits, homogeneous immunoassays and DNA probes using magnetic labels, geophysical surveying, environmental monitoring, detection of unexploded ordnance, diagnosis of intestinal ischemia, and screening for cardiac arrhythmias The potential market size for some of the applications reaches over $1 billion.

Title: SBIR Phase II: Very Large Scale Integrated (VLSI) Implementations of Neuromorphic Virtual Sensors for Intelligent Diagnostics and Control

Award Number: 9981852
Program Manager: Rosemarie D. Wesson

Start Date: May 15, 2000
Expires: November 30, 2003
Total Amount: $600,000

Investigator: Alexander Moopenn, alex@mosaixtech.com
Company: Mosaix, LLC
176 Melrose Avenue
Monrovia, CA 91016
Phone: (626)305-5550

Abstract:

This Small Business Innovation Research Phase II project will develop a novel, compact, low-cost adaptive neuroprocessor chip for advanced diagnostics and control in the next generation of low emission "environmentally friendly" vehicles. This digital CMOS VLSI electronic neural network device combines on-chip integration of a fully reconfigurable feed-forward/time-lagged recurrent neuroprocessor module with backpropagation-through-time (BPTT) weight training module. Specifically, the technical objectives are to develop a neuroprocessor chip suitable for direct insertion into an automobile's electronic engine computer (EEC). This stand-alone electronic neural network will function as a co-processor to the EEC's central processing unit (CPU), off-loading it of computationally intensive neural based tasks and enabling event rate automotive diagnostics and control. The neuroprocesor is programmable, allowing it to execute multiple neural network applications on-the-fly; is capable of event rate computational throughput (<<50 microseconds) per appli-cation; is a system-on-a-chip (SOAC) design (stand-alone neuroprocessor with on-chip weight training); and cost effective (<$5/chip). On-chip adaptation will not only enable adaptive control, but will address the problem of fixed weight networks - namely that of enabling on-board self-calibration of electronic and mechanical systems for optimal performance.

Applications areas of the proposed neural network formalism cover the following industry sectors: (1) advanced diagnostic and control strategies for low emision vehicles & hybrid electric vehicles in the automotive industry; (2) prognostics and diagnostics of jet engines for the aerospace industry; (3) and adaptive equaliza-tion of cell phones for superior noise rejection in the communication industry.

Title: STTR Phase II: Microsensors for In-Situ, Real-Time Detection and Characterization of Toxic Oganic Substances

Award Number: 0080128
Program Manager: Om P. Sahai

Start Date: August 1, 2000
Expires: January 31, 2003
Total Amount: $448,547
Investigator: James Carter, James_Carter@eeg-inc.com
Company: Environmental Engineering Group, Incorporated
11020 Solway School Road
Knoxville, TN 37931
Phone: (423)927-3717

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project has as the primary focus the development and commercialization of a novel microsensor for the in-situ, real-time detection of toxic organic chemicals. The proposed microsensor will be capable of operating under field conditions, with sufficient sensitivity to permit high detection rates, and with sufficient selectivity to prevent high false alarm rates. Using a revolutionary photo-thermal concept, the detector will operate with both high chemical selectivity and a less than parts per billion sensitivity. The technological concept of the proposed detector (CalSpec) won the 1998 R&D 100 award. The chemical sensitivity can be substantially enhanced to a less than parts per trillion level by simply operating in an integrating chemical detection mode.

The objective of this research is to demonstrate highly specific, sensitive and selective detection of organic chemical compounds and to develop a multichemical detector which can detect toxic organics with concentrations varying from a few parts per thousand to a few parts per trillion. Sensitive monitoring and detection is an area of continuing importance to EPA, DOD, DOE and other federal agencies. The CalSpec detector could be used in a variety of applications, including process monitoring and control, environmental compliance (including emissions monitoring), ambient air monitoring, airport security, personal dosimeters for toxic gases or metal vapor, and smoke and fire constituent detection.

Title: SBIR Phase II: Disposable Infrared Water Vapor Sensor

Award Number: 9983307
Program Manager: Winslow L. Sargeant

Start Date: May 15, 2000
Expires: April 30, 2003
Total Amount: $749,890

Investigator: Edward Johnson, ejohnson@ion-optics.com
Company: Ion Optics, Inc.
411 Waverly Oaks Road, Suite 144
Waltham, MA 02154
Phone: (617)788-8777

Abstract:

This Small Business Innovation Research Phase II project will develop a prototype instrument ready for field-testing. Phase I research demonstrated the feasibility of a radically simpler infrared gas sensor based on MEMS photonic bandgap structures. This instrument will sensitive enough to compete with water vapor measurements made by much larger, more complex equipment, but cheap enough to be treated as a 'throw-away' device. Unlike current infrared instruments, assembled from many discrete components, it features a highly integrated 'sensor-on-a-chip' employing advanced surface modification technology and semiconductor fabrication methods. This new, integrated approach replaces discrete-component instruments in much the same way integrated circuits have superseded distributed elements in electronic systems. In addition to the potential for atmospheric research applications, the proposed device is a stepping-stone to next-generation gas sensors for environmental and industrial monitoring. The phase I project showed proof-of-concept while establishing sensitivity and signal-to-noise performance and developed drive circuits and other components to achieve necessary stability. Most important, this project achieved a breakthrough by demonstrating tunable, narrow-band, emission from a photonic bandgap surface structure.

The proposed device is a simple, low-cost, lightweight alternative to conventional infrared absorption instruments. By reducing weight, complexity, and cost, it opens applications beyond the reach of current infrared instruments. It is the first step towards next-generation gas sensors for indoor air quality, environmental research, and industrial controls.

Title: SBIR Phase II: Advanced Micro-Pixelized Scintillator for Structural Biology

Award Number: 9983337
Program Manager: Om P. Sahai

Start Date: June 1, 2000
Expires: May 31, 2003
Total Amount: $550,000

Investigator: Vivek Nagarkar, vnagarkar@rmdinc.com
Company: Radiation Monitoring Devices Inc
44 Hunt Street
Watertown, MA 02472
Phone: (617)926-1167

Abstract:

This Small Business Innovation Research Phase II project is aimed at developing a novel digital x-ray detector for macromolecular crystallography. This detector is based on a new generation micro-pixelized scintillator optically coupled to a large area digital readout array. The micro-pixelized scintillator will provide a unique combination of very high sensitivity, spatial resolution, and signal to noise ratios resulting in excellent point spread function (PSF), thus improving the quality of the measured Bragg peak data.

When integrated with a large area digital optical detector it will allow a wide dynamic range and substantially enhanced throughput at relatively low costs. In addition to the structural biology application, the proposed detector would find widespread use in instrumentation wherever high-resolution x-ray imaging is used.

Title: SBIR Phase II: Integration and Distribution of Low-Jitter On-Chip Clock for High-Speed Analog-to-Digital Converters

Award Number:	9983361
Program Manager:	Winslow L. Sargeant
Start Date:	April 1, 2000
Expires:	September 30, 2003
Total Amount:	$645,271

Investigator: Deepnarayan Gupta, gupta@hypres.com
Company: HYPRES, Inc.
175 Clearbrook Road
Elmsford, NY 10523
Phone: (914)592-1190

Abstract:

This Small Business Innovation Research Phase II project aims to integrate two superconducting technologies (rapid-single-flux-quantum (RSFQ) and long-Josephson junction (LJJ)) to build a wide-bandwidth digitizer with on-chip clocking. The performance of a Flash analog-to-digital converter (ADC) can be enhanced by replacing the external high-frequency clock generator with an on-chip clock with very low timing jitter. In Phase I, we demonstrated an on-chip 10-50 GHz RSFQ clock source using an LJJ resonator with a quality factor of 106. We also built a clock selector circuit that allows the user to select different clock frequencies. We also implemented ballistic transport of SFQ pulses on impedance-matched striplines. In Phase II, we will integrate the high-quality LJJ oscillator along with associated circuitry with a Flash ADC through a hybrid stripline/JTL (Josephson transmission line) clock distribution network. A phase-locked loop (PLL) will be built to synchronize the LJJ oscillator with an external stable low-frequency reference to ensure long-term stability. The LJJ oscillator together with the PLL will constitute a self contained clock module capable of generating 10-100 GHz SFQ clock with femtosecond time jitter. This universal clock module can be used in almost all future superconducting electronic circuits and systems. A transient digitizer instrument capable of sampling rates above 10 GSamples/s is not commercially available today, in spite of a growing demand in fields such as inertial confinement fusion and high-energy physics. HYPRES is developing such an instrument focusing on the $630M/year market for digitizer instruments. Elimination of expensive multi-GHz external clock generators will simplify the digitizer design, lower power consumption, simplify packaging and reduce its cost. Other applications of a wideband ADC include communication signal processors and microscan receivers. A by-product of the Phase II work will be a self-contained multi-GHz clock module that can be used as on-chip clock for a variety of superconducting circuits, including processors for a petaflops-scale supercomputer currently being developed.

The LJJ oscillator coupled with the fluxon sender circuit, developed in Phase I, can be used for building instantaneous clock recovery and data re-timing circuits for handling burst-mode data in data communication networks.

Title: SBIR Phase II: A Self-Triggered Pulse Acquisition System with Greater than 10 GHz Bandwidth

Award Number:	9983345
Program Manager:	Winslow L. Sargeant
Start Date:	April 15, 2000
Expires:	March 31, 2002
Total Amount:	$400,000

Investigator: Steven Kaplan, steve.kaplan@hypres.com
Company: HYPRES, Inc.
175 Clearbrook Road
Elmsford, NY 10523
Phone: (914)592-1190

Abstract

This Small Business Innovation Research Phase II project will result in a demonstration of a self-triggered transient digitizer chip containing a flash analog-to-digital converter (ADC) and advanced triggering circuits. The self-triggering circuit designed during Phase I will be improved such that an arbitrary delay can be imposed. This will enable parts of single-shot signals occurring before the triggering point to be captured. The advanced comparator work begun in Phase I will be completed in Phase II to result in an error-correcting comparator with sub-picosecond accuracy. The resulting self-triggering transient digitizer chip will be able to trigger either by the signal itself, or an externally supplied trigger pulse. This generalization of our previous transient digitizer chip, together with the advanced architecture developed under other programs, will operate with greater than 10 GHz input bandwidth, and at a sampling rate of up to 20 GSa/s. The Tektronix SCD-5000 transient digitizer provided the highest bandwidth and performance of any digitizer based on an analog-to-digital converter.

The removal of this product from the market provides a significant business opportunity. Potential customers from the National Ignition Facility and the Relativistic Heavy Ion Accelerator at Brookhaven National Laboratory have expressed interest in our potential product

Title: SBIR Phase II: Wireless Acoustic Emission Technology (AET) Sensor System for Quantitative Nondestructive Evaluation and In Situ Testing of Prestressed Concrete Cylinder Pipe

Award Number:	9984235
Program Manager:	Winslow L. Sargeant
Start Date:	March 15, 2000
Expires:	February 28, 2002
Total Amount:	$398,328

Investigator: Will Worthington, will@pipetech.com
Company: Pipeline Technologies, Inc.
1435 North Hayden Road
Scottsdale, AZ 85257
Phone: (602)990-2466

Abstract:

This Small Business Innovation Research Phase II Project will further develop the passive acoustic system to non-destructively pressure test concrete water pipelines. It will locate points of structural weakness in these water pipes to permit reinforcement, and in so doing it will avoid the costs and consequences of catastrophic ruptures. The established goals of the project include: (1) Autonomous Hydrophone System Enhancement - The AH-3 acoustic test system developed and demonstrated during Phase I will be enhanced to incorporate those improvements that will make the system commercially viable; (2) Pipeline Distress Research - The characteristics of concrete pressure water pipe deterioration will be replicated under field conditions in cooperation with one of the major pipe manufacturers. This will provide greater insight into the process of pipe deterioration as well as providing a proving ground for the field testing of the acoustic system; (3) Commercial Feasibility - The research has the potential to greatly prolong the useful life and reliability of the $40 billion U.S. water pipeline infrastructure.

PTI has seen significant growth in revenue fueled in part by commercial acceptance of its early technology.

Title: SBIR Phase II: Development of Self-Sensing Active Control Foil Bearing

Award Number: 9986107
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2000
Expires: July 31, 2002
Total Amount: $385,466

Investigator: Lei Wang, lwang@bcea.com
Company: B&C Engineering Associates, Inc.
411 Wolf Ledges Parkway, Ste 104
Akron, OH 44311
Phone: (330)375-1632

Abstract:

This Small Business Innovation and Research (SBIR) Phase II project will develop a 'Self-Sensing Active Control Foil Bearing' (SSACFB). Through the use of a stack of piezoelectric ceramic elements attached at the lower side of foil elements, the load on the foil element can be determined from the voltage generated by the piezoelectric elements. At the same time, the piezoelectric stack also acts as an actuator to push/pull the foil element from the shaft to increase the loading capacity of the bearing and/or to ensure lift-off at low shaft rotational speeds. The novelty of the concept is in elimination of the sensing system, the integration of sensing and control in a single unit, and the active control of the bearing to provide long-life, lower power loss, and larger loading capacity. In addition, elastic bed and diamond-like coatings on the foil element will be addressed in this proposal. Phase I found the self-sensing and controllability in this bearing to be feasible. Construction and testing of a fully instrumented, prototype self-sensing controllable foil bearing will be performed in Phase II. Potential commercial applications are planned in the $1.5 billion bearing market, which is growing presently at about 11% annually with moderate growth forecasted in the future.

The SSACFB technology is aimed at commercial needs for oilless high-speed controllable bearings. Successful development of SSACFB will impact high speed bearing applications, especially in the aerospace/aeronautic and other high speed precision manufacturing industries.

Title: SBIR Phase II: Improvement of Spatial Resolution in Scanning Microwave Microscopy

Award Number: 0078486
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $396,537

Investigator: Andrew Schwartz, Schwartz@neocera.com
Company: Neocera, Inc.
10000 Virginia Manor Rd, Ste 300
Beltsville, MD 20705
Phone: (301)210-1010

Abstract:

This Small Business Innovation Research (SBIR)Phase II project focuses on the improvement of spatial resolution in microwave microscopy, reducing in particular the measurement sampling area over which sheet resistance and dielectric permittivity at 1 GHz - 20 GHz can be determined with numerical accuracy. A particular focus will be on proprietary semiconductor applications and on the imaging of dielectric properties. Modifications of the existing prototype as required for this goal will lead to additional applications in fields of economic and academic importance, including the non-contact measurement of the electric field dependence and the frequency dependence of the dielectric permittivity at microwave frequencies. Work at Neocera will include instrument modifications, test sample preparation, and a thorough analysis of the probe-sample interactions. Numerical simulations, semiconductor sample preparation, and comparison to an instrument based on a different feedback mechanism will be performed through a subcontract with the University of Maryland.

The result of this Phase II SBIR will be an instrument developed for a particular (proprietary) semiconductor application, leading to a multi-million dollar market. In addition, the technology will be available for various research applications, with universities being potential customers

Title: SBIR Phase II: Advanced Positron Beam Source

Award Number: 0078468
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2000
Expires: March 31, 2004
Total Amount: $588,491

Investigator: Rod Greaves, greaves@firstpsi.com
Company: First Point Scientific, Inc.
5330 Derry Avenue, Suite J
Agoura Hills, CA 91301
Phone: (818)707-1131

Abstract:

This Small Business Innovation Research Phase II project will develop and demonstrate a laboratory prototype of the Advanced Positron Beam Source (APBS) that will provide a high quality pulsed positron beam suitable for a range of analytical instruments for materials science. The project extends the latest developments in techniques to accumulate positrons from a radioactive source in Penning traps. The technical objectives of the Phase I project were fully achieved. The technical objectives of Phase II are: (1) to develop a compact, low-cost, two-stage positron trap; (2) to develop an advanced cryogenic positron moderator system; (3) to develop a high- performance positron buncher; (4) to refine the Phase I approach for extracting positrons from the magnetic field of the trap; and (5) to assemble and demonstrate the APBS system. If successful, this project will provide the basis for commercialization of the APBS in Phase III.

A major obstacle to the commercial exploitation of positron-based surface analytical techniques has been the lack of a suitable slow positron beam source. The APBS will fill this need by providing a compact, low-cost, user-friendly positron beam source that can function ultimately as a turnkey system in an industrial environment. The APBS will have advanced performance characteristics that are not available from any other system.

Title: SBIR Phase II: Cavity Ringdown Evanescent Wave Fiber Optic Sensor

Award Number: 0078367
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $399,352

Investigator: Anthony O'Keefe, aoklgr@ix.netcom.com
Company: Los Gatos Research
67 East Evelyn Avenue, Suite 3
Mountain View, CA 94041
Phone: (415)965-7772

Abstract:

This Small Business Innovation Research Phase II project plans to develop a new fiber based chemical sensor technology that can be used to make rapid trace chemical analysis of gaseous and liquid environments without the need for time consuming sample extraction and preparation. This new miniature sensing technology will combine aspects of fiber optics, enhanced absorption analysis techniques, and ultimately wireless internet communications. This technology will provide commercial and government users a chemical monitoring system which can be inexpensively networked over wide areas. Such a network of sensors can be monitored in real time from any secured computer via the Internet, providing real time information relating to chemical processing and transport, as well as for the monitoring of leaks and hazardous accidents. Such a system could be used as a warning network for large plant facilities and neighborhoods.

This technology is being developed for commercial application in several areas in collaboration with an established fiber sensor supplier for trace detection of chemicals around storage facilities and industrial facilities.

Title: SBIR Phase II: Sol-Gel Processed Thin-Film Nitrogen Oxides Sensors

Award Number: 0078730
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2000
Expires: July 31, 2002
Total Amount: $400,000

Investigator: Ayyasamy Aruchamy, amsen@mindspring.com
Company: Amsen Technologies
1684 South Research Loop
Tucson, AZ 85710
Phone: (520)546-6944

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop thin-film nitrogen oxide sensors based on novel binary-phased nanocomposites by sol-gel processing. Sol-gel processing offers many advantages for sensor fabrication, including facility and versatility for nano-engineering of the microstructure. In Phase I, such sensor elements have shown much improved microstructure, enhanced sensitivity, and faster response speed than powder-derived sensor elements of the same composition by conventional processing. Thin-film sensors can be readily incorporated with silicon microelectronic technology and conveniently allow miniaturization, low process costs, and high reproducibility. Phase II will systematically optimize the processing, microstructure, and performance of the binary-phased thin-film nitrogen oxides sensors by sol-gel processing.

Potential commercial applications of the research are expected in reliable, compact solid-state chemical sensors. This innovation is expected to provide highly stable and sensitive thin-film nitrogen oxides sensors for automotive emission control, industrial processing control, and environmental monitoring. These sensors may be used as stand-alone sensing devices or as sensing units to be integrated into on-chip multifunctional sensors and smart structures

Title: SBIR Phase II: Enhanced Phase Sensitive Spectroscopy Using Matched Gratings

Award Number: 0233846 (Formerly 0078887)
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2000
Expires: July 31, 2002
Total Amount: $399,387

Investigator: Rand Swanson, swanson@resonon.com
Company: Resonon Inc.
611 N. Wallace Avenue, Suite 7
Bozeman, MT 59715
Phone: (406)586-3356

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a trace-gas detection system based on a novel laser spectroscopic technique called Phase Sensitive Spectroscopy. This new spectroscopy technique may increase sensitivity by an order of magnitude compared to existing capabilities, and it is expected have lower capital and operating costs as well. The proposed technique relies on measurements of phase shifts of an amplitude modulated laser beam that occur when the laser is tune through a molecular resonance. Unlike current technologies, the measured quantity is insensitive to variations in the amplitude of the frequency components within the modulated laser beam. This fundamental difference promises to eliminate the need for calibrations that are currently required. Phase II will develop the fundamental understanding and lay the groundwork for commercialization. A prototype instrument will be fabricated by utilizing the 'backbone' of an existing commercially successful laser based trace-gas detector. The detection limit, stability, and cost of the prototype instrument will be characterized.

Potential commercial applications are expected in monitoring gases in aluminum production and in other industries as environmental regulation and work place safety may require. Point source monitoring.

Title: SBIR Phase II: A Large Mosaic Liquid Crystal Fabry-Perot Etalon for Atmospheric Sensing

Award Number: 0079163
Program Manager: Winslow L. Sargeant

Start Date: January 1, 2001
Expires: December 31, 2002
Total Amount: $397,788

Investigator: Robert Kerr, kerr@sci-sol.com
Company: Scientific Solutions Incorporated
55 Middlesex Street
North Chelmsford, MA 01863
Phone: (978)251-4554

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the traditional size limit of the Fabry-Perot interferometer (FPI) input aperture. This limit (approximately 8-inches) is imposed by (1) practical fabrication limits to the size of glass flats that can be polished to a surface figure of lambda/100 and (2) by cost limitations. Although an array of smaller glass plates might be used to expand the collecting area of the FPI, coordination of spectral scans over the array elements requires unwieldy control systems or else is not possible with conventional barometric or piezo-electric FRI systems. This research establishes arrays of innovative FPI etalons that use liquid crystal (LC) in the FPI resonant cavity. Spectral scanning of these devices is accomplished by application of a low current to conducting layers applied to the glass substrates. The electric field imposed upon liquid crystal in the resonant cavity alters the orientation of the LC, and thus the index of refraction of the material in the resonant cavity. The ease of electronic control over the refractive index in the FPI cavity permits simple, low weight, low power coordination of multiple LC filled cells and thus makes possible a large array of FPI cells, scanning a spectrum in unison.

Phase II will design and fabricate two 10-inch diameter arrays of LC FPI (LCFP) filters. One array will be configured for Doppler measurements of atmospheric emissions and the other for 0.16-nanometer spectral resolution. Potential commercial applications are expected in (1) atmospheric lidar, (2) space-based environmental sensing, (3) passive airglow sensing, (4) clear-air turbulence detection, and (5) target detection.

Title: SBIR Phase II: Rapid Detection of Cyanide

Award Number: 0078718
Program Manager: Winslow L. Sargeant

Start Date: July 15, 2000
Expires: December 31, 2002
Total Amount: $400,000
Investigator: Eugene L. Watson, ewatson@wyoming.com
Company: CC Technology
PO Box 610
Laramie, WY 82073
Phone: (307)745-9148

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will result in the development of two detection systems utilizing Surface Enhanced Raman Spectroscopy (SERS) capable of rapidly measuring the concentration of cyanide, a highly toxic substance used in large quantities in the extractive metals industry. A portable system will be well suited for use in the field for on-site measurements of cyanide for environmental compliance monitoring. An automated system will be useful for the measurement of cyanide levels in process control of precious metal extractive processes, and in monitoring wells for environmental compliance. Current methods of cyanide analysis give either the total amount of cyanide present in all forms, or that of free cyanide in combination with cyanide in weak acid dissociable (WAD) metal complexes. Our method of cyanide determination will be markedly superior to these methods because it will yield the concentration of free cyanide in addition to that of WAD cyanide.

This has very important practical and economic implications for the precious metals extractive industries (e.g., gold and silver mining), since it is free cyanide which is of importance in optimizing metal extraction efficiency, and it is free cyanide which is the species of primary interest from an environmental regulatory standpoint.

Title: SBIR/STTR Phase II: Microchip-Laser-Based Optical Alloy Analysis Instrument

Award Number: 0216309
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,957

Investigator: Joda C. Wormhoudt, jody@aerodyne.com
Company: Aerodyne Research Inc.
45 Manning Road
Billerica, MA 01821-3934
Phone: (508)663-9500

Abstract:

This Small Business Innovation Research (SBIR) Phase II project concerns the development of an optical alloy composition sensor based on laser induced plasma spectroscopy. A key element of the sensor is the use of a microchip laser excitation source. The technology has the capability to detect industrially relevant compositions in steel alloys and possibly aluminum alloys. The Phase I results indicated the efficacy of the technique for the analysis of iron alloys. The Phase II project will focus on the development of a small, lightweight and mobile field prototype, which will be able to analyze various alloy samples.

The key commercial application of this technology is aluminum and iron scrap metal analysis, substantial market niches which are not effectively covered by existing analysis technology. The major market is for steel and aluminum alloys that have significant components of light elements. These precision instrument currents have sales worldwide in excess of $10 million per year.

Title: SBIR Phase II: Enhanced Phase Sensitive Spectroscopy Using Matched Gratings

Award Number: 0233846
Program Manager: Winslow L. Sargeant

Start Date: June 30, 2002
Expires: July 31, 2003
Total Amount: $59909

Investigator: Rand Swanson, swanson@resonon.com
Company: Resonon
611 North Wallace
Bozeman, MT 59715-3082
Phone: (406)586-3356

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a trace-gas detection system based on a novel laser spectroscopic technique called Phase Sensitive Spectroscopy. This new spectroscopy technique may increase sensitivity by an order of magnitude compared to existing capabilities, and it is expected have lower capital and operating costs as well. The proposed technique relies on measurements of phase shifts of an amplitude modulated laser beam that occur when the laser is tune through a molecular resonance. Unlike current technologies, the measured quantity is insensitive to variations in the amplitude of the frequency components within the modulated laser beam. This fundamental difference promises to eliminate the need for calibrations that are currently required. Phase II will develop the fundamental understanding and lay the groundwork for commercialization. A prototype instrument will be fabricated by utilizing the 'backbone' of an existing commercially successful laser based trace-gas detector. The detection limit, stability, and cost of the prototype instrument will be characterized.

Potential commercial applications are expected in monitoring gases in aluminum production and in other industries as environmental regulation and work place safety may require point source monitoring.

Title: STTR Phase II: Low Cost, Nano-Crystalline Sensors, for Real-Time Monitoring of Carbon Monoxide and Volatile Organic Compounds

Award Number: 0091388
Program Manager: Winslow L. Sargeant

Start Date: March 1, 2001
Expires: February 28, 2003
Total Amount: $492,908

Investigator: Nicholas J. Smilanich, Nsmilanich@aol.com
Company: Sensor Development Corp.
3449 Delmar Drive
Rocky River, OH 44116
Phone: 440/895-9520

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop a fully functional, cost-effective, prototype sensor for carbon monoxide and volatile organic contaminants in air. Phase I results suggest that a sensor array based on catalyst-doped, nano-crystalline metal oxide films will provide a marked improvement in detection of contaminants, such as formaldehyde, and thereby upgrade control of indoor air quality. Phase II will develop this sensor technology with objectives of long-term use, low cost, high sensitivity, and sufficient selectivity for commercial applications.

These applications include indoor air quality monitoring, environmental air monitoring, oil referencing, chemical manufacturing, automotive emission control systems, and industrial process.

Title: SBIR Phase II: An Imaging Sensor for Measuring and Controlling the Particle Conditions in Thermal Sprays

Award Number: 0091451
Program Manager: Winslow L. Sargeant

Start Date: January 15, 2001
Expires: September 30, 2003
Total Amount: $484,747

Investigator: James E. Craig, Info@stratonics.com
Company: Stratonics Inc
23151 Verdugo Drive Ste 114
Laguna Hills, CA 92653-1340
Phone: (949)461-7060

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a short-exposure imaging sensor for measuring and controlling particle temperature and velocity of thermal sprays. Thermal spray is a rapidly growing element of the metals processing industry, which needs process control. Currently, there are no direct particle condition controls, for lack of a sensor to provide real-time measurements. This imaging sensor technology will continuously view the entire particle stream, utilize the entire emission across the spectral range of the sensor, and employ fast image processing algorithms to obtain on-line measurements. Phase II will develop a sensor response model, hardware and software design, and prototype sensors will be constructed and calibration tested. These sensors will be incorporated in process control systems and operated in an industrial environment.

Thermal spray technology is changing and improving the way high quality metal parts are manufactured for the automotive, aerospace, energy, and heavy equipment industries. Sensor and thermal spray controls will provide new levels of cost efficiency and consistency to challenges in material processing, namely thermal, wear and corrosion, by coating the surface with metals and ceramics.

Title: SBIR Phase II: Novel Ultrasensitive Gas Chromatography (GC) Detector with Highly Specific Response to Aromatic Hydrocarbons

Award Number: 0238545
Program Manager: Winslow L. Sargeant

Start Date: January 1, 2003
Expires: December 31, 2004
Total Amount: $500,000

Investigator: Brian E. Very, bvery@dakotatechnologies.com
Company: Dakota Technologies, Inc.
2201A 12th Street North
Fargo, ND 58102-1808
Phone: (701)237-4908

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will advance commercialization of an aromatic-specific laser ionization detector (ArSLID). The photoionization detectors (PIDs) that are widely used as gas chromatography (GC) detectors and hand-held organic vapor analyzers form a natural basis of comparison for the ArSLID concept. The ArSLID uses a high repetition rate pulsed laser instead of a vacuum ultraviolet lamp to create molecular ions. The prototype ArSLID built and tested in Phase I is approximately 10-times more sensitive, has ten-times shorter response time, and is several orders of magnitude more selective toward aromatic hydrocarbons than any commercially available PID. The linear dynamic range is at least 5 orders-of-magnitude. The ArSLID is also immune from interferences by water vapor or oxygen. Technical improvements planned for Phase II include improving the resolution by 4 bits and correction for variations in the laser pulse repetition frequency. Features will be added to facilitate easy integration of the ArSLID with existing GCs. Another focus of Phase II will be applications development to show the versatility and value of ArSLID. The Phase I work, which emphasized GC detection, will be expanded to HPLC detection, which opens up tremendous opportunities in the Life Sciences.

The aromatic-specific detector will find a wide range of applications as the detector for gas chromatography, high performance liquid chromatography (HPLC), general vapor monitoring, and specialized environmental techniques. Of these, the HPLC detector has the greatest commercial potential as a highly sensitive, low cost alternative the liquid chromatography-mass spectrometer.

Title: SBIR Phase II: Nonintrusive Species Specific Velocimeter

Award Number: 0215930
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $499,930
Investigator: Allen Flusberg, allen.flusberg.@srl.com
Company: Science Research Lab Inc
15 Ward Street
Somerville, MA 02143
Phone: (617)547-1122

Abstract:

This Small Business Innovation Research Phase II project will develop a passive, nonintrusive species-specific velocimeter (SSV) that simultaneously measures spatially resolved velocities of multiple species in a flame, sorting the information by species and spatial scale size. The SSV will be geared to spatially resolve the mixing and chemical dynamics occurring within flames, and to track these effects in real time. No instruments are available that can make such measurements passively and non-invasively in a compact geometry. The SSV will play a critical role in a novel deposition process, combustion chemical vapor deposition (CCVD). CCVD is a continuous open-air deposition process that is targeting a wide spectrum of thin-film-coating markets, including electronics, glass, anti-corrosives, superconductors, catalytics, polymers, and nanopowders. Phase 1 demonstrated feasibility by measuring spatially resolved, species-specific CCVD flame velocities on different spatial scales. Phase 2 will be a proof-of-principal program to (1) construct an engineering prototype, (2) demonstrate the correlation between SSV data and bottom-line CCVD film properties, and (3) design an SSV-based CCVD controller that can be fabricated economically and commercialized in a privately funded This technology will facilitate smart deposition that streamlines the reliability of CCVD. Incorporated into a CCVD system, the SSV will become the central element of a feedback control module that maintains the consistency of the flame and maximizes deposition efficiency.

The commercial market for this technology generates about $50 million annually. This project addresses the interest in advanced control techniques for manufacturing. It supports the development of improved and more reliable coatings that will enhance technology and lower the cost of many common products, e.g. electronic memory devices in computers, appliances, and automobiles.

Title: SBIR Phase II: Nonintrusive Diode Laser Sensor for Bottled Drugs

Award Number: 0215797
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $500,000

Investigator: Mark E. Paige, mpaige@swsciences.com
Company: Southwest Sciences Inc
1570 Pacheco Street
Santa Fe, NM 87505-3993
Phone: (505)984-1322

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is designed to develop a nonintrusive diode laser sensor for detecting oxygen in the headspace of pharmaceutical vials. Many drugs are oxygen sensitive and must be bottled in an oxygen free environment. There are no nonintrusive methods available to measure residual oxygen levels in sealed product vials. A nonintrusive sensor would generate large cost savings for pharmaceutical manufacturers. During the Phase II project, a prototype off-line instrument will be constructed. This instrument will be tested at pharmaceutical manufacturing facilities. In addition if time permits, on-line experimental measurements will be performed.

In addition to being useful for the pharmaceutical industry, this technology will be extendable to a variety of packaged products in other industries. These industries include the food, alcoholic beverage, and medical instrument markets. This technology can also be used to detect other species in packaged products such as water vapor or carbon dioxide.

Title: SBIR Phase II: Revitalizing Spectrofluorimeters with Cryogenic Fiber Optic Probes, Fluorescence Lifetime Capability, and Tunable Laser Sources

Award Number: 0110432
Program Manager: Winslow L. Sargeant

Start Date: November 15, 2001
Expires: October 31, 2003
Total Amount: $500,000

Investigator: Gregory D. Gillispie, gillispie@dakotatechnologies.com
Company: Dakota Technologies, Inc.
2201A 12th Street North
Fargo, ND 581021808
Phone: (701)237-4908

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new instrumentation for fluorescence and phosphorescence spectral measurements. Phase I produced a customized spectrofluorimeter equipped with a tunable laser source, fluorescence lifetime capability, and fiber optic probe for cryogenic measurements. However, better methods are needed to analyze benzo[c] fluorene, which researchers now believe may be an environmental concern comparable to benzo [a] pyrene. Phase II will develop an upgraded new instrument, capable of retrofitting the low temperature probe, fluorescence lifetime, and tunable laser capabilities onto laboratory spectrofluorimeters. The emission monochromator, photomultiplier tube detector, and control/analysis computer can be retained from the spectrofluorimeter, and none of its functionality will be lost. Phase II is expected to produce several models of commercial spectrofluorimeters, test data for publication in technical journals and trade magazines, and instrument upgrade options as a commercial service.

The market for these upgrades presently has an estimated 30,000-40,000 spectrofluorimeters in service. An additional 4,000 individuals or institutions purchase new units each year. The new instrument upgrades will be used in research and development, analytical services, quality control, environmental studies and surveys, and teaching and other applications.

Title: STTR Phase II: Development of an Autonomous Equilibrating pCO2 Sensor

Award Number: 0110500
Program Manager: Winslow L. Sargeant

Start Date: November 15, 2001
Expires: October 31, 2003
Total Amount: $495,996

Investigator: Regis Cook, regis_cook@compuserve.com
Company: General Oceanics Inc
1295 NW 163 St
Miami, FL 33169-5830

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and test an autonomous, low cost, robust, precise, and miniaturized partial and total carbon dioxide measurement system. This system will be able to characterize the carbon dioxide exchange between ocean surface waters and the atmosphere, thus helping to analyze the "greenhouse effect" and assess global warming on a worldwide basis. The partial and total carbon dioxide systems are miniaturized for deployment by the International SeaKeepers Society in ocean and atmospheric monitoring modules on cargo ships, cruise ships, and super yachts around the world as well as for use on piers, ocean buoys, and other platforms. The prototype partial carbon dioxide system, developed in Phase I, measures carbon dioxide in seawater that has been equilibrated with air using an infrared detector. It is sensitive to five parts per million and responds to rapid changes in carbon dioxide. The prototype miniaturized total carbon dioxide system has a precision of three parts per million. Phase II will miniaturize and test both systems in the laboratory and in the field. Based on these tests and any modifications required, final commercial partial and total carbon dioxide measurement systems will be produced.

The International SeaKeepers Society is expected to deploy hundreds of these carbon dioxide sensor systems. Other purchasers would include government agencies worldwide performing research and monitoring on the global warming phenomenon.

Title: SBIR Phase II: Active Control of Gas Turbine Engines Using Eddy Current Sensors

Award Number: 0110316
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2001
Expires: October 31, 2003
Total Amount: $500,000

Investigator: Carole A. Teolis, carole@technosci.com
Company: Techno-Sciences
10001 Derekwood Lane Ste 204
Lanham-Seabrook, MD 20706
Phone: (301)577-6000

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and test algorithms for active control of blade vibration and engine stability (stall and surge) using an eddy current sensor (ECS) array. The approach utilizes signal analysis and diagnostic tools in active control algorithms for the detection of engine faults. Phase II will extend the functionality of the ECS system beyond diagnostics to active and automatic real-time control of gas turbine engines.

An ECS array is currently the favored sensor system for installation on the Joint Strike Fighter, in which a software system upgrade capable of using ECS data to compute the necessary indicators and estimate the disturbances needed, is desirable for active vibration and engine stability control. It would reduce the number of new sensors needed for active control and potentially save millions of dollars. Large commercial markets are indicated in commercial aircraft and gas turbine power plants.

Title: SBIR Phase II: Innovation of Real-Time, Integrative Computer Vision System for Accurate, Full-Field Characterization of Complex Component Response

Award Number: 0091520
Program Manager: Winslow L. Sargeant

Start Date: July 1, 2001
Expires: June 30, 2004
Total Amount: $500,000
Investigator: Scott J. Echerer, echerer@alphamfg.com
Company: Alpha Mfg.
100 Old Barnwell Road
West Columbia, SC 29170
Phone: (803)739-4500

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will advance full-field, three-dimensional image correlation measurement technology to a level far beyond the current state-of-the-art. The research will produce a prototype commercial measurement system that will present a cost effective solution to a wide range of deformation measurement problems. The four areas of research for this project are: system calibration, algorithm development, distributed computing and system validation. The completion of this project will result in an easy-to-use, real-time measurement system applicable to a wide range of size scales with high accuracy and a known level of uncertainty.

The unique ability to simultaneously measure surface shape, displacement and strain with high accuracy meets industrial measurement demands in many areas. The method is ideally suited for structural evaluation, computer model verification, non-destructive testing, material property measurement and shape measurement. Among others, the technology has applications in the following industries: automotive industry, commercial aviation manufacturers, space vehicle manufacturers, academic research institutions, government laboratories, and the biomedical and electronic packaging industry.

Title: STTR Phase II: Long-Gage Fiber Bragg Sensors for Structural Health Monitoring and Damage Identification

Award Number: 0131967
Program Manager: Winslow L. Sargeant

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $499,349
Investigator: Sean G. Calvert, sean@bluerr.com
Company: Blue Road Research
Clear Creek Business Park
Gresham, OR 97030
Phone: (503)667-7772

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will further explore the use of long-gage fiber Bragg grating strain sensors in conjunction with vibration-based system identification techniques for health monitoring and damage identification of civil structures. In phase I, the proof of concept was shown based on static and dynamic laboratory experiments on small-scale structural models. In this Phase II effort, field tests on bridges identified in Oregon and California will be performed to further validate this very promising tool for structural health monitoring and damage identification. These bridges provide unique opportunities as two of them are scheduled for demolition and both State Departments of Transportation have agreed to support testing as these bridges are systematically damaged to provide a true real-world test of the damage identification system. These field tests will be an important step in providing feasibility data for future commercialization of the structural health monitoring and damage identification system. Once the proposed methods are debugged and validated for s, the California and Oregon DOT's will strongly consider adopting them for widespread use in their structural health-monitoring and bridge rehabilitation programs.

The proposed structural health monitoring and damage identification system offers very promising advanced solutions to the triple problem of: (1) monitoring the state-of-health of the civil infrastructure system for optimum allocation of rehabilitation resources, (2) optimally designing the rehabilitation scheme for a specific deficient civil structure, and (3) evaluating the efficacy of the rehabilitation measure.

Title: SBIR Phase II: Development of a Dynamic, High-Resolution Volumetric Dilatometer

Award Number: 0321272
Program Manager: Winslow L. Sargeant

Start Date: February 1, 2003
Expires: July 31, 2003
Total Amount: $275,000

Investigator: Sean M. Christian, schristian@stellarnet.us
Company: StellarNet
13801 McCormick Drive
Tampa, FL 33626-3017
Phone: (813)855-8687

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop innovations pertaining to optrodes (optical sensors) and electro-optical instrumentation for advanced material characterization. Specifically, this project will develop the first commercially available high-resolution volumetric dilatometer. In addition, the innovations will allow for: (1) a linear dilatometer that possesses a resolution that is 2-3 orders of magnitude better than its conventional linear counterparts; (2) an optical control system for micro-translation stages; (3) an optrode for thin film characterization that possesses a linear resolution exceeding 1 nanometer; and (4) an ultra-fast, high-resolution spectrometer that will enable commercialization of three optical sensors (pressure, temperature, and load) suitable for harsh environments.

Potential commercial applications are expected in electronics and microelectronics manufacturing for dilatometry, thin films analysis, micro-translation stages, ultra-fast spectroscopy, and various optical sensors.

Title: SBIR Phase II: Micro Pulse Lidar for Water Vapor Profiling

Award Number: 0078664
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2001
Expires: May 31, 2004
Total Amount: $399,881

Investigator: Dave Shannon, dave.shannon@aculight.com
Company: Aculight Corporation
11805 North Creek Pkwy S.
Bothell, WA 980118803
Phone: (206)451-9558

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the need for a new generation of laser transmitters for differential absorption lidar (DIAL) measurements of water vapor. Phase II will develop a new laser technology for mini-DIAL measurements of water vapor. DIAL transmitter requirements will be achieved using a revolutionary technology that allows diffraction limited performance from diode bars. These ultra bright diode bars enable efficient end pumped, q-switched, low-gain, quasi-three level lasers. Recently, a laser material that operates directly at the 944.1 nanometer water vapor absorption line has become commercially available. Coupling these two technologies will result in an efficient compact DIAL transmitter. This technology will result in a new class of compact, efficient, and low-cost DIAL transmitters for atmospheric water vapor profiling.

Low cost DIAL transmitters are important for future improvements in weather forecasting, global climate models, and understanding of the transmission of communication signals in the atmosphere. In addition, potential commercial applications will be found in the medical and material processing industries.

Title: SBIR Phase II: Development of a Dynamic, High-Resolution Volumetric Dilatometer

Award Number: 0110317
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2001
Expires: May 31, 2003
Total Amount: $500,000
Investigator: Sean M. Christian, schristian@airak.com
Company: Airak, Inc.
9058 Euclid Avenue
Manassas, VA 20111-1053
Phone: (703)330-4961

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop innovations pertaining to optrodes (optical sensors) and electro-optical instrumentation for advanced material characterization. Specifically, this project will develop the first commercially available high-resolution volumetric dilatometer. In addition, the innovations will allow for: (1) a linear dilatometer that possesses a resolution that is 2-3 orders of magnitude better than its conventional linear counterparts; (2) an optical control system for micro-translation stages; (3) an optrode for thin film characterization that possesses a linear resolution exceeding 1 nanometer; and (4) an ultra-fast, high-resolution spectrometer that will enable commercialization of three optical sensors (pressure, temperature, and load) suitable for harsh environments.

Potential commercial applications are expected in electronics and microelectronics manufacturing for dilatometry, thin films analysis, micro-translation stages, ultra-fast spectroscopy, and various optical sensors.

Title: STTR Phase II: Integrated Water Quality Monitoring System

Award Number: 0091512
Program Manager: Winslow L. Sargeant

Start Date: February 1, 2001
Expires: January 31, 2003
Total Amount: $500,000
Investigator: Paul G. Duncan, pduncan@airak.com
Company: Airak, Inc.
9058 Euclid Avenue
Manassas, VA 20111-1053
Phone: 703/330-4961

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop optical sensors, called optrodes, and their systems for monitoring environmental water quality. Phase I research demonstrated the ability of optrodes to gather long-term environmental water quality data in harsh environments. Phase II technical issues are concerned with: (1) analyte specific probe chemistries; (2) optical coatings; and (3) optical configurations. With respect to systems, Phase I found lifetime phase-base measurement systems superior to traditional intensity-based systems. Phase II will develop an integrated phase-based analyzer capable of: (1) resolving dissolved oxygen, dissolved carbon dioxide, acidity, and temperature; and (2) transmission by remote data telemetry.

These innovations in optrode technology will: (1) improve mapping of geophysical fields; (2) substantially reduce direct labor costs associated with conventional monitoring technologies; (3) produce robust data for enhanced modeling capabilities; and (4) enable other technology for protecting natural resources.

Title: SBIR Phase II: Focused Beam Total X-Ray Fluorescence Analysis Using Doubly-Curved Crystals

Award Number: 0215914
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $499,864
Investigator: Zewu Chen, zchen@xos.com
Company: X-Ray Optical Systems, Inc
15 Tech Valley Drive
East Greenbush, NY 12061
Phone: (518)880-1500

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to meet the demand from the microelectronics industry for improved wafer contamination analysis. Wafer contamination control is critical for Ultra Large Scale Integrated (ULSI) technology and there is a strong demand for a non-destructive analytical tool with improved sensitivity and spatial resolution over the conventional total x-ray fluorescence (TXRF) method. A new technique, focused beam TXRF, can meet this important market need. Based on point-focusing toroidal crystal optics, focused beam TXRF will improve the spatial resolution by a factor of more than 100 and provide 30 times better detection sensitivity for local contaminants on Si as compared to the conventional TXRF method. This technique also has potential for low-level Al, Na and other low Z elements analysis on Si that cannot be addressed effectively by the conventional TXRF and other techniques. In this project, preliminary focused beam TXRF data will be collected using WL1 excitation provided by a toroidal Si (220) crystal to demonstrate the improvement of sensitivity and resolution for transition metal detection. Theoretical calculation will be also carried out to determine the feasibility for Al and Na detection for wafer contamination control at 10^ 9 to 10^10 atoms/cm^2 level.

Focused beam TXRF analysis has commercial applications in the microelectronics industry for wafer contamination control including localized and homogeneous contaminants with high resolution. These contaminants include many important elements such as transition metals, Al, Na and other low Z elements. By being able to identify these contaminants, the quality of silicon wafers can be improved. This will be a tremendous cost savings to a multi-billion dollar industry.

Title: SBIR Phase II: Non-Contact Measurement of Residual Strain in Composites

Award Number: 0110524
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2001
Expires: September 30, 2003
Total Amount: $499,978
Investigator: Stephanie A. Vierkotter, stephie.vierkotter@qm.com
Company: Quantum Magnetics, Inc.
7740 Kenamar Court
San Diego, CA 92121-2425
Phone: (858)566-9200

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a novel non-contact strain sensor for quality control in production of polymers and fiber-reinforced composites. By measuring residual strains, good parts can be distinguished from bad parts in the production stream. Internal and surface residual strains will be measured by a strain gauge based on the principle of nuclear quadrupole resonance (NQR). A small percentage of tiny additive crystals are blended into the resin during fabrication of the composite. For strain measurement, the composite is irradiated with radio frequencies (RF) to evoke a strain-dependent NQR response from the embedded crystals. Phase I manufactured parts with embedded additive via compression molding. Phase II will build a single-sided strain prototype and measure residual strains in pultruded parts. The NQR-active additive will be introduced into the pultrusion process, and several batches of different types of composites, e.g., fiberglass, will be manufactured. Pultrusion will permit several large batches of samples to obtain the statistics needed to obtain the NQR-based quality control method.

Potential commercial applications are expected in many industries, such as civil infrastructure, automotive, sporting goods, aerospace, and many others utilizing composite materials.

Title: STTR Phase II: Development of a Compact Cloud Spectrometer and Impactor

Award Number: 0110358
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2001
Expires: September 30, 2003
Total Amount: $460,945

Investigator: Gregory L. Kok, glkok@dropletmeasurement.com
Company: Droplet Measurement Technologies
2400 Central Ave Suite B2
Boulder, CO 80301
Phone: (303)44055

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop a compact cloud spectrometer and impactor (CSI) for the measurement and study of condensed water in the atmosphere. Condensed water includes cloud droplets and ice particles. Phase I demonstrated the feasibility of integrating a counterflow virtual impactor (CVI) for condensed water content (CWC) measurement together with a new forward scattering spectrometer system for measurement of the cloud droplet size distribution. This combined airborne instrument will be considerably lighter than previous versions of the two separate instruments, and easier to use. The objective of Phase II is a commercial, integrated instrument for the study of atmospheric condensed water content and droplet size distribution.

The accurate measurement of these parameters is important in weather prediction as well as understanding global climate change. This instrumentation will have worldwide application, and the users will be government, university, and commercial atmospheric research institutions.

Title: SBIR Phase II: Low-Cost, High-Efficiency Power Amplifiers for Magnetic-Resonance Imaging

Award Number: 0237474
Program Manager: Winslow L. Sargeant

Start Date: March 15, 2003
Expires: February 28, 2005
Total Amount: $500,000

Investigator: Frederick H. Raab, f.raab@ieee.org
Company: Green Mountain Radio Research Co.
50 Vermont Avenue
Colchester, VT 05446-3125
Phone: (802)655-9670

Abstract:

This Small Business Innovation Research Phase II will develop and test a prototype low-cost, high-efficiency transmitter for magnetic-resonance-imaging (MRI) systems. Existing MRI transmitters use conventional power amplifiers (PAs), which makes them inefficient and consequently large, heavy, and expensive. Phase I has demonstrated the feasibility of using developed high-efficiency amplification techniques to produce significantly more power from a given transistor, thus lowering the cost. Also demonstrated was the feasibility of using these amplifiers to produce the pulsed-RF signals used by MRI. Phase II will develop a prototype transmitter that combines high-efficiency power amplification with digital signal processing to provide both low cost and superior signal quality. This in turn will produce superior image quality, resulting in improved diagnostics. The transmitter will be organized into broadband RF-power modules that can be combined in building-block fashion to produce transmitters for different MRI applications. The prototype transmitter will be configured into a manufacture able form to facilitate transition to Phase-III commercialization. Finally, the prototype transmitter will be tested in an MRI system and images obtained will be compared to those obtained with a conventional transmitter.

The primary commercial application for the new transmitter is medical imaging. Every MRI system includes a high-power RF transmitter. The manufacturers of MRI systems purchase transmitters from smaller manufacturers. The RF transmitter is the most expensive subsystem, and keeping the cost down is of great interest. The building-block approach allows all market segments to be addressed, beginning with the lower-power "1-T" systems for specialized applications and moving subsequently to higher-power "3-T" systems for high-resolution whole body scans. The combination of lower cost and superior signal quality is expected to make the proposed transmitter very attractive to systems manufacturers. Secondary applications include security systems such as suitcase scanners and communication radios for both civilian and military applications.

Title: SBIR Phase II: Novel Electric Field Probe for High-Speed Integrated Circuits and Semiconductor Devices

Award Number: 0091454
Program Manager: Winslow L. Sargeant

Start Date: April 1, 2001
Expires: March 31, 2003
Total Amount: $500,000

Investigator: Daniel J. Kane, djkane@swsciences.com
Company: Southwest Sciences Inc
1570 Pacheco Street
Santa Fe, NM 87505-3993
Phone: (505)984-1322

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype high speed, non-invasive, optical probe for electric fields, and hence waveforms, in semiconductor devices. The technique is designed to work on any semiconductor regardless of its crystal structure and can be used for both imaging and single point detection without degradation of temporal resolution. Because the technique is optically based, no parasitic capacitance is added to the device being measured. A femtosecond laser probes the device to be measured, and temporal resolution is several orders of magnitude faster than the time resolution required to probe present devices. Bandwidths of greater than 10 terahertz should be possible.

This non-invasive probe technique will be applied to silicon-based devices, in their production and testing in the semiconductor industry.

Title: SBIR Phase II: A Parallax Barrier Technique for Autostereoscopic Displays

Award Number: 0238857
Program Manager: Winslow L. Sargeant

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000
Investigator: Jesse B. Eichenlaub, jbe@dti3d.com
Company: Dimension Technologies Inc
315 Mount Read Boulevard
Rochester, NY 14611-1911
Phone: (716)436-3530

Abstract:

The Small Business Innovation Research (SBIR) Phase II project is designed to leverage the success in polarized strip development. It will also advance two configurations for 2D and 3D capable auto stereoscopic display products, and initiate customer evaluation of these products. Specific objectives of the project include: completion of the technical developments necessary to produce 2D/3D products using the proprietary Strip Polarizer Parallax Barrier (SPPB) technique for flat panel displays; collaboration with a target customer to design and develop a market specific product; initiation of a pilot-manufacturing run to produce prototypes for initial market feedback; qualification of the initial prototypes in terms of performance, quality, manufacturability and acceptance; and continuation of research efforts needed to produce full resolution 2D/3D products. A successful Phase II program will advance the technology to prototype and initiate market feedback in target applications. Phase II prototypes will embody the majority of the technology needed to produce the full resolution products and will serve to firm up manufacturing processes while establishing initial market demand in those segments where natural upgrades to full resolution will increase market penetration.

The direct commercial potential of the projects lies in autostereoscopic products that will be manufactured using the proposed technology. Such display products will find widespread use in scientific and medical visualization applications, CAD, industrial inspection, and remote vision applications. Consumer based applications may include electronic commerce and computer gaming.

Title: STTR Phase II: A New Device for Quantitative Determination of Trace Gas Species

Award Number: 0132112
Program Manager: Ritchie B. Coryell

Start Date: January 15, 2002
Expires: December 31, 2003
Total Amount: $500,000
Investigator: Wen-Bin Yan, wbyan@meeco.com
Company: Tiger Optics
250 Titus Avenue
Warrington, PA 18976-2426
Phone: (215)343-6600

Abstract:

This Small Business Technology Transfer (STTR) Phase II Project substantially furthers the development of a powerful means to simultaneously measure trace amounts of multiple species vital to environmental control, industrial process control, and human health and safety. A fast, flexible, accurate, and low power-consuming technique, prism Cavity Ring-Down Spectroscopy (CRDS) will measure trace species to levels as low as parts-per-trillion. The research completed in Phase I demonstrated that the technology requires prisms fabricated from high-purity, super polished materials of high optical homogeneity. Phase I served both to identify appropriate materials to construct a fully functional prism and to prove that the prism cavity operates from the near UV down to the near IR range, greatly enhancing the breadth of CRDS performance.

The commercial market for the prism cavity lends itself to a wide range of applications: manufacture of compound semiconductors for telecommunications; continuous emissions monitoring for environmental compliance and workplace safety; laser weapon development and performance verification; detection of explosives or chemical warfare agents; and chemical analysis of breath for medical diagnostics.

Title: SBIR Phase II: An Improved Multi-Sensor Manufacturing System for Scrap Metal Sorting

Award Number: 0548698
Program Manager: George Vermont

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $499,991
Investigator: David Spencer, dbswte@aol.com
Company: wTe
7 Alfred Circle
Bedford, MA 01730
Phone: (617)275-6400

Abstract:

This Small Business Innovation (SBIR) Phase II project combines two technologies (XRF and Laser Induced Breakdown Spectroscopy) into a single processing system for high speed sorting of scrap metal. The proposed new technology has the potential to revolutionize the way nonferrous metals from recycling facilities are handled. Instead of disposing of the metals in a landfill or selling them as low priced metal mixtures, they can be used directly in commercial applications.

This project is aimed at validating small scale results on titanium and aluminum alloys from Phase I, and designing and constructing a prototype unit to demonstrate commercial feasibility.

Title: SBIR Phase II: High Power Deep UV LED-Based Lamps

Award Number: 0620525
Program Manager: Juan Figueroa

Start Date: August 29, 2006
Expires: August 31, 2008
Total Amount: $499,704
Investigator: Thomas Katona, tkatona@s-et.com
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1195 Atlas Rd
Columbia, SC 29209
Phone: (803)647-9757

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will result in solid-state high power UV LED based lamps for use in water/air/food sterilization/purification, bio-aerosol detection, bio-medical instrumentation, and laboratory measurement systems. Currently there are no portable, rugged, long-lifetime, non-toxic sources of ultraviolet radiation for integration into increasingly important UV water and air purification (particularly residential), bio-aerosol detection, and food sterilization systems. The predominant sources of UV radiation are low-pressure, medium-pressure and amalgam Hg based lamps. These high voltage lamps are large, non-directional, ozone-producing sources of radiation with radial emission from a tube source. This restricts the design flexibility of purification systems because of the geometrical constraints imposed by the lamp. High power deep UV LEDs require packaging designed to dissipate several watts of power, be stable under UV illumination, reflect UV light, and enhance UV extraction. The team proposes to develop manufacturing innovations in the packaging of high power UV LEDs to extend the range of applications that UV LEDs are suitable for including high power package/LED design, and the manufacturing processes required to fabricate these packages. Deep UV LED based lamps with output powers ranging from 50-100 mW are expected from this developmental effort.

If successful these Deep UV LED-based lamps will penetrate existing markets using UV radiation sources as the efficiency of the devices increases, as well as creating new markets previously unattainable due to the inherent limitations of current UV sources. The merits of UV radiation for sterilization/purification applications are beginning to be widely publicized. Several of the primary markets are: 1) Sterilization/Purification for Water, Air, and Food Preparation/Storage, 2) UV Spectroscopic Laboratory Analysis Equipment, 3) Bio-medical instrumentation, and 4) Biological weapons detection using UV fluorescence. This expertise will expand the technology base of the U.S. semiconductor manufacturing sector. In addition, low power point-of-use purification systems enabled by this technology will meet a crucial humanitarian need.

Title: SBIR Phase II: Development of an Imaging X-Ray Spectrometer

Award Number: 0620578
Program Manager: Murali Nair

Start Date: July 5, 2006
Expires: February 28, 2007
Total Amount: $644,000

Investigator: Michael Feser, mfeser@xradia.com
Company: Xradia
177 Balboa St.
Mayaguez, PR 00681
Phone: (787)834-5700

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project addresses the development of a novel real-time bio-aerosol machine for detecting and identifying harmful bio-aerosols present in the environment. The system will use the time of flight method to determine the aerodynamic size, and the Multiphoton Laser Induced Fluorescence (MLIF) method for the identification of the fluorescence spectrums. The novelty of the detection machine lies in the use of in-line, non-invasive techniques to measure these two important parameters. The system will consist of a compact laser source, a laser diode, a spectrometer, fiber optics couplings, a series of lenses and filters, pumps, flowmeters and pressure transducers. The sensor will be driven by two printed circuit boards and by computer software both uniquely designed for the proposed detector.

The need for the proposed instrument is of high priority in current times due to the extreme concerns about air quality issues and the high probability of terrorist attacks in large urban settings. The initial target markets for this product are "first emergency response" civilian agencies, medium to large size hospitals, and the armed forces.

Title: SBIR Phase II: Development of a Broad Spectrum Differential Mobility Aerosol Analyzer for Aerosol Size Distribution Measurements

Award Number: 0646182
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000
Investigator: Fredrick Brechtel, fredbmi@sbcglobal.net
Company: Brechtel Mfg. Inc.
1789 Addison Way
Hayward, CA 94544
Phone: (510)732-9723

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will support the continued development of a new Synchronous Differential Mobility Analyzer (SDMA) aerosol sizing and counting system that is simple to use, inexpensive, and allows rapid observations of ambient particle number size distributions over the 0.005 to 0.4 micron diameter range. The new technology will largely eliminate the cost, size, weight, and operator-expertise limitations of currently available sizing technologies. Prototypes of the particle sizing, growth and optical detection systems will be fabricated and the instrument will be tested side-by-side against standard instruments in the laboratory.

Broader impacts of the proposed research include satisfying the need for increased spatial and temporal coverage of ambient aerosol data while creating a measurement technique accessible to a more general group of users through reduced cost and ease of use. The broader application of the new technology will serve as an educational tool for students and investigators leading to more widespread understanding of how particle concentration varies with size in ambient, laboratory and industrial settings. Increased understanding of the variability of the ambient aerosol number size distribution will serve as important information for investigators in the areas of aerosol global climate and particulate pollution health impacts.

Title: SBIR Phase II: Sensory System for Autonomous Area-Wide Disease and Agriterror Detection and Reporting

Award Number: 0725388
Program Manager: Juan E. Figueroa

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Agenor Mafra-Neto, president@iscatech.com
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Riverside, CA 92507
Phone: (909)686-5008

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project will fabricate nanosensory arrays using the Micro-Electro-Mechanical Systems (MEMS) technique. This electrochemical polymerization of biomolecule-friendly conducting polymers was developed and successfully tested to build functional, highly reliable nanosensors. This research will address key technical challenges in automating the fabrication of antibody-functionalized conducting nanowires that are individually addressable and scalable to high-density biosensor arrays for the detection of Huanglongbing (HLB). The resultant nanosensory-arrays will form the base for the development of small, effective, inexpensive, field worthy, autonomous and automated pathogen detection devices. These units will permit the unattended processing of a large number of field samples, thus increasing the temporal and geographical density of data collection, providing superior pathogen and agri-terror detection.

Current disease management techniques typically lack the data collection technologies needed to avert epidemics; diagnostic instruments are not amenable to unattended autonomous operation. Devices currently used are slow, expensive, bulky, and must interface with humans. Consequently, only few pathogen introductions are detected before causing widespread disease or epidemics. This research will increase the efficiency in detection of plant pathogens and agents of disease, allowing for preventative rather than crisis or remedial control actions. The development of this automated system can mitigate the estimated $300 billion loss due to agricultural pests.

Title: SBIR Phase II: Efficient, High-Resolution Fast-Neutron Detector

Award Number: 0724503
Program Manager: Juan E. Figueroa

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $500,000

Investigator: Jay Cremer, ted@adelphitech.com
Company: Adelphi Technology, Inc
981B Industrial Rd
San Carlos, CA 94070
Phone: (650)598-9800

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop a fast-neutron imaging detector capable of high resolution and efficiency. Traditionally, fast neutron detection has required a thick, low resolution scintillator material. The proposed research will instead use light-channeling micro-capillaries filled with liquid scintillants. The capillary diameter and length that will yield optimal resolution and efficiency will be determined using a state-of-the-art image-intensified CCD camera capable of creating short time-interval images, in which noise can be identified and filtered out. The detector system will be tested using a new, revolutionary fast neutron source that is being fabricated and sold by the company. Because fast neutrons are highly penetrating, they have the possibility of imaging and interrogating large, high-density objects. The new high-resolution fast-neutron detector will be used with a high-brightness fast neutron source being developed under another program to form a fast-neutron radiographic system.

This system will serve the nondestructive testing interests of commercial and military aircraft, public utilities and petrochemical organizations. The detector and generator combinations will increase the safety, reliability and efficiency of nuclear and other power plant facilities. The discovery of fatigue cracks and piping integrity without the removal of insulation, and possibly the detection of aging in polymeric cabling materials will be possible. The imaging system will be portable, permitting imaging inside of thick steel, lead or even uranium for voids, corrosion and cracks. The proposed detector and neutron generator has a large market for screening for contraband, weapons, and explosives.

Title: SBIR Phase II: Automated Structural Health Monitoring Sensor

Award Number: 0724434
Program Manager: Muralidharan S. Nair

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,838
Investigator: An-Dien Nguyen, a.d.nguyen@lgrinc.com
Company: Los Gatos Research
67 E Evelyn Ave Ste 3
Mountain View, CA 94041
Phone: (415)965-7772

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will support the development of a new automated structural health monitoring (SHM) sensor system capable of detecting cracks and measuring stress in advanced structures. Current electrically-based SHM instrument is bulky and expensive. With the increase of sensing points and structure size, the amount of cabling, weight, and cost for hardware increases dramatically. This instrument combines optical waveguides and fibers, and Bragg Gratings (BG) with a low-cost, rugged light source to yield a SHM instrument capable of continuous measurements in the field with high precision and sensitivity. Phase II research will develop a field-tested 8-channel BG-based SHM instrument for simultaneous crack detection and loading stress measurements in large structures.

This novel SHM instrumentation will offer significant cost saving by providing a low cost solution for crack detection in large airframe structures such as wings, fuselage, and lap joints, as well as in civil structures such as oil pipelines, bridges, freeways, plants and buildings. The new sensor technology will enhance public safety as a result of low-cost condition-based maintenance and effective warning systems due to the sensor instrument's accurate prognosis and early prediction of catastrophic failures in large public transportation and utility systems.

Title: SBIR Phase II: A Novel Imaging Device for Infrared and Terahertz Radiation Beams Utilizing Thermochromic Liquid Crystal Materials

Award Number: 0724505
Program Manager: Juan E. Figueroa

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,170
Investigator: Alex Murokh, murokh@radiabeam.com
Company: RadiaBeam
1600 Sawtelle Blvd
Los Angeles, CA 90025
Phone: (310)444-1475

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will construct a detector with the capabilities of broadband imaging in the far infrared to terahertz band. The far infrared (FIR) to terahertz (THz) band of the electromagnetic spectrum has recently opened up with the proliferation of sources in this regime. However, the detector systems available on the market for this spectral region are currently expensive and inflexible. The research is centered on the study of a specific material that will convert the thermal imprint of incoming THz radiation into a visible, wavelength dependent signature that is analyzable by a detector and specialized software. A scanning system based on this detector combined with a tunable source will be designed for use as a security/inspection system. The research will incorporate this detector, capable of imaging a wide spectrum of FIR-THz radiation sources with sensitivities better than current technologies at a fraction of the cost, into a scanner system that can scan small parcels, bags and humans to identify hazardous materials or contraband.

As researchers and industries increasingly exploit this previously inaccessible portion of the electromagnetic spectrum, the need for a better imaging diagnostic tool becomes ever more important. A less-expensive, more sensitive imaging detector of FIR-THz sources is necessary before real-world applications, such as in medicine, become widespread. The realization of this particular application will impact the security and non-destructive testing markets.

Title: SBIR Phase II: Three-Dimensional Microscopy of Surfaces by Grazing Incidence Diffraction

Award Number: 0724428
Program Manager: Juan E. Figueroa

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $493,370

Investigator: Thomas Ditto, 3d@taconic.net
Company: DeWitt
237 LaFayette Street
New York, NY 10012
Phone: (212)226-6440

Abstract:

This Small Business Innovation Research (SBIR) Phase-II project is aimed at building a working three-dimensional microscope for industrial applications. This patented optics using holography will be grafted onto a two- dimensional inspection microscope now sold into the thread spinneret manufacturing industry. This research will seek to demonstrate that the expensive holographic master used in Phase I can be inexpensively mass replicated. Optical microscopy has almost always used refractive primary objectives, and 3D versions of classical refractive microscopes exploit the methods of triangulation, confocal focus accommodation, or interferometry. Here, a new concept into the technology of optical microscopy, primary objective gratings, is introduced. We have demonstrated that if an objective grating is fabricated using holography and is then configured at grazing incidence, it can be used as 3D profilometer. The demonstration microscope will be designed with features to show that it can be sold into the electronics surface mount technology inspection industry, a larger market than spinneret inspection.

This project will demonstrate the 3D capability to inspect solder paste and component insertions of sample circuit boards, and therefore will impact industrial inspection, and will provide robust field units for geology, archeology, anthropology, and paleontology. In medicine, this method has utility in endoscopy, and uses in surgery and dentistry is also foreseen. Generalized biological scientists will also be end users with the introduction of computer image processing, the availability of 3D profiles greatly expedites characterization and pattern recognition, because 3D data is immune to variations in surface shading typical of 2D image processing.

Title: STTR Phase II: Novel Deposition Rate Sensors for Real-Time Thickness Control of Plasma Spray

Award Number: 0724382
Program Manager: Muralidharan S. Nair

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $499,983

Investigator: Gregory Reimann, Reimann@gmail.com
Company: Cyber Materials
166 Melrose St.
Auburndale, MA 02466
Phone: (857)636-8339

Abstract:

This Small Business Technology Transfer (STTR) Phase II research project will develop a robust, commercial ready sensor that enables the first viable implementation of real-time control for plasma spray, reducing the cost for existing spray applications and enabling advanced coating applications that require tighter tolerances. The sensing scheme, based on a high speed solid state array, is superior to existing sensors because it can sense individual particles across the entire plume and can filter out non-molten particles that don't contribute to the coating. For the first time, a sensor will provide the basis for real-time, closed loop control for coating thickness of plasma sprayed parts. The Phase II research will develop production models of the sensor and the related closed loop control module, as well as establish proof of concept for advanced versions of the sensor.

Plasma spray is a high-throughput, economical, low environmental impact process that can be used to custom engineer coating microstructures to meet specific performance requirements, primarily in the form of thermal barrier coatings for gas turbines used in power generation and aircraft engine applications as well as emerging applications such as the electrolyte coating for fuel cells. Currently, the plasma spray process is run open-loop with respect to the critical deposition physics that determine coating quality and is characterized by large variations in coating thickness and structure.

Title: SBIR Phase II: Ultra-Low Power Microcontroller Design

Award Number: 0724361
Program Manager: Muralidharan S. Nair

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $500,000
Investigator: Alexander Ishii, alexander.ishii@cyclos-semi.com
Company: Cyclos
1995 University Avenue, Ste 375
Berkeley, CA 94704
Phone: (510)665-1341

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will investigate novel integrated circuit design technologies for the realization of ultra-low-power microcontrollers. The main objective of this project is to investigate the deployment of novel charge-recovery circuitry for the design of an ultra-low-power leading-edge commercial microcontroller core. The resulting charge-recovery core is expected to dissipate 25-30% less power than its conventional counterpart. In conventional circuit design, capacitors are switched abruptly between supply and ground, dissipating all their stored energy as heat across resistive devices. In charge recovery design, on the other hand, capacitors are switched gradually, returning any energy that remains un-dissipated back to the power supply. The significant potential of charge recovery to reduce power consumption has so far remained untapped in the commercial world, primarily due to the lack of support for such a new design style that deviates from established design practices.

The results of the proposed research are commercially applicable to the realization of a broad class of computer systems and consumer electronic devices that are subject to power efficiency requirements. Microcontrollers are essential elements of every System-on-Chip (SoC) and typically account for a substantial fraction of overall chip power, since they remain on most of the time. Embedded microcontrollers are key components of semiconductor chips for mobile devices such as cell phones and personal digital assistants. Generating a commercial microcontroller core with substantially reduced power consumption will lead to a broad variety of next-generation computer and communication systems with enhanced features, longer battery life, and improved performance.

Title: SBIR Phase II: Particle Metrology and Diagnostics using Microchannel Resonators

Award Number: 0724350
Program Manager: F.C. Thomas Allnutt

Start Date: July 15, 2007
Expires: une 30, 2009
Total Amount: $499,142
Investigator: Ken Babcock, ken@affinitybio.com
Company: Affinity Bio
75D Robin Hill Rd
Santa Barbara, CA 93117
Phone: (805) 455-0181

Abstract:

This Small Business Innovation Research (SBIR) Phase II program develops an instrument capable of measuring micron-scale particles using their weight as the measured parameter. At the instrument''s core is a novel microfabricated sensor containing a vibrating microchannel. The target particles are suspended in fluid as they pass through the channel, causing channel vibration frequency to change with a sensitivity of less than a picogram.

The broader impact of this research will to provide a method for particle size analysis that in addition to size gives mass. Manufacturing processes in many industries could benefit from this type of instrument to improve their processes and thereby lower production costs as well as improving product quality when used in a quality assurance program.

Title: SBIR Phase II: Photon-Assisted Hydrogenation Process Technology for Manufacturability and Improved Operability of HgCdTe Infrared Detectors

Award Number: 0724233
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,901
Investigator: Ronald Hellmer, admin@amethystresearch.com
Company: ARI
720 North Commerce
Ardmore, OK 73401
Phone: (405)227-9414

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will deliver an innovative hydrogen passivation technique for improving manufacturability and performance of HgCdTe infrared detectors. Photon-Assisted Hydrogenation (PAH) causes the substrate to be hydrogenated by simultaneous exposure to hydrogen gas and ultra-violet (UV) light which allows hydrogen to diffuse into and become a permanent part of the substrate. In Phase I the feasibility of PAH for the fabrication of high-performance near-infrared HgCdTe avalanche photodiode (APD) arrays on large-area silicon wafers was demonstrated. In Phase II PAH will be optimized for fabrication of HgCdTe infrared sensors from a variety of sources.

The PAH process will not only create a new product line of high-performance HgCdTe/Si-based APDs, but may also provide a means to effect significantly higher yields, and thus lower costs for all manufacturers of HgCdTe-based detectors. PAH technology will enable all HgCdTe infrared device manufacturers to grow on Silicon wafers, significantly reducing the cost of these high value systems, and making them more generally available for a broad range of currently unaffordable applications, including civil transport, aviation, medical and robotic vision systems. Derivatives of the this technique may be applied to the manufacture of a variety of other optoelectronic semiconductor devices requiring passivation to mitigate defects.

Title: SBIR Phase II: Structurally Integrated Organic Light Emitting Device-Based Sensors for Dissolved Oxygen in Water

Award Number: 0724090
Program Manager: Juan E. Figueroa

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,976

Investigator: Ruth Shinar, rshinar@iastate.edu
Company: Integrated Sensor Technologies, Inc.
3138 Sycamore Rd
169, IA 50014
Phone: (515)292-4226

Abstract:

This Small Business Innovative Research (SBIR) SBIR Phase II project aims to develop and commercialize a novel, next-generation photoluminescence (PL)-based, palm-size and miniaturizable dissolved oxygen (DO) sensor. DO sensors are primary monitors of water quality in industrial wastewater treatment. The new sensor is based on a pioneering platform for PL-based biochemical sensors where the excitation source is a pulsed organic light emitting device (OLED) pixel array that is structurally integrated with the sensor component. The individually addressable pixels and the sensor film are fabricated on either side of the glass substrate. The photodetector is "behind" the OLED array, monitoring the PL passing between the OLED pixels. This uniquely simple structural integration enables multi-sensor fabrication on a single, compact substrate, and should therefore yield field-deployable micro-sensor arrays for simultaneous detection of various analytes.

This sensor has applicability in water quality measurements in wastewater treatment, power, pulp and paper, chemical, food, beverage, brewing, and pharmaceuticals plants, fish farms, fresh water, coastlines, and the oceans. Current sensors suffer from key drawbacks that limit their utility and application. Electrochemical sensors require frequent calibration and maintenance, and are typically slow to respond. PL-based sensors are expensive due to intricate design. The proposed sensor will be reliable, require very little maintenance/calibration, and will be inexpensive, with a flexible design and size. The proposed device will be uniquely simple, initially palm-size and eventually micro-size, autonomous, fast, miserly on power consumption, and inexpensive. It will be structurally integrated and will operate in a pulsed PL-lifetime mode, eliminating the need for optical components and frequent calibration.

Title: SBIR Phase II: Electronic Pills for Medication Compliance

Award Number: 0646491
Program Manager: Muralidharan S. Nair

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000
Investigator: Neil Euliano, neil@conveng.com
Company: Convergent Engineering
4817 SW 34th Street, Suite 4
Gainesville, FL 32608
Phone: (352)378-4899

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project shall evaluate the use of electronic pills for medication compliance monitoring. Medication compliance monitoring is critical in pharmaceutical clinical trials, geriatrics, and mental health /addiction medicine. The only proven method for accurately determining medication compliance is directly observed therapy where personnel are present during
ingestion by the patient. This technique is labor intensive, but effective. In vivo biotelemetry and monitoring is a rapidly growing field that may provide the next critical breakthrough in medical monitoring. This research will focus on the development of these two solutions, namely a UHF resorbable antenna printed on the outside of an existing capsule or pill with or without a chip designed to improve signal to noise ratio and provide ID capability. The antennas will be printed with standard ink-jet technology. A handheld RF communication device will sense the presence of the pill in the GI tract and positively confirm that the medication regimen was followed appropriately.

Electronic pill technology and R&D will help expand the rapidly growing field of in vivo telemetry. The development of biodegradable low power miniature circuits will be an important step to future bio-implantable chips and sensors. Additionally, the field of medication compliance is tremendously important in many areas of medicine. In particular, better compliance monitoring can greatly reduce the costs associated with FDA approval of pharmaceuticals as well as provide dramatically improved data for accurate determination of low probability side effects.

Title: SBIR Phase II: Balloon-Based Instrument for Measurements of Atmospheric Water Vapor and Methane

Award Number:	0646479
Program Manager:	Muralidharan S. Nair
Start Date:	February 15, 2007
Expires:	January 31, 2009
Total Amount:	$500,000

Investigator: Mark Zondlo, mzondlo@swsciences.com
Company: Southwest Sciences Inc
1570 Pacheco St Ste E11
Santa Fe, NM 87505
Phone: (505)984-1322

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop, test fly, and inter-compare a balloon-based sensor for measuring atmospheric water vapor and methane. The chemical sonde is based upon low power vertical cavity lasers, compact optical cells, and noise-lowering data analysis algorithms. Water vapor is the most important radiative gas in the atmosphere, but accurate measurements of it in the upper troposphere and lower stratsophere are limited to custom, one-of-a-kind instruments. Methane is the second most important anthropogenic greenhouse gas, photochemically breaks down into water vapor in the stratosphere, and is a useful tracer for troposphere-stratosphere exchange. In combination, the water vapor and methane balloon based sensor offers more accurate insight into atmospheric chemistry (e.g. recovery of the ozone layer), atmospheric dynamics, and the Earth's radiative budget.

Improved data on water vapor and methane in the upper troposphere and lower stratosphere will help to better understand and predict how climate will change in the future. The costs of action and inaction on climate change are expected to be large, and it is imperative that society implement policies that maximize environmental protection while minimizing economic costs. More accurate assessments of climate change will indirectly benefit the economy by giving society time to prepare and adapt to potential changes in future climate.

Title: SBIR Phase II: Atmospheric Pressure Microplasma Emission Spectrometer

Award Number: 0646415
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Chris Doughty, cdoughty@verionix.com
Company: Verionix
251 Granville Lane
North Andover, MA 01845
Phone: (617)905-0015

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop a miniature atmospheric pressure plasma spectrometer using a source which generates a highly confined, high-density discharge (kW/cm3). The source would be based on a high frequency ring resonator structure and would utilize low cost widely available IC power amplifiers and drivers, would have extremely low cost in moderate volume production, and would consume <2 W rf power, allowing for portable operation. The compact size of this discharge should allow straightforward coupling to fiber optic spectrometers, and intense optical emission.

This research will substantially add to the scientific knowledge base and lead to fundamental understanding of the physics and engineering of these high-power-density, small and highly non-equilibrium plasmas. The source technology to be developed here will enable the miniaturization of a variety of chemical and gas analysis technology. This technology, by dramatically lowering the cost (10-100x), form factor (100x), and portability of the analytical equipment will provide economic benefits to customers in industrial settings, enhance worker and workplace safety, and allow for wider environmental monitoring.

Title: SBIR Phase II: RFID Tags for Cardiopulmonary Monitoring in Clinical Setting

Award Number: 0646422
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $499,998
Investigator: Ronald Salesky, salesky@jerseymicro.com
Company: New Jersey Microsystems
211 Warren Street, M/S 31
Newark, NJ 07103
Phone: (973)297-1450

Abstract:

This Small Business Innovation Reseach (SBIR) Phase II research project will develop an RFID system with sensor tags. This work focuses on design and implementation of a custom CMOS integrated circuit which contains hybrid analog-digital circuits on a micro-power tag. The biomedical application is vital signs monitoring including heart and lung sounds. The sensor tag operates within an RFID environment. Micro-electromechanical systems technology is used to fabricate an optimized sensor together with CMOS circuitry on the RFID-compatible tag. Heart sounds are presented as time-varying waveforms and processed algorithmically for feature extraction. Micro-power designs are used throughout the planned system.

The commercialized product with disposable tag sensors can replace the jungle of wiring currently used with direct-wired sensors or, for wireless pods, the need to replace batteries frequently. The system provides a patient monitoring capability that is very convenient, highly-cost effective, capable of chronic use, and does not interfere with nearby heart pacers. The ease of application makes this system ideal as a teaching tool for medical students and specialists with both visual waveforms and sound presented to the operator simultaneously. The system will be used in hospitals, clinics, medical offices, and for outpatients in the home.

Geoscience Instrumentation

Title: STTR Phase II: A Rapid-deployment, Three-dimensional (3-D), Seismic Reflection

Award Number: 0239071
Program Manager: Muralidharan S. Nair

Start Date: May 15, 2003
Expires: April 30, 2005
Total Amount: $494,296

Investigator: Patrick F. Miller, pfm_mt@msn.com
Company: PFM Mfg. Inc.
108 North Spruce Street
Townsend, MT 59644
Phone: (406)266-5148

Abstract:

This Small Business Technology Transfer (STTR) Phase II project aims to build a prototype of a rapid-deployment, three-dimensional (3-D), seismic reflection system for near-surface exploration. Although the 3-D seismic reflection method enjoys tremendous commercial success in marine applications, 3-D seismic systems for land-based geophysical exploration have been limited because cost-effective and environmentally friendly deployment systems have not been developed. Such a system would be useful to build models of ground water flow, track pollutants, identify mineral-laden zones, and aid the sitting of large construction projects.

The next generation seismic system based on the land streamers concept using gimbal-mounted vertical geophones will be assembled. An industrial, low-impact All Terrain Vehicle (ATV) is a critical part of the system both to pull the land streamers and minimize environmental impact. The primary advantage of such a system is that fewer field personnel would be needed compared to conventional surveys and data can be collected more efficiently. The customer base for this seismic reflection system includes civil and environmental engineers and geophysical contractors.

Title: SBIR Phase II: Digital Correlator Imaging Spectrometer For Submillimeter Astronomy

Award Number: 0521830
Program Manager: Muralidharan S. Nair

Start Date: January 1, 2005
Expires: August 31, 2007
Total Amount: $434,230
Investigator: Steven Kaplan, steve.kaplan@hypres.com
Company: HYPRES, Inc.
175 Clearbrook Rd
Elmsford NY, 10523
Phone: (914)592-1190

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop technology to significantly improve digital-auto-correlator spectrometer bandwidths and clock rates. Astronomers are increasing their reliance on digital auto-correlators for receiving sub-millimeter-wavelength signals buried in noise. For larger red-shift sources, bandwidths of tens of GHz are required. Digital spectrometers are also required to manage communications spectrum for wideband wireless software-defined radio systems. These systems under development are based on a radically new wireless-communications paradigm: the analog wireless signal is converted directly to the digital domain at RF frequencies. Wideband superconducting digital-RF hardware will result in extremely robust systems, with revolutionary new opportunities for handling complex waveforms (e.g. the Wideband Networking Waveform).

Astronomers need compact spectrometers to study sources such as planetary atmospheres, molecular clouds, and extragalactic objects. Distant sources have very small signals that are red-shifted by as much as tens of GHz. Therefore, spectrometer bandwidth and sensitivity must be better than present instruments offer. Applying these technology elements to communications enables software-defined all-digital radio systems. Improvements in wireless communications are helping the U.S. to become more productive and socially active. Power efficiency and sensitivity will be orders of magnitude greater than conventional systems, while enabling software functionality and upgrades, at a fraction of the cost.

Title: SBIR Phase II: Advanced Unified Oceanographic Data Logger

Award Number: 0450461
Program Manager: Muralidharan S. Nair

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $495,716

Investigator: Thomas VanZandt, thomas.vanzandt@geosense.com
Company: GEOSense, LLC
409 N. Pacific Coast Hwy., #427
Redondo Beach CA, 90277
Phone: (818)388-2826

Abstract:

This SBIR Phase II research project aims to complete the development of a fully-characterized, commercial prototype, Advanced Unified Oceanographic Data Logger (AUDL). This system aims to provide a new commercial standard for standalone data recording within existing and future oceanographic applications. The same technology will also provide best-in-class performance within the larger markets of terrestrial environmental monitoring. One key feature is that the AUDL will provide a nearly universal sensor interface. It will record data transparently from analog, serial-asynchronous, and digital sensors and instruments. This will enable GEOSense to target a wider range of applications and customers, with a single, low-cost system.

GEOSense will provide a commercial solution that significantly lowers the cost of technical data acquisition within a number of research and engineering applications. By reducing the overall cost of data recording, it is expected that the technology will enhance both the scientific return, and the educational opportunities, from limited research funds. It is hoped that the widespread application of this technology will increase the scope of expertise in oceanographic instrumentation

Title: SBIR Phase II: Pipeline Integrity in Natural Gas Distribution and Transmission Systems

Award Number: 0422171
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2004
Expires: August 31, 2006
Total Amount: $499,984
Investigator: Paul Lander, paull@flowmetrix.com
Company: Flow Metrix, Incorporated
2 Clock Tower Place, Suite 425
Maynard, MA 01754
Phone: (978)897-2033

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will solve challenging problems in processing, tracking, and communicating vibration recordings from remote locations in pipelines to determine whether a pipeline has suffered an integrity breach. The solutions include design of new battery-powered, wireless-enabled, rugged field instruments for the harsh pipeline environment, and the development of advanced signal processing methods to characterize and interpret the complex acoustic energy in pipelines.

The broader impact of this research project will be to provide the industry with state-of-the-art, cost-effective equipment that will allow owners and operators to protect their investment in pipeline infrastructure and to meet the mandated pipeline integrity management regulations safely, efficiently and effectively. The societal impact will be increased personal safety through faster and more accurate inspection methods and the preservation of continued affordable energy transportation into the future.

Title: SBIR Phase II: Ultra-fast Broadband Imaging Spectroscopy for Geosciences Applications

Award Number: 0422094
Program Manager: Muralidharan S. Nair

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $400,732
Investigator: Qiushui Chen, qchen@bostonati.com
Company: Boston Applied Technologies, Incorporated
150-H New Boston Street
Woburn, MA 01801
Phone: (781)935-2800
Abstract

This Small Business Research (SBIR) Phase II project is aimed to capitalize on our Phase I success of ultra-fast tunable optical filter technology for the applications of hyperspectral imaging, environmental monitoring and optical communication. During Phase I period, the feasibility of ultra-fast tunable filters based on electro-optical effect have been demonstrated through prototyping. State-of-the-art filter characteristics have been achieved, including ultra-fast response (< 500 ns), wide tuning range (> 80nm at 1550nm), narrow line width (< 0.1nm) and broad working spectral band (from visible to middle infrared continuously). Based on the successful Phase I execution, the major effort of Phase II will be developing an advanced tunable filter platform. At which several commercial products are expected to emerge. Such as ultra-fast hyperspectral imaging systems suitable for geosciences and medical diagnostics, high frequency wavelength modulators for high sensitivity spectroscopic detection of trace-gas and wide-range fast-tuning optical filters for spectroscopy and wavelength-division-multiplexing (WDM) optical communication Hyperspectral imagery has many existing and potential applications in agriculture, forestry, emergency response/disaster management, insurance, national security, oil and gas exploration, medical imaging, and military surveillance.

The proposed components and system, featuring in lightweight, fast action, broad wavelength band, and low cost, is needed for airborne hyperspectral imagery. The tunable add/drop is promise to reduce network complexity and cost by eliminating expensive optical-electrical-optical conversion and reducing inventory of fixed-wavelength devices. A fast wavelength modulation, combined with synchronized detection, can form a very sensitive spectroscopic analytic instrument for trace-gas sensing. These gases usually have characteristic absorption lines in infrared (IR) band, where no other fast tunable filter existed. It has seen a growing demand from the largest application areas, such as chemicals, petrochemicals, power generation, national security and environmental monitoring.

Title: SBIR Phase II: Remote Radio Frequency Measurements for Pipeline Monitoring - FloWatch911

Award Number: 0322092
Program Manager: Muralidharan S. Nair

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $493,680
Investigator: Mitchell Auerbach, mauerbach@cfl.rr.com
Company: Emergency Management Telecommunications
2496 Park Place Blvd
Melbourne, FL 32935
Phone: (321)259-8947

Abstract:

This Small Business Innovation Research (SBIR) Phase-II project will develop and test remote radio frequency measurements for integrity monitoring of gas fuel-pipelines. This novel application of RF measurements uses the pipe as a transmission line. Antennas launch pulses that travel inside the pipe, without disturbing the transported fluid. Pulses reflect-off obstructions/breaches in the pipe and are measured by distributed low-cost receivers to locate the fault. Phase-I research demonstrated the proof of concept for this automated monitoring system and defined interfaces with an emergency management telecommunications system that provides notification to the pipeline response team and warning to affected residents/businesses - all within minutes of the event. The objectives for Phase-II are to develop an engineering model FloWatch system, to install this system in an operating gas pipeline, and to perform end-to-end testing of the sensors and emergency notification system.

The outcome of this research will lead to a marketable product, which when implemented by pipeline operators, can save millions of dollars annually in pipeline spills and avert potential loss of life and property. Further benefits will result through improved pipeline operations that will result in lower-cost and reliable delivery of energy needs for businesses, industry and the general public.

Title: SBIR Phase II: Integrated Electric and Magnetic Free-Space Sensor for Geosciences

Award Number: 0349333
Program Manager: Muralidharan S. Nair

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,607
Investigator: Andrew Hibbs, andy@quasarusa.com
Company: Quantum Applied Science and Research
5764 Pacific Center Blvd
San Diego, CA 92121
Phone: (858)373-0232

Abstract:

This Small Business Innovation Research Phase II project proposes to integrate a new, free-space electric field (E) sensor with a recently introduced, miniaturized magnetic induction (B) sensor to form a compact six-channel sensor system. The proposed new E-field + B-field sensor should offer a completely new instrumentation capability for geosciences, providing for the first time measurement of all components of the electromagnetic (EM) field vector at low frequency in a single package without contact to the ground or any other physical object. The Phase II objectives are to develop a system prototype with sensitivity and bandwidth suitable for the majority of applications in geophysical surveying, lightning detection, electromagnetic sounding for detection of buried objects, and for general EM research. A side-by-side comparison with state-of-the-art conventional technology will be performed for magneto-tellurics and lightning detection in collaboration with academic and industry experts.

This technology should help develop products for the stand-alone electric and magnetic sensors, as well as a new class of bio-electrode that shares the same basic technology as the E-field sensor. Applications for the bio-electrodes are for human physiologic monitoring such as the electrocardiogram (ECG) and the electroencephalogram (EEG

Title: SBIR Phase II: Remotely Operated Vehicles (ROV) Mounted Sensor for Benthic Studies

Award Number: 9983306
Program Manager: Winslow L. Sargeant

Start Date: March 1, 2000
Expires: December 31, 2002
Total Amount: $400,000
Investigator: Salvador Fernandez, fernandez@ciencia.com
Company: Ciencia Inc
111 Roberts Street, Suite K
East Hartford, CT 06108
Phone: (860)528-9737

Abstract:

This Small Business Innovation Research Phase II Project will result in development of a novel oceanographic chlorophyll fluorescence sensor for the study of benthic microalgae. This sensor will be the first to incorporate fluorescence lifetime measurement capability, and the first to implement such capability for stand-off measurements from an ROV. This is of major significance, because it will permit, for the first time, direct in situ measurements of fluorescence quantum yield, and hence of photochemical efficiency, a feat that is not possible with simple amplitude-based fluorimeters. Continental shelf benthic ecosystems are of critical importance to marine biology and the viability of these ecosystems can be objectively assessed from the physiological status of the resident microalgae. The most important component of this status is the level of their photosynthetic performance, determined by the rates and efficiency of primary stages of light-driven photochemistry. Yet, knowledge about these processes, which control the health, long-term viability, productivity and dynamics of benthic microalgae is minimal because of the lack of suitable research tools for their study.

Potential commercial applications include oceanographic sensors, precision farming, photosynthesis analyzers for the laboratory research market, non-invasive brain oxymetry, product authentication, High Throughput Screening, clinical in vitro diagnostics and on-line process analysis.

Title: SBIR Phase II: Microminiature, High Resolution, Passive Peak Strain Detector for Smart Structures and Materials

Award Number: 0078617
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2000
Expires: July 31, 2003
Total Amount: $486,491

Investigator: Steven Arms, swarms@microstrain.com
Company: MicroStrain Inc
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Williston, VT 05495
Phone: (802)862-6629

Abstract:

This Small Business Innovation Research (SBIR) Phase II project combines hermetically packaged, differential variable reluctance transducers (DVRT) capable of peak strain detection (PD) with shape memory alloy (SMA) actuators to produce improved passive PDs. These detectors can withstand harsh environmental conditions, e.g., moisture, salt, vibration, and can be reset for repeated uses. Sensors in smart structures generally require system power in order to operate, but power outages may result in loss of key data. Therefore, sensors that can record peak information without power, i.e., passively, are needed in smart structures. Earlier passive PDs have relied on measuring the magnetic properties of transformation induced plasticity (TRIP) steels. However, these devices suffer from bulky size, low resolution, high nonlinearity, and a one time use limitation due to material yielding. This technology addresses these problems by using modified, microminiature DVRT-PDs. Phase I successfully designed, built, and tested hermetic packages, and SMAs were successfully employed for resetting of the devices. Techniques for remote interrogation using radio frequency identity tags were investigated, micropower prototypes were designed and built, and methods for wireless delivery of power to the SMA actuator were demonstrated. In Phase II, highly integrated microelectronics will be combined with the hermetic DVRT-PD packages to produce self-contained, remotely queried and remotely resettable PDs. Novel micropower sensor excitation circuits, capable of long range interrogation, will be built, tested, and packaged for independent laboratory evaluation and eventual field deployment. Field tests will include health monitoring of structural joints, repairs, and supporting members of civil structures, including bridges. The physical attachment of the DVRT-PDs to these structures will be designed for reliability, low cost, and ease of use. Applications include health monitoring of composite structures, aircraft, trains, bridges, dams, and buildings.

Military and commercial markets for these systems are significant. Health monitoring has the potential to enhance the safety and life of military, aerospace, and civil structures. Sensate structures equipped with passive networks of peak displacement or strain measurement devices could be interrogated for their response to test loads or potentially damaging events, and either replaced or their embedded sensors reset for future interrogation. Critical civil and military structures require 'smart' sensors in order to report their strain histories; this can help to insure safe operation after exposure to potentially damaging loads, e.g., earthquakes, hurricanes, military combat, etc.

Title: SBIR Phase II: A High Frequency Beam Steered Electromagnetic Impulse Radar to Locate Human Targets Through Opaque Media

Award Number: 0216574
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $500,000
Investigator: Scott R. Thompson, scott@realtronics.com
Company: RealTronics
PO Box 228
Hermosa, SD 57744-0228
Phone: (605)255-4410

Abstract:

This SBIR Phase II project will develop a through material imaging system that will locate human targets through opaque media. The technology will also provide wide area subsurface sensing for ground probing applications. The phase I results demonstrated that the system has the capability of detecting human targets on the opposite of building walls and through walls of granite over 10m thick. The thrust of the phase II research lies in software development to classify targets in the downrange profile, track targets, and count targets; and hardware development to eliminate the need for an external off the shelf receiver. The latter effort will also require software development to process data for the classification algorithms. The unique innovation of this project is that it can conduct full area investigations and locate stationary targets from a fixed location.

There are two primary applications for this technology, situational awareness and subsurface investigation. The former, which is the most attractive for early market entry, comprises homeland security, police/fire/search and rescue, and military actions where the location of human subjects on the opposite side of walls, vegetation, snow, fire, or other opaque media is sought. The latter includes geophysical exploration, ore body investigation, utility detection and location, road-bed and bridge subsurface scans for cracks and voids, and unattended ground sensing from a fixed point to assess subsurface changes that can be used to predict earth or structural failure.

Title: SBIR Phase II: Gamma Ray Detector for Geophysical Exploration

Award Number: 0522021
Program Manager: Muralidharan S. Nair

Start Date: October 28, 2005
Expires: October 31, 2007
Total Amount: $479,410
Investigator: Gerald Entine, GEntine@rmdinc.com
Company: Radiation Mon Devices Inc
44 Hunt Street
Watertown, MA 02472
Phone: (617)668-6801

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to produce a radiation detector technology that will be able to provide a completely new level of performance for demanding industrial applications. Three different scintillator materials - $LaBr_3$, $LaCl_3$ and $CeBr_3$ - have been shown in Phase I to provide outstanding results even when subjected to high temperatures. This trait makes these materials well suited for geologic well logging applications where radiation measurements must be in environments where temperatures exceed 175 C. The keys to furthering these materials are tailoring their chemical composition through dopants, producing ingots of larger sizes and packaging them to resist such environments.
Producing more accurate well-logging tools should be a direct outcrop of this project. These tools should in turn enable the geology researcher to more efficiently conduct experiments, and to reduce some of the uncertainties in the otherwise highly speculative field of oil exploration. The broader impacts of this program will encompass both a better understanding of this family of scintillator materials and their use in other applications for which temperature performance is not a key issue. Applications include nuclear science to medical imaging to security and monitoring.

MEMS

Title: SBIR Phase II: Large Area Platform Technology for Small Diameter Silicon Carbide

Award Number: 0321616
Program Manager: Winslow L. Sargeant

Start Date: July 15, 2003
Expires: June 30, 2005
Total Amount: $499,999

Investigator: Lee O. Kareem, lee.kareem@zin-tech.com
Company: ZIN Technologies
3000 Aerospace Parkway
Brook Park, OH 44142-1001
Phone: (216)977-0631

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will optimize the key technologies for deployment of high-temperature pressure sensors from proven silicon carbide (SiC) sensor dies for harsh environment applications within aerospace and automotive markets. These include wafer bonding and planarization, electrical characterization, selection of integrated electronics manufacturing methods, and temperature compensation algorithms. The Discrete Wafer Array Process (DWAP) technique will be further developed to demonstrate fabrication of SiC pressure sensors. Prototype platforms for demonstration of low-cost and high volume manufacturability of single crystal SiC devices in conventional foundries will be provided and the semiconductor-on-insulator (SOI) technology provided by the DWAP concept will be leveraged to demonstrate superior device performance. This work will focus on developing and optimizing the necessary technical foundation of SiC sensor dies through electrical characterization and interface electronic development, and fabrication of SiC pressure sensor dies on 4-inch platform for testing by GE and Ford.

The increasing demand for miniaturization presents unique growth opportunities in the MEMS Market, which is estimated at $7Billion. Combined skills in MEMS manufacturing processes, electronics system design, algorithm development, and market access are required for success. The harsh environment market segment, estimated at $4.5Billion by 2005 is poised to be a major beneficiary of the technical and cost saving superiority of Silicon Carbide (SiC) over Silicon (Si) as the primary semi-conducting material. The pressure sensor sector of the market segment will grow from $3.5Billion by 2005 to $9.06Billion, with a Compounded Annual Growth Rate (CAGR) of 16.5%.

Title: SBIR Phase II: Lead Zirconate Titanate (PZT) Multimorph Micro-Opto-Electro-Mechanical Systems (MOEMS) Deformable Mirror

Award Number: 0522321
Program Manager: Juan E. Figueroa

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,798

Investigator: Michael Helmbrecht, michael.helmbrecht@irisao.com
Company: Iris AO, Inc.
2680 Bancroft Way
Berkeley CA, 94704
Phone: (510)849-2375

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to deliver a dramatic advance in microelectromechanical system (MEMS) deformable mirror performance. Deformable mirrors are the key active component in adaptive optics (AO) systems that provide vastly improved resolution through turbulent air, water, and biological samples. The lack of low- cost, high-deflection (stroke), and low-voltage deformable mirrors has prevented the widespread deployment of AO in a range of fields including biotechnology, ophthalmology, and national security. Phase I successfully demonstrated a new actuation approach for shaping MEMS deformable mirrors. The new approach combines piezoelectric actuation with MEMS deformable mirror technology. The piezoelectric actuators are a true breakthrough as deformable mirror actuation voltage may be reduced from 100-200 volts down to 10-20 volts - a full order of magnitude reduction. The use of smaller, less expensive, safer, and more reliable low-voltage electronics opens the door for a host of applications. The goal of Phase II is to build on the Phase 1 actuator designs to manufacture complete deformable mirror arrays with groundbreaking high stroke, low voltage, low cost, high speed, coupled with superb optical quality.

The high resolution and contrast enhancement enabled by adaptive optics (AO) using deformable mirrors is poised to dramatically advance astronomy, ophthalmology, biology, and national security. Yet for the full potential to be realized, miniature deformable mirrors with high stroke, low voltage, and low cost are critical. If successful the proposed mirror will address the key requirements vital for moving AO into mainstream scientific laboratories and commercial markets. This will have enormous social and commercial impact. Biological microscopes that have far higher resolution, ophthalmoscopes that can image single cells in a living retina, laser microsurgery with precise beam control, and telescopes that can image through atmospheric turbulence will push the boundaries of science. The health and well being of millions will be directly improved as commercialization moves early eye disease detection, customized vision correction, and new medical treatments into doctor offices across the nation. Free space optical communication, and long-range surveillance applications will also reap the benefits of this technology.

Title: SBIR Phase II: Micromachined Vacuum Microelectronic Devices Using Nanoscale Self-Assembly

Award Number: 9983511
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $400,000

Investigator: Dmitri Routkevitch, droutkevitch@synkera.com
Company: Nanomaterials Research LLC
1831 Left Hand Circle
Longmont, CO 80501
Phone: (720)652-4001

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a novel low-cost microfabrication technology for vacuum microelectronics. Affordable and reliable microfabrication of refractory materials is needed, since these materials are able to withstand high temperature and severe electromagnetic radiation. Although several materials have been identified as candidates, they have both high cost and difficulties with high aspect ratio, high resolution bulk micromachining. An approach based on self-organized nanoporous anodic alumina with unique anisotropy morphology will allow high aspect ratio, high resolution micromachining. Phase I demonstrated that a vacuum microtriode with promising performance could be fabricated from micromachined alumina ceramic. This may be the only technology for making ceramic micro-electromechanical systems (MEMS) for vacuum microelectronics and other applications, that are stable in harsh environments, have mechanical durability, are compatible with mainstream microfabrication, cost less, and scale up suitably. Phase II will optimize the technology and design, fabricate prototypes of vacuum integrated circuits (logic and amplifier), and scale-up the processes of device batch production for evaluation.

Potential commercial applications include vacuum microelectronics and MEMS for the harsh environments of space, satelliate communicaitons, radars, deep drilling, nuclear reactors, as well as less strenuous environments that attend such uses as cellular phone networks, flat panel displays, and various sensors

Title: SBIR Phase II: Electrostatic Self-Assembly Processes for Fabrication of MEMS Materials and Devices

Award Number: 9983175
Program Manager: Winslow L. Sargeant

Start Date: May 15, 2000
Expires: April 30, 2004
Total Amount: $461,800

Investigator: Tingying zeng, tyzeng@nanosonic.com
Company: Nanosonic Incorporated
P.O. Box 618
Christiansburg, VA 24068
Phone: (540)953-1785

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop sensor, actuator, and micro-electromechanical system (MEMS) products based on electrostatically self-assembled piezoelectric and electrostrictive polymer thin films. Phase I found that an electrostatic self-assembly (ESA) process may be used to synthesize piezoelectric and electrostrictive materials with large transduction coefficients from a variety of dipolar molecular materials. This indicates an ability to replace poled polymer and conventional ceramic transducer materials in numerous sensor and actuator devices and produce benefits in simplified processing, cost savings and improved performance. In addition, the ability to select patterns and release portions of ESA-processed multilayer films allows the formation of MEMS structures, and thereby a new approach to surface micromachining.

Phase II will optimize the ESA synthesis process in manufacture of sensors, actuators, and MEMS products and demonstrate ESA thin-film based devices, including polymer MEMS. New ESA-processed piezoelectric and electrostrictive thin film materials will have widespread potential commercial applications in sensor and actuator devices used for instrumentation and controls.

Title: SBIR Phase II: In-Situ, Real-Time Process Control for Micro-Electro-Mechanical System (MEMS) Applications

Award Number: 9983399
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: August 31, 2003
Total Amount: $399,983

Investigator: Sylvie Charpenay, Sylvie_bosch-charpenay@mksinst.com
Company: On-Line Technologies Incorporated
87 Church Street
East Hartford, CT 06108
Phone: (860)291-0719

Abstract:

This Small Business Innovation Research Phase II project will develop a multiple-applications, low-cost, real-time process monitoring and control tool for micro-electro-mechanical system (MEMS) deep-etch fabrication. Deep-etch processes are used to manufacture high aspect ratio structures up to several hundred microns thick, and promise to deliver new devices with increased performance and functionality at lower cost. A major difficulty in deep-etch technology is the control of the etch depth, which is currently measured post-etch using ex-situ destructive scanning electron microscopy. This is extremely inefficient, and is a major hurdle to be surmounted before extensive production takes place. During Phase I, an FTIR-based sensor was designed, constructed and installed on top of an etcher chamber. Etch depth and photoresist thickness measurements were obtained, for the first time ever, in-situ and in real-time on several MEMS structures. An excellent correlation between the FTIR measurements and SEM measurements was found. During Phase II, analysis models will be developed and implemented to measure the widest possible range of MEMS structures. These models will extract multiple parameters on any type of patterns, and will allow the use of the sensor for various applications, including deep trenches in silicon or SOI (silicon on insulator) wafers, membranes, thick photoresist, and mainstream silicon applications such as DRAM (Dynamic Random Access Memory) trenches. Hardware will be optimized for spot size, measurement spot range, compactness and, very importantly for the cost-sensitive MEMS industry, for cost.

The result of this project will be the development of a metrology tool with capabilities currently unavailable, and which are in high and increasing need. The specific anticipated results of the use of the proposed metrology are: (1) to reduce cost through the reduction of destructive measurements and the improvement in process control,(2) to increase the reproducibility of the MEMS structures through better process control (run to run accuracy is currently ~3 % and is expected to be lowered by the use of the sensor to <0.5 %), (3) to provide useful feed-back for process development, thus reducing development time. These results will have a great impact on the deep-etch MEMS market, as they willhelp future MEMS applications to mature and come to market at a faster pace through cheaper characterization and improved process control. In addition, this first-of-a-kind real-time wafer-state monitoring and control technology will lead to applications within mainstream semiconductor processing such as DRAM.

Title: SBIR Phase II: Photonic Networking of Micro-Electro-Mechanical Systems Arrays for Smart Structures

Award Number: 9986118
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2004
Total Amount: $797,292
Investigator: Behzad Moslehi, bm@ifos.com
Company: Intelligent Fiber Optic Systems Corporation
650 Vaqueros Avenue, A
Sunnyvale, CA 94085
Phone: (408)328-8610

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop novel photonic ModeRouting networks containing many nodes for monitoring and controlling the structural health and function of complex systems. Each node is, in general, a microsystem that combines sensing, computing, and actuating functions. The microsystems may contain many Micro-Electro-Mechanical Systems (MEMS) with aggregate data rates approaching gigabits-per-second. This research addresses the enormous challenge for interrogating, activating, and controlling all microdevices through a high-capacity interconnection system. Wire-based and wireless approaches cannot handle such data rates. Further problems include operation in electrically noisy and potentially explosive environments. The innovative IFOS solution offers high-efficiency, ultra-high capacity, electromagnetic-interference-immunity, electrical-passivity, and expendability. Phase II will optimize, fabricate, and test several MEMS array nodes, MEMS fiber interfacing, and PhotoPowering, as well as design and build an expandable, ModeRouting network of MEMS nodes.

Commercial applications of the IFOS photonically-interconnected MEMS array networks include civil, mechanical, aerospace, chemical, and marine engineering, particularly monitoring and control of programmable structures by microsensors and microactuators for mechanical systems, electrical power plants, automobiles, materials processing, and medicine.

Title: SBIR Phase II: Investigation of Charge Trapping in Plasma Enhanced Chemical Vapor Deposition (PECVD) Dielectrics Using Electrostatically Actuated Mechanical Resonators

Award Number: 0331436
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,882

Investigator: Igal Ladabaum, igal.ladabaum@sensant.com
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14470 Doolittle Dr.
San Leandro, CA 94577-5546
Phone: (510)346-8166

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop high quality dielectric films and structures for a family of ultrasonic transducers for medical imaging applications. The technology and methods developed in Phase I to characterize charge-trapping behavior of dielectrics are the critical innovations required to take micro-fabricated ultrasonic transducers from their current state to a commercially viable state. Charge trapping created by the high electric fields in the device is detrimental to transducer performance. Charge trapping is dependent on field polarity and causes shifts in electromechanical conversion efficiency in time. Variations in charge trapping within a transducer array are even more disruptive. A process that removes the polarity dependence of charge trapping and thereby enables a new type of bipolar ultrasound imaging array that improves image quality will be developed. Since performance and reliability are critical to successful commercialization of these ultrasound probes, the issues of how dielectric charging causes time-dependent loss in performance and material degradation that could limit lifetime will be researched.

The development and commercialization of micro-fabricated ultrasound transducers (MUT) is targeted at the medical applications market. This work will also enable the development of ultrasound probes that can non-invasively provide more accurate diagnostic information for doctors, such as improved ability to distinguish between cancerous and benign tissue. The image quality to price ratio drives market share in the global $3Billion diagnostic ultrasound market. These novel ultrasonic transducers will significantly improve the image quality/price ratio, and thus realistically create market share swings of 5% upon product release. Specifically, in the $1Billion mid-to-premium segment of the radiology market most relevant to the proposed research, $50M of annual system sales would be generated by the introduction of MUT probes, of which approximately one third are direct probe sales.

Title: SBIR Phase II: An Innovative Normal Stress Sensor System for Complete Characterization of Polymer Shear Flow Properties

Award Number: 0318662
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,289
Investigator: Seong-Gi Baek, seonggibaek@rheosense.com
Company: Rheosense
2357 Ventura Drive, Suite 104
Woodbury, MN 55125
Phone: (651)714-3842

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will address several technical improvements needed for successful commercialization of a novel MEMS sensor plate containing monolithic miniature capacitive pressure sensors. As shown in Phase I, the sensor plate can be used to accurately measure the first (N1) and second (N2) normal stress differences, which are important nonlinear elastic flow properties of various classes of viscoelastic liquids. In Phase II, sensor packaging and lead transfer to the sensors will be made suitable for high volume, high quality manufacturing of sensor plates. One version will be optimized for measurements at lower pressures and another version optimized for measurements on molten commercial thermoplastics at higher temperatures and pressures. The latter version of the sensor plate will be smaller in diameter to make possible measurements on smaller samples at higher shear rates, and will contain miniature temperature sensors that will enable accurate compensation for changes in sensor calibration constant with temperature. Improvements will be tested with a wide variety of commercial polymer systems and other important classes of viscoelastic liquids.

This novel sensor plate will meet the critical market need for an inexpensive instrument for fully characterizing shear flow properties of molten thermoplastics. The competing alternative technology, the force rebalance transducer (FRT) is expensive and works best with large samples. It is simpler/less expensive to adapt a sensor plate rather than a transducer to existing rheometers. Hence the sensor plate has significant commercial potential to satisfy pent-up demand for an inexpensive way to upgrade rheometers to allow flow elasticity measurements.

Title: SBIR Phase II: Harsh Environment Fluid Viscosity-Density Sensor

Award Number: 0239151
Program Manager: Winslow L. Sargeant

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000

Investigator: Richard Mlcak, mlcak@bostonms.com
Company: Boston MicroSystems, Inc.
30-H Sixth Road
Woburn, MA 01801-1758
Phone: (781)933-5100

Abstract:

This Small Business Innovation Research Phase II project is aimed at developing MEMS-based miniaturized fluid viscosity and density sensors that can operate within small confines provide electronic readout, and that are capable of surviving harsh environments (high temperature, high pressure, corrosive, abrasive) typical of many fluid sensor applications. The Harsh Environment Fluid Viscosity-Density Sensor consists of a packaged flexural plate wave (FPW) resonator instrumented with low cost, compact electronics for sensor read-out. In Phase I, the technical objectives were successfully accomplished by fabricating resonant FPW fluid sensors from harsh environment compatible single crystal SiC and epitaxial piezoelectric AlN materials, and demonstrated their ability to independently measure fluid viscosity and density. In Phase II, fully functional, packaged and electronically instrumented Harsh Environment Fluid Viscosity-Density Sensor prototypes will be developed and optimized for specific customer applications. The fluid sensors will be field tested in our customer's systems to demonstrate precise and accurate fluid viscosity and density measurements and stable operation in the customer's fluids and environmental conditions. After successful completion of Phase II, the Harsh Environment Fluid Viscosity-Density Sensor will be ready for scale-up manufacturing and commercialization in Phase III.

The Harsh Environment Fluid Viscosity-Density Sensor has commercial applications in 1) Condition-Based Maintenance of oils and other fluids in engines and industrial process equipment, 2) Process and Quality Control in manufacturing, chemical processing and water/waste treatment industries, and 3) down-hole sensors for Petrochemical Exploration and Extraction.

Title: SBIR Phase II: Novel Joining Method for Self-Assembly of Reliable Three Dimensional Micro-Electro-Mechanical Systems

Award Number: 0091582
Program Manager: Cheryl F. Albus

Start Date: June 1, 2001
Expires: May 31, 2003
Total Amount: $499,867

Investigator: Brian R. Schaible, brian@sporian.com
Company: Sporian Microsystems
4699 Nautilus Court South #201
Boulder, CO 80301
Phone: (303)516-9075

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will continue to develop a solder self-assembly process that was the concept explored in Phase I. It will build upon the successful Phase I results that demonstrated the use of solder to self-assemble two-dimensional surface micromachined Micro-Electro-Mechanical Systems (MEMS) into useful three-dimensional structures. This concept is a next step in the evolution of MEMS assembly. The overall objective of Phase II is to move the technology from the lab environment to a commercial production process that is well understood and has excellent yield. Research personnel from industry and education are involved and state-of-the-art equipment will be utilized.

A number of promising commercial applications have been identified and discussions with potential commercial partners suggest interest in commercializing this technology.

Title: SBIR Phase II: Microelectromechanical (MEMS) Mirror Arrays for Bioimaging Applications

Award Number: 0548508
Program Manager: F.C. Thomas Allnutt

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $511,290

Investigator: Tom Tsao, ttsao@umachines.com
Company: Umachines
2400 Lincoln Ave
Altadena, CA 91001
Phone: (626)296-6282

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will advance the state of the art in MEMS deformable mirror arrays. The research will address the key technology bottlenecks in the production of affordable, high performance adaptive optics systems. The objective is to further expand the proof of concept and to successfully fabricate and package the MEMS arrays.

The mirror arrays will play a key part in the understanding, diagnoses, and treatment of the leading causes of progressive vision deterioration and blindness in humans. Having improved retinal resolution will allow physicians to detect diseases and prescribe treatment earlier than current technologies allow. This will allow for increased preservation of eyesight and increase in lifestyle. Further, improved resolution will allow for increased research into various pathologies for additional scientific and medical advancement in a more efficacious time frame.

Title: SBIR Phase II: Advanced MicroDisplay Engine for Full Windshield Transparent Display

Award Number: 0724453
Program Manager: Juan E. Figueroa

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Jianqiang Liu, jq.liu@compass-innovations.com
Company: Compass Innovations
3001 Winchester Blvd, Suite 3
Campbell, CA 95008
Phone: (408)866-6836

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a revolutionary miniature projector engine for automotive full windshield display (FWD). The invention allows high quality images with rich graphics to be displayed directly on automobile windshields. The mini-projector engine can be integrated with a rearview mirror. It can be interfaced to the on-board electronics or other communication devices using standard protocols. Based on Micro-Electro-Mechanical Systems (MEMS) fabricated micromirror devices, the proposed display engine provides 4X faster display speed than state-of-the-art vector display devices. Its size is less than 1 in3 and consumes less than 1W of energy. It can be mass produced at low cost and is the most suitable for automotive applications.

If successful the outcome of this project will provide the most effective method to convey information to driver without causing distraction. Unlike traditional HUD, it can display information on the entire windshield. As augmented information display, it can effectively reduce road accidents and save thousands of lives every year! When implemented, even a small 10% of deployment, the market size for this display engine will be 6 millions of units annually in the 60 millions global vehicles market. It will generate hundreds of millions dollars of tax and hundreds of jobs for the United States and bolster the economy.

Title: SBIR Phase II: Wafer-Scale, Hermetic Packaging of Intelligent MEMS-Based Systems

Award Number: 0724340
Program Manager: Juan E. Figueroa

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Sonbol (Sarah) Massoud-Ansari, sonbol@mems-issys.com
Company: Integrated Sensing Systems
391 Airport Industrial Drive
Ypsilanti, MI 48198
Phone: (734)547-9896

Abstract:

This Small Business Innovation Research (SBIR) Phase-II project continues to address development of a novel packaging method for wafer-scale hermetic packaging of intelligent Micro-Electro-Mechanical Systems (MEMS). Packaging of MEMS along with their requisite electronics is one of the main technical barriers to commercialization of these devices. Packaging methods are often expensive, have long development cycles, and may adversely affect device performance and reliability. In cases where direct media access is required and the MEMS device needs to operate in harsh environments, protecting the electronics from the media provides a huge challenge. The proposed packaging approach consists of extending the MEMS device and etching a deep cavity into the substrate to house the electronics. A wafer-level hermetic bonding method will then be used to cap the electronics while allowing electrical connection between the electronics and the device. This Phase II project will focus on development of hermetic lead transfer using buried metal layers, and expansion of the packaging method to include wireless applications. Wired and wireless pressure sensor/electronics testbeds will be fabricated to verify overall system integration and evaluated both internally and by external customers.

The potential commercial value of this Small Business Innovation Research proposal will be in several areas. The most immediate area will be revenue from sale of foundry services for packaging and integration of MEMS and their associated electronics. Through its existing Foundry Services Division, ISSYS will provide a packaging platform for wired and wireless MEMS sensor/electronics subassemblies. The second source of revenue is product sales, where off-the-shelf MEMS pressure sensor subassemblies (wired and wireless) will be sold to customers in various medical and industrial fields. The long-term vision is use of this packaging platform for a variety of MEMS-based devices. According to Yole Development, the worldwide MEMS market is forecast to grow from $5.1 Billion in 2005 to $9.7 Billion in 2010. The main product families in this market are inkjet heads, pressure sensors, microphones, accelerometers, gyroscopes, optical MEMS, microfluidics, RF MEMS and micro-fuel cells. The proposed packaging technology will be highly beneficial to pressure sensors, microphones and microfluidic devices, with a combined market forecast of $2.5 Billion in 2010.

Nanostructured Materials

Title: SBIR Phase II: A New Scale-Up Technology for Industrial Production of High Quality Semiconductor Nanocrystals

Award Number: 0321611
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $498,433
Investigator: Yongqiang A. Wang, awang@nn-labs.com
Company: NanoMF
3468. W. Yale St.
Fayetteville, AR 72704
Phone: (479)871-0707

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop the so-called Continuous Batch (CB) technology for the massive production of high quality semiconductor nanocrystals inexpensively. The CB technology has the following advantages over the most closely competitive technology, continuous flow production (CFP: It uses much less toxic and less expensive chemicals as reactants).

To date, production of high quality semiconductor nanocrystals can only be performed in well-equipped labs and in very small (dozens of milligram) quantities. The CB's potential for cost savings, improved qualities (i.e. size distribution, optical absorption, and photoluminescence emission) and the high productivity (thousand kilograms/year) makes it superior in comparison to the existing CFP technology.

Title: SBIR Phase II: Carbon-Coated Nano-Structured Electrodes for Next-Generation Lithium-Ion Batteries

Award Number: 0522287
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $476,850

Investigator: Timothy Spitler, tspitler@altairinc.com
Company: Altair Nanomaterials Inc
204 Edison Way
Reno NV, 89502
Phone: (775)858-3742

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will demonstrate superior power-delivery, rapid-charge, and long cycle-life performance of prototype carbon-coated, nanoparticle-based electrodes for use in inherently safe, moderate-to-large sized lithium ion batteries of various commercial designs. The primary innovation is the use of optimally sized, arranged and assembled carboncoated nanoparticles that preserve the intrinsic performance characteristics of the bare nanocrystalline materials when fabricated into thin-film electrode structures for use in advanced power sources. Phase I focused on improving performance of nanostructured aggregates of 20nm lithium titanate (n-LTO, used in anode service) via carbon coating for better electrical and ionic connectivity. Phase II will develop appropriate carbon-coated nanomaterials for cathode service designed to match the n-LTO anode performance; providing matched Li-ion host anode-cathode pairs for next-generation performance

There are demonstrated market for fast-charge, long-life batteries in a broad range of consumer applications. Markets require that it be possible to reliably and economically recharge remote devices, including portable computers; hand tools, lawn mowers and medical devices; electric cars, motorcycles and mopeds in a matter of minutes rather than hours, and faster discharge rates translate immediately to higher power per unit weight.

Title: SBIR Phase II: Quantum Confined Atom Based Nanophosphors for Future Efficient Lighting

Award Number: 0521948
Program Manager: T. James Rudd

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $424,693
Investigator: Rameshwar Bhargava, rbhargava@nanocrystals.com
Company: Nanocrystals Technology Limited Partnership
235 Elm Rd
Briarcliff Manor NY, 10510
Phone: (914)923-1142

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will involve quantum confining a single atom in 2 to 5 nm size nanocrystal of ternary semiconductor, from which new and efficient nanophosphors will be developed. The band-gap engineering of nanophosphors allows improvement in the luminescence characteristics such as absorption and emission spectra, half-width, efficiency, life-time, etc. Indeed the role of conventional activators (rare-earths and transition metal impurities) in nanophosphors can be re-evaluated for different applications. Specifically, ternary wide band gap semiconductors such as ZnCdS with dopants like Ag, Cu, Mn offer very efficient broad-band visible spectra that is close to white light. The possibility of band-gap engineering in nanocrystals of ternary semiconductors, similar to that catapulted the optoelectronic devices from III-V semiconductors, opens the door to design of new nanophosphors that match well with the excitation spectra of LED's and compact fluorescent lamps. This development would lead to a new class of white light sources in this Phase II project. By developing different nanophosphors that can be excited by blue/UV LEDs, it successfully demonstrates that nanophosphors can significantly enhance the performance of not only white LEDs but also can improve the performance of compact fluorescent and arc lamps.

Commercially this technological breakthrough of engineering of nanophosphors when used with current efficient lamps, is expected to enhance the efficiency of LED's by 40% and lamps by 15%, respectively. These improvements in overall power efficiency of these lamps, will significantly lower the cost of energy used and it is projected will help to save energy costs equivalent to $25 billion by 2025.

Title: SBIR Phase II: Carbon Nanotubes Field Effect Transitors (FET) Platform for Electronic and Sensors Applications

Award Number: 0450648
Program Manager: T. James Rudd

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $499,999
Investigator: Jean-Christopher Gabriel, jcgabriel@nano.com
Company: Nanomix, Inc.
5980 Horton St.
Emeryville CA, 94608
Phone: (510)428-5313

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to design and develop a molecular nano-sensor platform for researchers developing new chemical and bio-sensors. The principal component of these devices will be an array of single-wall carbon nanotube transducers on a silicon chip. The product itself will be a sensor development kit comprised of a set of sensor chips, an electronics module with a standard PC interface, adaptors for gas and liquid sensing, data reduction and analysis software, and directions for product use. General guidelines for the additional of specialized functionalization chemistry and biology to the sensor chip will be included. The project objectives include developing a set of 5-10 different chip architectures for gas, liquid and biosensing together with modules for sensing in both gases and liquids. The CMOS mask design will include as many as ten different architectures suitable for different types of experiments and functionalization layers. The sensor chips themselves will be manufactured on 4-inch silicon wafers and set into a standard CERDIP package that fits into the top of the electronics module. Signal processing electronics and software systems will be designed and integrated to deliver digital sensor output to LabView(TM) on a PC. The research involved in meeting these goals encompasses the design, prototyping and experimental testing of each component of the development platform. At the culmination of Phase II, the molecular nano-sensing platform will be validated by collaborative users in UCLA, UC Berkeley and UC Irvine, and positioned for market introduction.

Commercially this novel nanosensing platform will enable research and product development in molecular level phenomena related to chemical reactions and catalysis, chemical and biological sensing, and photonics. The work described in this proposal will produce a valuable new nanoelectronics research tool that will ultimately result in new discoveries and products in sensing and diagnostics. Researchers seeking to develop new direct electronic detection sensing applications and conduct charge transfer experiments at the molecular level lack a robust, inexpensive experimental platform. In most cases researchers must develop their own experimental apparatus, interfaces and software. For those wishing to take advantage of the sensitivity and flexibility of nanoelectronic arrays, fabricating the devices is a formidable and cost prohibitive challenge. This project seeks to provide a state-of-the-art nanotechnology-based solution in an ultra sensitive and flexible detection platform

Title: SBIR Phase II: High Performance Thin Film Transistors on Plastic Fabricated from Dense Thin-Films of Oriented Semiconductor Nanowires

Award Number: 0450585
Program Manager: T. James Rudd

Start Date: March 1, 2005
Expires: February 29, 2008
Total Amount: $999,554

Investigator: David Stumbo, dstumbo@nanosysinc.com
Company: Nanosys Inc
2625 Hanover St
Palo Alto CA, 94304
Phone: (650)331-2106

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a revolutionary new high-performance thin-film-on-plastic technology that will provide single-crystal silicon, thin film transistor (TFT) performance. This technology is based on a novel thin-film semiconductor on plastic composed of a dense film of parallel nanowires with electronic properties comparable to single-crystal silicon that can be deposited at low temperatures. In Phase I, the feasibility of this innovative technology was successfully demonstrated and key device design and material processing parameters to address underlying device performance were identified. Specific developments included (1) nanomaterial deposition (2) contact technology (3) doping processes and (4) device architecture. Phase II research will build on the knowledge gained in Phase I, and focus on further optimization of device performance and the development of roll-to-roll manufacturing processes. The output of Phase II will be a prototype array of transistors on plastic. In addition, this fundamental concept can be applied to nanowire materials other than silicon, allowing the production of thin films of material that presently are impossible to produce over large areas on any substrate, including semiconductors relevant to communications (GaAs, InAs), optically active materials (GaN, InP), piezoelectric or ferroelectric materials (SrTiO3), or materials of mixed composition with newly engineered properties.

Commercially, this research will impact greatly the development of high performance TFT devices on plastic for commercial, military, and homeland security markets. These high-performance, flexible semiconducting films have the potential to replace amorphous and polycrystalline silicon in important large-area electronics applications such as displays and also radio frequency identification tags (RFID'S).

Title: SBIR Phase II: Dye Co-Sensitizer Combinations for Increasing the Efficiency of Dye-Sensitized Titania Nanoparticles in Solar Cells

Award Number: 0450532
Program Manager: T. James Rudd

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $511,977
Investigator: Russell Gaudiana, rgaudiana@konarka.com
Company: Konarka Technologies Inc
100 Foot of John Street
Lowell MA, 01852
Phone: (978)569-1410

Abstract:

This Small Business Innovation Research(SBIR) Phase II project aims to commercialize lightweight, flexible, affordable solar cells and modules that efficiently generate electricity from sunlight or indoor room light. These cells are based on dye-sensitized titania which is coated on a flexible substrate at high speed in a continuous coating, laminating process. The overall objective of Phase II is to raise the cell efficiency from its current 7% to 10% or higher, thereby raising the module efficiency from 5% to over 8%. To accomplish this, the ability of the sensitizing dyes to harvest a much larger number of available photons and convert them into electrons must be increased. In Phase I of this program, a new class of sensitizing dyes that cover a larger portion of the solar spectrum, have larger absorptivity than the currently used ruthenium-based dyes was discovered. In addition, materials that have similar molecular structures to those of the new sensitizing dyes, and act as co-sensitizers by boosting electron injection from the dye to the titania, are co-adsorbed with the dyes on the surface of the titania. It is anticipated that the combination of these materials will bring the cell and modules performance to the desired level.

Commercially, the project will result in an inexpensive, efficient, flexible photovoltaic (PV) technology that can be integrated into consumer products. Therefore a renewable source of energy could be used to power products, minimizing the battery capacity and disposal requirements, and ultimately delivering power to building structures, avoiding emissions associated with fossil fuels. Security is a broad benefit on two levels. First, grid instability demonstrated by widespread blackouts in 2003 emphasizes the need for distributed power in our national grid. Secondly, growing homeland security concerns underscore the importance of wireless networks of sensors, cameras, and other monitoring systems for building and border security. Photovoltaics are uniquely suited to serve these distributed applications

Title: SBIR Phase II: Nanotube-Based Electronic Pressure Sensor

Award Number: 0422198
Program Manager: T. James Rudd

Start Date: October 1, 2004
Expires: September 30, 2006
Total Amount: $499,260

Investigator: Lian Zhang, lian@monano.com
Company: Molecular Nanosystems, Inc.
977 Commercial Street
Palo Alto, CA 94303
Phone: (650)846-2519

Abstract:

This Small Business Innovation Research (SBIR) Phase II program focuses on developing carbon nanotube-based electromechanical pressure sensors. To translate the change in pressure into an electrical signal, current solutions (MEMS devices) use membranes with sensors made out of doped silicon. Silicon, however, is prone to effects of temperature changes and as a result, such devices require additional electronics for temperature compensation and more stringent packaging. They also have sensitivity limitations. The device in this work will use carbon nanotubes as strain gauges. Because nanotubes have higher sensitivity (higher gauge factor) and better temperature stability, this will result in development of devices that are easier to manufacture (fewer manufacturing steps), have superior precision, and require less stringent packaging, leading to less expensive end-product. This work will combine chemistry for synthesis of materials and microfabrication to explore important properties of a novel nano-material carbon nanotubes. Key technical innovations will include precise placement of nanotubes on thin membranes, novel approaches to avoiding membrane damage during nanotube integration, forming nanotube circuits on membranes for electromechanical pressure sensors and other integration issues.

If successful, the project will lead to the first application of carbon nanotubes in high-end electronic devices, enabling the development of nano-electromechanical systems (NEMS), which convert mechanical effects into electrical signal. Such devices, which would include pressure sensors, accelerometers, gyroscopes and acoustic sensors, could address the unmet needs in a wide range of applications, such as in automobiles, safety, medical, military and process control. Specifically, in the automobile market, a nanotube-based pressure sensor could serve as a tire pressure measuring device and could result in over $180million in annual savings for such end users as the automotive industry.

Title: SBIR Phase II: Direct Conversion of Heat to Electricity with Nanowire Antenna Arrays

Award Number: 0422219
Program Manager: T. James Rudd

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $488,855
Investigator: Lin Simpson, LSimpson@itnes.com
Company: ITN Energy Systems Incorporated
8130 Shaffer Parkway
Littleton, CO 80127
Phone: (303)420-1141

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop enabling nanotechnology that collects and converts infrared radiation (IR) from heated sources into DC power using nanowire antenna arrays with monolithically integrated rectifying diodes (IR-AAID). The innovation uses scaleable (square meters), self-organizing, and inexpensive electrochemical processing with low cost materials to engineer antenna/diode systems to convert light from heat sources. IR-AAID can convert heat to electricity at over 40 percent efficiency and be adapted to different emitters simply by changing the antenna geometry. The best IR thermo-photovoltaic modules typically operate at less than 5 percent efficiency, cost more than $300 per Watt, require up to 2000 degree Kelvin emitter temperatures to match available bandgaps, and require expensive materials with chemically tailored compositions, that are temperature sensitive, to match specific energy applications. In Phase I, the team demonstrated the feasibility of forming nanometer scale IR collecting antenna/diode structures over large areas, developed unique measurements to independently evaluate antenna and diode performance, demonstrated materials and diode structures that will provide the required IRAAID performance, generated DC power from light with IR-AAID devices, and demonstrated 6 percent conversion efficiency with non-optimized diodes. For Phase II, the team will develop robust processing to form inexpensive (less than $2 per Watt), IR-AAID prototypes to efficiently convert light to DC power.

Commercially, since IR-AAID does not require prohibitively expensive advanced lithography or direct serial nano-patterning, this effort will produce low-cost nanowire arrays with high density over relatively large areas, for heat collection. These applications will vary from portable power packs that use low temperature heat, to the generation of electricity from high temperature nuclear and conventional heat sources where noise or other environmental concerns are an issue. The enabling IR-AAID features are ideally suited for heat recovery applications, a $100B resource that is virtually untapped at present due to the limitations and costs of existing technology.

Title: STTR Phase II: Novel Nanocoated Ferromagnetic Materials

Award Number: 0422220
Program Manager: T. James Rudd

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $469,030
Investigator: Karen Buechler, buechler@aldnanosolutions.com
Company: ALD NanoSolutions, Inc.
11711 Chase Ct
Westminster, CO 80020
Phone: (303)460-9865

Abstract:

This Small Business Technology Transfer Phase II project will build on the great successes of the Phase I program by proving that the nanocoating of fine ferromagnetic particles is possible on the large scale and that such nanocomposite particles have commercial uses. The Phase I program proved that atomic layer deposition (ALD) of an alumina film can provide these properties.The objectives of the Phase II program are to prove the scalability of the process as well as to work with supporting companies to develop specific products for commercial markets. A pilot scale facility will be constructed to increase the scale of production to provide the kilogram quantities of material that most partners require for product development. This facility will be optimized to provide the best quality coatings at the lowest production cost. It is anticipated that at the close of the Phase II program, the company will have developed at least one market for full scale production with 2-4 markets still being developed. The ALD nanocoating of individual ultrafine particles to control individual ultrafine particle surface chemistry is enabling technology that is unparalleled compared to more conventional CVD, PVD, PE-CVD, or wet chemistry solution processing. The process allows for individual ultra-fine particles to be nanocoated, rather than coating aggregates of ultra-fine particles. It is independent of line of sight and provides for chemically bonded films to the substrate particle surface. It is easily scalable. It is a forgiving process where the nanocoating thickness is controlled by self-limiting surface reactions (not flux, temperature, or time of processing like CVD, etc.). Films are pin-hole free and conformal. Commercially, fine iron particles are used in a variety of applications such as metal injection molding, radar absorption, localized drug delivery carriers, electronic devices etc. Most of these applications would benefit from a smaller initial iron particle size and reduced oxidation sensitivity. Thus nanocoating of ultrafine particles provides many opportunities. It is now possible to produce ultrafine particles with designed electrical, magnetic, optical, mechanical, rheological, or other properties.

Markets for such functionalized ultra-fine powders include microelectronics, defense, hardmetals, cosmetics, drug delivery, energetic materials, and polymer/ceramic nanocomposites, among others.

Title: SBIR Phase II: Nanofluidic Reference Electrode with an Invariant Liquid Junction Potential

Award Number: 0422237
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $494,988

Investigator: Scott Broadley, sbroadley@broadleyjames.com
Company: Broadley-James Corporation
19 Thomas
Irvine, CA 92618
Phone: (949)829-5524

Abstract:

This Small Business Innovative Research (SBIR) Phase II is for the development of nanofluidic-flowing liquid junction (NFLJ) reference electrodes using nanochannel glass arrays developed by the Naval Research Laboratory. While consuming electrolyte at less than 2 ml/yr, the NFLJ reference electrodes will allow a flow at velocities of over 0.1 cm/sec to impede back diffusion of sample solution into the electrode. A variety of challenging test sample solutions, potentiometric measurements made with NFLJ references varied < 0.5 mV with response times of less than 60 seconds while measurements made with conventional reference electrodes varied up to 20 mV with response times of over one hour have already been completed. The NFLJ reference electrode's exceedingly small electrolyte consumption makes possible handheld NFLJ pH sensors with significantly higher precision and longer operational life. The high impedance of NFLJ reference electrodes, when using modern commercial pH electrodes, has no measurable effect on the precision, response time, or span of the pH measurement. The nanochannel glass nanofluidic-flowing liquid junction (NFLJ) adds a new dimension to the design and construction of reference electrodes.

The unique ability of the NFLJ design to separate flow volume and flow velocity will provide scientists with a tool for investigating reference electrode behavior as a function of flow, velocity, and resistance. It should help to develop a more fundamental understanding of mass transfer effect on liquid junction potentials. Initial results indicate that velocity is the critical parameter in stabilizing the potential.

Title: SBIR Phase II: Nanocomposite Solar Cells

Award Number: 0422147
Program Manager: T. James Rudd

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $499,990

Investigator: Erik Scher, escher@nanosysinc.com
Company: Nanosys, Inc.
2625 Hanover Street
Palo Alto, CA 94304
Phone: (650)331-2106

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative solar technology that combines nanotechnology with conducting polymer photovoltaics to achieve light weight, flexible solar cells that surpass current solar cell efficiencies, but can be manufactured at a fraction of the cost. Phase I, successfully demonstrated the feasibility of this innovative technology and identified key device design and material requirements to address underlying loss mechanisms limiting the nanocomposite photovoltaic performance. Specific developments included (1) controlled nanocrystal surface chemistry (2) novel nanocrystal synthesis (3) film morphology control and (4) reproducibility and control of the entire process from synthesis to device measurement. Phase II research will build on the knowledge gained in Phase I, and focus on the development of optimized optical and electronic materials and the development of an advanced stacked-intra-layer recombination device architecture. The output of Phase II will be a prototype of an optimized, light-weight, low-cost, flexible solar cell with efficiency greater than 10%; amenable to large-scale, low-temperature manufacturing by roll-to-roll.

Commercially this technology has the potential to meet the market needs to enable solar energy to become an integral and critical power generation source world-wide, providing societal benefits in the areas ranging from environment to national and economic security. Commercial applications exist for high performance, low-cost solar cells that can provide an alternative power generation source. Specific examples of use include on-grid building integrated electricity generation systems; on-grid wholesale power generation; remote off-grid power generation; portable power generation; and power generation for long-term aerospace applications.

Title: SBIR Phase II: Next Generation Nano-Probes for Ultra-High Resolution Near Field Microscopy, Nanolithography, and High-Density Data Storage

Award Number: 0422018
Program Manager: T. James Rudd

Start Date: July 1, 2004
Expires: June 30, 2006
Total Amount: $498,094

Investigator: Ahmed Sharkawy, sharkawy@emphotonics.com
Company: EM Photonics, Inc.
51 E. Main Street
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Phone: (302)456-9003

Abstract:

This Small Business Innovation Research Phase II project focuses on the development, demonstration, and commercialization of ultra-high resolution nano-probes for applications in near field scanning optical microscopy/spectroscopy (SNOM), nano-lithography and high-density optical data storage based on photonic band gap technology. In this Phase II project the planar, photonic crystal-based nano-probes analyzed and fabricated in Phase I will be optimized. In addition, the process for realizing full three-dimensional photonic crystal nano-probes will be developed. Tune-ability will be incorporated in the nano-probes by either varying the physical dimensions of an embedded nanocavity, within our probe, or by applying an external electric, or magnetic, field to modify the optical properties of a nanocavity and hence modulate its resonant frequency, or line width. By tuning the operational wavelength of the nano-probes, they can be used to image rather complex spatial features at various spectral wavelengths. The nano-probe will be combined with an integrated spectrometer for spectral filtering of various detected wavelengths. Both the nano-probe and the spectrometer are photonic crystal based and hence can be integrated on a single device. Recently developed technology, which is referred to as combinational lithography, will be used to realize a three-dimensional nano-probe. The advantage here is that by having full lateral confinement one can realize a nano-probe that can be scanned over a photoresist coated sample and used to expose it. The advantage the technique has over conventional SNOM exposure is that by using a photonic crystal nano-probe the lateral fields are localized to a much smaller region, which results in a much higher resolution exposure. To this end, the combinational lithography process is a technique for the fabrication of defects, such as tapered waveguides and resonators, embedded in a three-dimensional photonic crystal. The method is efficient, flexible and very economical for fabricating large-scale photonic crystals. As such, it allows for the arbitrary placement of defects within a high quality photonic crystal lattice of arbitrary symmetry, and achieves this in a minimum number of process steps.

Commercially the project will lead to multi-functional, high resolution photonic crystal based nanoprobes that will dramatically impact both the commercial and research fields of near-field optical microscopy, optical data storage, and nanolithography. The innovation has near term potential integration with current nano-photonic imaging and writing systems. In the future, these devices show potential for various systems requiring high resolution such as single molecule detection, which have generated significant interest in the physical and biological sciences and the study of small numbers of quantum dots, where probe requirements are far below that achievable by classical optics (~100nm) as is due in part to the high density of quantum dots which necessitate sub-micron optical resolution in order to isolate quantum dot structures.

Title: SBIR Phase II: Highly Efficient, Long Lifetime, and Inexpensive Nanocrystal Light Emitting Diodes (LEDs)

Award Number: 0349730
Program Manager: T. James Rudd

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $468,743

Investigator: Yongqiang Wang, awang@nn-labs.com
Company: NanoMaterials and NanoFabrication Laboratories
3468. W. Yale St.
Fayetteville, AR 72704
Phone: (479)871-0707

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will advance the performance of light emitting diodes based on semiconductor nanocrystals (NanoLEDs) to the same level of that of organic/polymer light emitting diodes (OLEDs). The key parameters of NanoLEDs targeted for this Phase-II program are 2000 hours operation lifetime, above 200 Cd/m2 brightness, and 0.5-2% external quantum efficiency. The Phase-II program will improve the performance of the NanoLEDs through a unique design of the nanocrystal thin layer in the devices. This design enables the ligands of all nanocrystals to be inter- and intra-particle cross-linked, which results in the thermally stable nanocrystal thin films required for high performance devices. The three dimensionally cross-linked ligands are short and have quasi-conjugated electronic structures, instead of the traditional long aliphatic ligands. This choice aims to dramatically improve the charge injection and charge transport in the NanoLEDs. New types of nanocrystals to be used will diminish the re-absorption and energy transfer in the densely packed nanocrystal thin films identified in literature. With the committed support from a state agency and extensive collaboration with mainstream industry it is expected to commercialize this technology in the display and lighting industry within five years.

The commercial potential of NanoLEDs is enormous. NanoLEDs possess nearly all of the advantages of OLEDs, but with readily tunable and narrow emission profiles. OLEDs are currently being used in active commercial development. The commercial goal in the Phase-II is to boost the performance of the NanoLEDs to at least the same level of that of the polymer LEDs, the low end of OLED devices. The first generation of NanoLEDs will be used in portable electronic devices. When the lifetime of NanoLEDs is extended over ten years, they will be used for other display technologies and in the lighting industry. NanoLEDs will one day change the way we see the world. Based on industry estimation, the near-term market for flexible LEDs, including NanoLEDs, will be $5 billion in 2005. After they are adapted to the mainstream of the flat panel graphics and lighting applications, the market size is going to be at least tens of billions.

Title: SBIR Phase II: Reactive Mounting of Heat Sinks

Award Number: 0321500
Program Manager: Winslow L. Sargeant

Start Date: October 15, 2003
Expires: September 30, 2005
Total Amount: $500,000

Investigator: Timothy Weihs, tweihs@reactivenanotech.com
Company: Reactive NanoTechnologies
111 Lake Front
Hunt Valley, MD 21030
Phone: (410)771-9801

Abstract:

This Small Business Innovation Research (SBIR) Phase II project introduces a new reactive joining process for mounting heat sinks onto chips, chip packages and substrates. The process uses reactive multi-layer foils as local heat sources for melting solder layers, and consequently bonding the components. The foils are a new class of nano-engineered materials, in which self-propagating exothermic reactions can be ignited at room temperature with a spark. The work will focus on reactive mounting of heat sinks onto server chips, an application that is in critical need of performance improvements. Two alternatives will be considered - the reactive mounting of a copper heat sink onto a metallized heat spreader that surrounds the chip, and reactive mounting of the heat sink directly onto a metallized chip. Significant improvements in heat conduction in microelectronic devices are needed as existing approaches such as adhesives, greases and epoxies suffer a number of limitations such as poor thermal conductivity, low mechanical strength and/or susceptibility to degradation. With the decrease in the size and the increase in speed of microelectronic devices, poor heat dissipation has started to limit device performance and applications and thus has become a critical issue.

The worldwide market for thermal management in microelectronic devices is about $3.7 billion/year and high-end heat-sink mounting constitutes approximately 10% of this market

Title: SBIR Phase II: Aligned Carbon Nanotubes for Use as Atomic Force Microscope Tips

Award Number: 0078536
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2000
Expires: August 31, 2002
Total Amount: $369,369

Investigator: Vladimir Mancevski, vam@xidex.com
Company: Xidex Corporation
8906 Wall Street, Suite 105
Austin, TX 78754
Phone: (512)339-0608

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to establishing the first-ever, large-scale production capability needed to manufacture carbon nanotube tips for scanning probe tools. To achieve this, the investigator must combine several fabrications technologies in a unique way. The investigator must also solve challenging problems related to the design, structural form and attachment of the tips themselves that will enable them, as the manufacturer, to guarantee that the products sold meets customers' performance specifications. It is believed, for example, that one of their proprietary technologies will enable them to produce carbon nanotube tips that meet the important requirement for adequate stiffness in lateral bending.

The core technology being commercialized stems from a new approach for growing a single, aligned carbon nanotube directly on a cantilever, originally identified by the PI. This approach is suitable for fabricating both the carbon nanotube tip and the cantilever in one continuous process, ideal for large-scale manufacturing. Xidex will develop, manufacture and sell carbon nanotube tips for use with critical dimension atomic force microscopes (CD-AFMs), scanning capacitance microscopes (SCMs), regular atomic force microscopes (AFMs) and scanning tunneling microscopes (STMs).

Title: SBIR Phase II: Development of High-Tc Superconducting Quantum Interference Device (SQUID) Magnetometers for Unshielded Operation

Award Number:	9983502
Program Manager:	Winslow L. Sargeant
Start Date:	April 1, 2000
Expires:	March 31, 2002
Total Amount:	$399,974

Investigator(s) Mark DiIorio, markd@magnes.com
Company: Magnesensors, Inc. (MSI)
9717-A Pacific Heights Boulevard
San Diego, CA 92121
Phone: (619)458-5752

Abstract:

This Small Business Innovation Research Phase II project is aimed at developing an ultra-sensitive magnetic sensor technology that is capable of operation in an unshielded environment. These compact sensors will be based on superconducting quantum interference devices (SQUIDs) that are fabricated from high temperature (high-Tc) superconducting materials. A collaborative effort between MagneSensors and U.C. Berkeley will employ novel design and materials processing solutions to produce high-Tc SQUIDs operating in ambient fields with an unprecedented level of sensitivity. The program will test the developed sensors on real-world applications at both low and high frequencies to demonstrate operation in the presence of large background magnetic field interference. This new enabling technology seeks to overcome the limitations in sensitivity, bandwidth, size, and spatial resolution, which restrict the more widespread application of present conventional magnetic field sensors. The eventual goal is the development of a low-cost, portable system with much greater sensitivity than is available with any other instrumentation.

This technology will enable the development of an entirely new generation of instrumentation that will find use in a wide variety of applications. Such applications include non-destructive evaluation of cracks and corrosion in aircraft, inspection of integrated circuits, homogeneous immunoassays and DNA probes using magnetic labels, geophysical surveying, environmental monitoring, detection of unexploded ordnance, diagnosis of intestinal ischemia, and screening for cardiac arrhythmias The potential market size for some of the applications reaches over $1 billion.

Title: SBIR Phase II: Characterization of Ceramic Particles Based on Elliptically Polarized Light

Award Number: 9983405
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2000
Expires: July 31, 2003
Total Amount: $761,977

Investigator: Sivakumar Manickavasagam, sivam@synergetic-tech.com
Company: Synergetic Technologies, Incorporated
One University Place Suite D-210
Rensselaer, NY 12144
Phone: (518)525-2650

Abstract:

This Small Business Innovation Research Phase II project is aimed at developing and demonstrating an innovative information-rich and real-time system for particle characterization. Encouraged by results from Phase I which established the feasibility of using polarized light scattering for characterization of micron, sub-micron and nano-sized ceramic particles, Synergetic Technologies proposes to develop an accurate and reliable on-line instrument. Phase I illustrated the high accuracy achievable, the ability to detect and quantify nano-size particles, and the capability of determining the size distribution of high aspect ratio whiskers and irregularly shaped particles. Project tasks include: system design, construction, calibration and testing; software development for more accurate shape determination and automized system use; study of different lasers; and testing and demonstration at three potential customer sites (a major ceramic research university, a large industrial research laboratory, and a small company at the leading edge of nanomaterials production). The University of Kentucky staff and students will assist in this project.

The ability to measure fine particle sizes and shapes on-line is necessary for controlling the quality of many high technology products, such as advanced ceramics and pharmaceuticals. In addition, monitoring and controlling particle size is fundamental to the manufacture of many consumer products, medical products, food processing and environmental monitoring.

Title: SBIR Phase II: Nanocrystalline Fe-Co For Electromagnetic Interference (EMI) Suppression

Award Number: 0239008
Program Manager: Winslow L. Sargeant

Start Date: January 1, 2003
Expires: December 31, 2004
Total Amount.: $500,000

Investigator: T. S. Sudarshan, sudarshan@matmod.com
Company: Materials Modification Inc
2721-D Merrilee Drive
Fairfax, VA 22031-0113
Phone: (703)560-1371

Abstract:

This Small Business Innovation Research Phase II project focuses on developing nanocrystalline soft ferromagnetic materials for various end use applications such as Electromagnetic Interference (EMI) suppression, magnetic bearings and inductors. Phase I clearly established the feasibility of producing these materials via a patented microwave plasma technique. In addition, these nanomaterials were consolidated to near theoretical densities using a patented plasma pressure compaction technique and the compacts exhibited high magnetic strength and low coercivity. During Phase II, the process will be to develop these materials for specific applications. Our Industrial partners will evaluate the produced materials to evaluate parameters, which are critical for transitioning the technology to an immediate useful product. In addition, an IP protection and various avenues to commercialize the technology will be sought.

There are numerous applications for nanocrystalline soft magnetic materials with superior magnetic and mechanical properties and low core loss. This includes EMI prevention components, generators, transformers, data communication interface component, magnetic bearings (commercial high-performance applications in the domain of rotating machinery), magnetic recording heads, motors, sensors, and reactors. MMI plans to focus on three market segments including (1) EMI suppression (2) Magnetic Bearings and (3) Inductors.

Title: SBIR Phase II: Nanoparticle Photostimulated Luminescence Based Optical Storage

Award Number: 0132030
Program Manager: Cheryl F. Albus

Start Date: February 1, 2002
Expires: January 31, 2004
Total Amount: $499,988
Investigator: Wei Chen, wchen@nomadics.com
Company: Nomadics Incorporated
1024 S. Innovation Way
Stillwater, OK 74074-1508
Phone: (405)372-9535

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will demonstrate the ability to generate photostimulated luminescence (PSL) in nanoparticles. The potential applications in digital imaging and storage offered by PSL phosphors, including X-ray imaging could be significant. PSL phosphors currently in use present several drawbacks including greater expense and poorer resolution as compared to conventional screen-film methods. The quantum confinement of nanoparticles offers solutions to many of the shortcomings of existing PSL phosphors. The project will characterize nanoparticles with a goal of optimizing these materials for use as phosphors in thin films. The project will also fabricate the required thin films and compare them to commercially available PSL phosphors for performance, longevity, and other factors of interest.

The commercial applications will be widely applicable to digital imaging, offering high resolution, low cost, easy storage, low complexity, easy portability, and other desirable features. Materials with efficient PSL have great potential for technical applications such as optical storage, X-ray imaging, radiation measurements and quality control, optical dosimeters and dating, infrared sensors, image intensifiers, near-infrared-to-visible light converters, and bio-molecular structure recording and probing.

Title: SBIR Phase II: Dissolution of Single-Walled Carbon Nanotubes

Award Number: 0110221
Program Manager: Cheryl F. Albus

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $499,938
Investigator: Mikhail E. Itkis, mitkis@engr.ucr.edu
Company: Carbon Solutions, Inc
5094 Victoria Hill Drive
Riverside, CA 92506-1450
Phone: (909)787-2229

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a cost-effective procedure for the production of soluble single-walled carbon nanotubes (SWNT) in commercial quantities. Phase I results demonstrated dissolution of full-length SWNTs in common organic solvents by exfoliation and covalent functionalization. It has been found that the purity of as-prepared SWNT (AP-SWNT) soot greatly influences both the cost and quality of the final product. The major emphasis for the project will be directed towards the synthesis of byproduct-free AP-SWNT soot, in purification of the SWNTs and in optimizing and scaling-up the dissolution step.

The dissolution of carbon nanotubes can greatly enhance the processability of this unique material and facilitate the entry of SWNTs into commercial applications requiring high strength lightweight materials, electromagnetic shielding materials, conductive composites and nanoelectronics. The development of the solution chemistry of SWNTs will facilitate applications in polymer science, and in medicine.

Title: SBIR Phase II: Nanomaterial for Microchip Chemical Sensors

Award Number: 0215819
Program Manager: T. James Rudd

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $499,994
Investigator: Stuart Farquharson, stu@rta.biz
Company: Real-Time Analyzers, Inc.
87 Church Street
East Hartford, CT 06108-3728
Phone: (860)528-9806

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will develop a novel microchip chemical analyzer that incorporates a new nanomaterial that performs both separation and detection of small quantities of chemicals and biochemicals. Phase I demonstrated feasibility by incorporating a proprietary nanomaterial in 20- by 50-micron channels etched in a glass microchip and performing chemical separation and surface-enhanced Raman spectral analysis of several test chemicals. Phase II will complete development of the microchip chemical analyzer by designing reproducible plastic microchip cards that fit into an integrated micro-fluidics and Raman system. Development will include the following chemicals: p-aminobenzoic acid, phenyl acetylene, adenine, acetaminophen, secobarbitol, cocaine, and related metabolites.

The microchip analyzer will have broad commercial value to the agricultural, biotech, chemical agents, environmental, medical and pharmaceutical industries. Specifically, the microchip is being designed to measure drugs and metabolites in body fluids to aid clinical trials of new drugs, assist dosage control of chemotherapeutic drugs, and diagnose drug overdose.

Title: SBIR Phase II: Synthesis of High Capacity Sn/MOx Nano Composite Anode Materials for Lithium Rechargeable Batteries

Award Number: 0321628
Program Manager: T. James Rudd

Start Date: September 1, 2003
Expires: August 31, 2005
Total Amount: $500,000
Investigator: John M. Miller, jmiller@tjtechnologies.com
Company: T/J Technologies, Inc.
PO Box 2150
Ann Arbor, MI 48106-2150
Phone: (313)213-1637

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a metal-oxide tin-alloy nano-composite for use as an anode material in a new ultra-low cost lithium-ion battery. This new battery system could impact many applications and offer an environmentally benign alternative to lead acid batteries with significant performance enhancements. With the advent of ultra-low cost cathode materials, for example lithiated metal phosphates, the development of a complementary anode material is now the gating item for low-cost lithium-ion batteries. In Phase I, mixtures of transition metal oxides and tin alloy were successfully produced. The electrochemical and physical characteristics were evaluated and these materials showed excellent electrochemical performance but exhibited a high first cycle loss. Internal work on tin alloys mixed with transition metal carbides and nitrides suggests the first cycle loss could be improved through simple chemical modification of the oxide component. The Phase II work will involve development of these modified oxides to reduce first cycle loss. In addition low cost production methods will be developed for preparing the precursors and materials. Optimized electrodes for use in ultra-low cost battery prototypes will be produced and targeted for outside evaluation.

Commercially, this anode material will be combined with metal phosphate cathodes to make a new class of lithium-ion batteries that are cost competitive with lead-acid batteries and maintenance free. This higher energy lead acid replacement opens up opportunities in the growing UPS and HEV markets. There are also non-commercial impacts. Any reduced use of lead acid batteries, which creates toxic waste, is beneficial to the environment. This new class of batteries would lead to the reduction of the 50,000 tons of toxic lead released due to incomplete recycling of lead-acid batteries. The development of materials that enable lithium-ion batteries to be cost competitive with lead acid batteries could give US battery manufacturers a chance to compete against the Asian dominated rechargeable battery market.

Title: SBIR Phase II: Randomly Textured Nanoscale Surfaces for Silicon Solar Cells

Award Number: 0109098
Program Manager: Ritchie B. Coryell

Start Date: January 1, 2002
Expires: December 31, 2003
Total Amount: $472,584

Investigator: Saleem H. Zaidi, saleem@uswest.net
Company: Gratings, Incorporated
7104 Jefferson, N.E.
Albuquerque, NM 87109-4311
Phone: (505)889-4072

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will integrate random, reactive ion etching (RIE) texturing techniques into low-cost, multi-crystalline (mc) silicon (Si) solar cells. RIE texturing techniques, developed in Phase I, are distinguished by their low-reflection (1 percent), large area (200 square centimeters) application, and the ability to control etched profiles. This texture control has been employed to increase near infrared absorption in Si by enhanced oblique optical coupling into the substrate. RIE-texturing techniques have potential application in several fields including low-cost substrates for surface enhanced Raman scattering and field emission devices. Phase II will be concerned with conformal emitter formation techniques uniquely suited to RIE-textured surfaces. These methods will lead to solar cell manufacturing in a cluster environment with similar chambers for texturing, emitter formation, and nitride films for surface passivation.

Potential industrial applications are expected in high-efficiency, RIE-textured, mc-Si solar cells using processes suitable for their respective manufacturing environments.

Title: SBIR Phase II: Continuous Flow Reactor and Size-Selection Chromagraphic Scheme for Use in High Throughput Manufacture of Silicon Nanoparticles

Award Number: 0321688
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,903

Investigator: Fred V. Mikulec, fmikulec@innovalight.com
Company: InnovaLight
6801 N. 360 Hwy
Austin, TX 78731-1786
Phone: (512)795-5835

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to continue the scale up of luminescent Si nanocrystal production using the continuous flow reactor developed during the Phase I period where the main objective of the Phase I proposal of converting a cumbersome batch process into an efficient continuous one was accomplished. This new continuous flow reactor will serve as an enabling technology because the system will be applicable to the high temperature synthesis of numerous nanoscale colloidal materials.

This technology could raise the average efficiency of conventional lighting from under 15% to more than 50%, potentially reducing the electricity consumed for illumination by a factor of 3X. The process can create particles that have many favorable attributes that lend themselves to other applications as well, many of which will be pursued for licensing. These include multi-level floating gate memory, optical interconnects, optical integrated circuits, electro-chemical products, fuel cells, bio-molecular recognition, battery electrodes, and displays.

Title: SBIR Phase II: Nanoparticle Te Inks for Spray Deposition of Submicron Te Contact Layers in CdTe Solar Cells

Award Number: 0216422
Program Manager: T. James Rudd

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Doug Schulz, schulz@ceramem.com
Company: CeraMem Corporation
12 Clematis Avenue
Waltham, MA 02453
Phone: (617)899-4495

Abstract:

This Small Business Innovation Research Phase II project is aimed at making Photovoltaic (PV) solar electric power more affordable to our nation and to the world. The technology in this program represents a new process for the manufacturing of cadmium Telluride (CdTe) solar cells. In this process the contact layers of copper-doped tellurium nanoparticles are sprayed on rather than sputtered, which promises to be a more efficient method of manufacturing. The successful CdTe solar cell prototype will be designed with input from potential end-users as a means of increasing the likelihood for commercialization.

It is anticipated that this process will result in solar cells with superior initial and long-term efficiencies. Such improvements in performance could result in reduced costs for solar cell manufacturing ($/W), higher power during operation (kW-h/yr), and an extension of the useful lifetime - three aspects that will allow solar energy to be more competitive with existing methods for electric power production.

Title: SBIR Phase II: High Performance Nano-Fe/SiO2 Soft Magnetic Cores Based on Exchange Coupling

Award Number: 0216929
Program Manager: T. James Rudd

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,997

Investigator: Yide Zhang, inframat@aol.com
Company: Inframat Corporation
74 Batterson Park Road
Farmington, CT 06032
Phone: (860)678-7561

Abstract:

This Small Business Innovation Phase II project is directed toward optimizing and scaling up fabrication of exchange coupled Fe/ceramic nanocomposites for high performance soft magnetic applications. In Phase I, Inframat Corporation took pioneering steps to develop Fe/ceramic magnetic nanocomposites, which resulted in significant improvements over microsized ferrites including higher saturation magnetization and lower power loss. The design of the Fe/ceramic nanocomposite is based on an exchange coupling effect between neighboring nanoparticles, where Fe nanoparticles are uniformly distributed within an insulating ceramic matrix. Successful Phase I efforts have provided the scientific and technological groundwork for further magnetic nanocomposite technology advancement in Phase II. The proposed Phase II program scales-up the Fe/ceramic nanocomposite technology performed in Phase I. Emphasis is on rapid commercialization of nanocomposite cores. Key Phase II milestones include (1) scale-up of the demonstrated chemical synthesis into pilot-scale production, (2) demonstration of prototype cores having desirable magnetic properties through exchange coupling, and (3) demonstration of high performance prototype DC-to-DC converters using the exchange coupled magnetic nanocomposite cores.

Phase II participants include Ceramic Magnetics, UConn, Villanova Univ., Georgia Tech, and a converter specialist, Colonel William McLyman. Ceramic Magnetics has pledged $75,000 cost share to the Phase II and will carry a $250,000 follow-on funding.

Title: SBIR Phase II: Fluorescent Polymeric Nanoparticles

Award Number: 0239285
Program Manager: T. James Rudd

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,998

Investigator: Lawrence F. Hancock, lhancock@nomadics.com
Company: Nomadics Incorporated
1024 S. Innovation Way
Stillwater, OK 74074-1508
Phone: (405)372-9535

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new generation of fluorescence amplifying reagents based on poly (phenylene ethynylene (PPE) nanoparticles. Because of the role of the amplifying polymer in the enhanced sensitivity of these compounds, these compounds are called Amplimer reagents. The project will develop and launch two types of Amplimer reagents: microarray and quantitative PCR reagents. The Amplimer reagents will improve the sensitivity and performance of fluorescence-based assays by providing brighter, more stable fluorescence signals and by improving sensitivity through fluorescence amplification effects.

The commercial and broader impacts of this technology are consumable fluorescent reagents that improve the sensitivity and reliability of two rapidly growing diagnostic platforms for genetic sequence analysis: microarray-based assays and quantitative PCR assays. Diagnostics based on genetic sequence information currently account for $1 billion of the $24 billion dollar diagnostics market. This figure is expected to grow significantly as the follow-on of the human genome project filters through drug discovery and medical science.

Title: SBIR Phase II: Advanced Light Weight Thermal and Electrical Insulation Using Fullerenes

Award Number: 0320618
Program Manager: T. James Rudd

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $500,000
Investigator: Eugene M. Wexler, eveksler@mercorp.com
Company: Materials & Elctrochem/MER
7960 South Kolb Road
Tucson, AZ 85706
Phone: (520)574-1980

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a technology to produce an advanced high efficiency multi-layer thermal and electrical insulation using fullerenes. The recently completed Phase I project has demonstrated absolute technical and economical feasibility of producing and utilizing such insulation systems resulting from the unique thermal properties of fullerenes. Fabricated samples of fullerene-based insulation were shown to possess R-values of 36 to 40 per inch of thickness, which considerably exceeds those of commonly available insulation materials (for example, polyurethane (R6.7), expanded polystyrene (R3.8), and even vacuum insulated panels (R9~24)). In addition, proposed fullerene-based insulation is very compact, lightweight and cost-effective. During the course of this Phase II project, the team will optimize fabrication technology, structure and properties of the proposed fullerene-based insulation as well as perform an extended prototype study by producing and fully characterizing various insulation systems. At the completion of this effort, an optimized fabrication technology for producing advanced thermal and electrical insulation systems will be demonstrated, commercial application identified and extensive testing at a potential customer site initiated in order to start the product certification process.

Commercially, the proposed high efficiency thermal and electrical insulation system will have numerous applications, especially in the area of cryogenic temperatures. Based on high performance, ultimate compactness, flexibility and lightweight, the premier field of application will include miniature cryogenic storage and shipping containers utilized in pharmaceutical industry, neuro- and bio-storage, assisted reproduction, oncology research, immunology, gene therapy, tissue banking, food industry, micro-refrigerators and mechanical freezers, etc.

Title: STTR Phase II: Vertical-Cavity Surface-Emitting Laser Based on Nanostructured Active Material

Award Number: 0321699
Program Manager: T. James Rudd

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $500,000
Investigator: Matt Kim, mkmicrolink@aol.com
Company: MicroLink
6457 Howard Street
Niles, IL 60714-3301
Phone: (847)588-3001

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop a vertical cavity surface emitting laser (VCSEL) that operates at 1.3 micron wavelength based on incorporating a quantum dot active region of GaAs-based InAs and GaAsSb. It is based on recent research developments within the university laboratory in developing novel 1.3 micron laser and VCSEL sources, and the commercial epitaxial growth capability of the company. In the project the tasks involved include growing GaAsSb quantum dots and quantum well structures, fabricating VCSELs using the InGaAs and GaAsSb based quantum dot and GaAsSb quantum well active regions, and development, demonstration and evaluation of manufacturable, high Q cavity suitable for commercial 1.3 micron VCSELs.

Commercially the project will lead to important new products for an emerging fiber optic market. The low cost 1.3 micron wavelength VCSEL is viewed by industry analysts as a key enabling device for high volume production of fiber optic transceivers for the metro and metro access markets.

Title: STTR Phase II: Benign Thin Film Composite Particles for Protection from UVA/UVB - Rays

Award Number: 0548739
Program Manager: George Vermont

Start Date: January 9, 2006
Expires: December 31, 2007
Total Amount: $448,225

Investigator: Karen Buechler, buechler@aldnanosolutions.com
Company: ALD NanoSolutions, Inc.
580 Burbank St, Unit 100
Broomfield, CO 80020
Phone: (303)318-4145

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project provides for the commercialization of surface-passivated composite titania/zinc oxide particles for benign protection from UVA and UVB radiation. The composite particles are manufactured via novel atomic layer deposition (ALD) technology. These materials are targeted at use in sunblock skin care formulations; the inert coating will allow easy dispersion of the particles in a variety of formulations, and will prevent direct contact between active titania or zinc oxide and the skin. The major health problem of sun-induced skin cancer could be helped with the introduction of new, more effective UVA/UVB protection in a wider variety of skin care products.

This Phase II project will focus on refining the material design, production at larger scale, and proving the effectiveness of these composites in formulations for UVA/UVB transmittance and sun protection factors.

Title: SBIR Phase II: Lithium Reservoir Nanocarbons for Lithium Ion Batteries

Award Number: 0548708
Program Manager: Rosemarie Wesson

Start Date: January 27, 2006
Expires: January 31, 2008
Total Amount: $462,455
Investigator: Ronald Jacobsen, rljacobsen@mlpc.com
Company: Applied Sciences, Inc
141 W. Xenia Ave.
Cedarville, OH 45314
Phone: (513)766-2020

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop Li-ion battery anodes that exploit the unique morphology of low cost carbon nanofibers (CNF). Primary efforts will focus on reduction of irreversible capacity, through a variety of nanofiber surface modification techniques, characterization of the upper limits of anode discharge rate, and development of a new type of compound anode material that combines CNF with elements that form high energy alloys of lithium. The latter effort has the potential to combine the high rate capability of CNF with the higher operation voltage of alloys in a manner that synergistically increases the reversible capacity of both components of the compound anode.

Safe, rechargeable, inexpensive Li-ion batteries are enjoying a growing customer base in diverse markets from consumer electronics to space vehicles. The unique morphology of carbon nanofibers and the fact that these materials can readily be transitioned into an existing client base of Li-ion battery producers and users, holds great promise for this cutting-edge research.

Title: SBIR Phase II: Commercial Scale Production of High Quality and Affordable Fe3O4 Nanocrystals for Nano-Biomedicine

Award Number: 0620323
Program Manager: Murali Nair

Start Date: August 8, 2006
Expires: July 31, 2008
Total Amount: $499,997

Investigator: Yongcheng Liu, ycliu@nn-labs.com
Company: NN-Labs
513 Harrogate Rd
Pittsburgh, PA 15241
Phone: (412)223-2443

Abstract:

This Small Business Innovation Research (SBIR) Phase II project intends to finalize commercial production protocols for high quality, highly stable, bio-compatible, bio-accessible, and yet affordable Fe3O4 nanocrystals and related magnetic beads. Current state-of-the-art methodology for making Fe3O4 nanocrystals for biomedical applications has many critical deficiencies including poor ability to control size, broad size distribution, difficult/complicated surface chemistry, high cost and low solubility in solutions. This technology will produce high quality of Fe3O4 nanocrystals. The company's products have excellent control of size and size distribution and offer super stability and friendly surface chemistry so that they are completely dispersible in solutions due to their simple processing and manufacturing technique. Their terminal groups are ready to conjugate various bio-molecules so that they can be used in various biomedical applications.

The primary application for this technology will concentrate on the life science research. Specific applications include (1) Magnetic bio-separation, (2) Magnetic resonance imaging (3) Drug delivery, and (4) Biomedical treatment. The biomedical applications related to the Fe3O4 magnetic nanocrystals cover many aspects of biomedical fields, ranging from diagnostics, detection, therapy, separation, and pollution control. The environmentally benign nature of this technology helps to achieve a sustainable environmentally-aware business paradigm.

Title: SBIR Phase II: Synthesis and Processing of High Performance Polymer Nanocomposite Foams

Award Number: 0620502
Program Manager: James Rudd

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $500,000
Investigator: Guojun Xu, xu96@yahoo.com
Company: Nanomaterial Innovation Ltd.
1109 Millcreek Lane
Columbus, OH 43220
Phone: (740)522-6617

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and scale-up a new group of light-weight, high-strength and fire-resistant polymeric foams by using innovative nanotechnology. The project explores the synthesis of nanocomposites using both plate-like and fiber-like nanoparticles with high carbon dioxide (CO2) affinity. Polymer blends including a minor phase with high CO2 solubility are used as the matrix material. To improve fire-resistance, surfactant-free and water-expandable polymer/clay nanocomposites are also prepared by suspension polymerization of inverse emulsion. Since low molecular weight surfactants are not needed, there is no fire hazard problem. These polymer blend nanocomposites are then used to produce high performance foam products aimed at both insulation and structural applications. The presence of nanoparticles in polymer blends allows better control of cell morphology and foam density in the manufacturing processes. Ultra-low-density foams with thermal insulation properties better than the existing insulation materials and high-density microcellular foams with mechanical properties close to those of solid polymers are achieved. The materials and processing conditions will be optimized to obtain better foamability and mechanical properties of these novel nanocomposites foams.

Commercially, nanocomposite reinforced foams have the potential in structural applications to replace solid polymers. The U.S. market for polymer foams was more than 7.4 billion pounds in 2001. Currently, their applications are limited by poor mechanical strength, surface quality, thermal stability and fire retardance. Furthermore, traditional chlorofluorocarbon (CFC) blowing agents cause ozone depletion and will be banned by 2010. As environmentally benign blowing agent CO2 is used to replace CFCs, the success of this project will be extremely valuable for environmental protection. A successful implementation of this novel technology can lead to significant impact on energy saving, material saving, and environmental protection that are critical to our nation's economy and societal health.

Title: SBIR Phase II: Quantum Dot / Fluoropolymer Composites: A New Approach for Enhancing Performance in Light Sources

Award Number:	0646322
Program Manager:	Juan E. Figueroa

Start Date:	March 1, 2007
Expires:	February 28, 2009
Total Amount:	$499,997
Investigator:	Earl Wagener, ewagener@bellsouth.net

Company: Tetramer
657 S Mechanic Street
Pendleton, SC 29670
Phone: (864)653-4339

Abstract:

This Small Business Innovation Research (SBIR) Phase II project describes an innovative approach to encapsulating nanocrystals (quantum dots and rare earth doped inorganics) using functionalized perfluorocyclobutyl (PFCB) polymers. This project will expand the range of ligands synthesized in Phase I specifically designed to enhance the encapsulation of nanocrystals currently being developed for commercialization in the rapidly growing light emitting diodes, displays, planar infrared amplifiers and photovoltaic markets. In Phase I, the company developed a significant competitive advantage by increasing nanocrystal loading to unprecedented levels with uniform distribution and little or no loss of performance. Further competitive advantages over current encapsulating polymers such as silicones, epoxies, and polycarbonates are Tg's above 250 0C, optical clarity at 800, 1330 and 1550 nm, and no free radicals or by-products during polymerization. This encapsulating performance creates an excellent competitive advantage since it meets a critical enabling need in the field of nanophotonics. The technical objectives for this project are 1) Synthesize 7 new functionalized polymers 2) Work with nanocrystal and device manufacturers to commercialize new nanocrystal composites for the markets shown above 3) Down select and scale up the best materials for commercialization. The Tetramer team has over 50 years of successful specialty polymer commercialization.

If successful the results of this project will enhance scientific and technical knowledge in the very active field of quantum dot and rare earth doped inorganic nanocrystals. In particular, the interaction between the unique functionalized PFCB polymers and the nanocrystal surface will provide new fundamental technical insights for the origins of performance of these materials in LED's, displays, infrared amplifiers, and photovoltaic devices. Improvement of devices in these markets has the potential for strong societal and commercial impact. For example, light emitting diodes replacing incandescent lighting alone could decrease national energy consumption by 29%, while more efficient, lower cost solar cells would reduce the US dependence on foreign oil. Use of these new encapsulating materials will enable new device designs for these high priority markets. This in turn will lead to improved cost performance therefore accelerating commercialization and the subsequent societal benefits of reduced energy usage and improved communications.

Title: SBIR Phase II: Integration of Nanostructured Electrodes with Organosilicon Electrolytes for High Energy-Density Supercapacitors

Award Number: 0724469
Program Manager: Rathindra DasGupta

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $496,384

Investigator: Robert West, rwest@silatronix.com
Company: Silatronix
University Research Park, Inc
Madison, WI 53719
Phone: (608)441-2700

Abstract:

The Small Business Innovation Research (SBIR) Phase II project proposes the development of ultracapacitor devices that combine the use of nanostructured carbon electrodes with organosilicon electrolytes. These innovative ultracapacitor devices are expected to provide higher working voltages than existing devices, yielding significantly increased energy and power density. This Phase II project will use laboratory results to develop prototype devices and address issues associated with scale up and development of procedures for creating prototype devices. These ultracapacitor devices will be characterized for long-term use by evaluating their physical properties and stability.

The size of the ultracapacitor market, already surpassing $200M, continues to grow at a compound annual growth rate of more than 15%. The development of improved ultracapacitor energy storage devices should accelerate this growth by facilitating the commercial development of low-emission vehicles, which should reduce the overall demand for energy. Organosilicon-based electrolytes should improve the overall safety profile of ultracapacitor devices due to their low flammability and low vapor pressures. The improved safety and improved physical characteristics will expand opportunities for the use of ultracapacitors as robust energy storage devices in consumer electronics and industrial applications. This work will also assist in the development of a trained workforce by involving graduate students and postdocs in the research and development effort.

Title: SBIR Phase II: Developing Advanced Ultracapacitors Using Carbon Nanomaterials and Environmentally Friendly Electrolytes

Award Number: 0724468
Program Manager: Rathindra DasGupta

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $499,993

Investigator: Wen Lu, wenl@adatech.com
Company: ADA Technologies, Inc.
8100 Shaffer Parkway
Littleton, CO 80127
Phone: (303)792-5615

Abstract:

The Small Business Innovation Research (SBIR) Phase II project seeks to develop advanced ultracapacitors for hybrid electric vehicles (HEV). The proposed research combines the unique properties of carbon nanotube (CNT) electrodes with those of environmentally friendly ionic liquid electrolytes to develop ultracapacitors possessing high performance (energy and power densities) and long life for HEVs. The proposed research will focus on optimization of CNT materials, production of selected CNT electrodes on a larger scale, and fabrication and evaluation of packaged prototype ultracapacitors.

Advanced vehicular ultracapacitrs are extremely useful in achieving better fuel economy, decreasing harmful emissions, and reducing the nation's reliance on foreign sources of petroleum. More generally, ultracapacitors are essential components in consumer electronics (ex: notebook computers, cell phones, pagers, video cameras), medical electronics (ex: drug delivery units), and military and defense systems (ex: spacecraft probes, missile systsms). In addition to ultracapacitors, research in the proposed project will also have a broad impact on the applications of carbon nanomaterials to other electronic and electrochemical devices.

Title: SBIR Phase II: Nanostructured Materials and Process for Improved Electrochromic Device Performance

Award Number: 0724375
Program Manager: William Haines

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Douglas Weir, dweir@sage-ec.com
Company: SAGE Electrochromics Inc
One Sage Way
Faribault, MN 55021
Phone: (507)331-4902

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project is to develop full size electrochromic (EC) window glazings with superior performance and durability due to the incorporation of sputtered nanocomposite thin film materials. These window glazings can be electronically darkened to control solar light and heat in buildings and vehicles. The new materials and processes will be tested for prototype glazings followed by the development of a robust manufacturing process with optimum product yield and reliability. Numerical simulation techniques will be used to model how process input variables impact product attributes with a goal of minimizing device variation and optimizing performance.

The performance and reliability improvements achievable from this SBIR project are essential for widespread acceptance of electronically tinted windows. The improved transmission properties and more neutral coloration obtainable with nanostructured materials are highly desired commercial features. A successful project will lead to widespread adoption of EC windows and enable annual energy savings of up to 0.7 quad to occur sooner. This corresponds to a reduction in carbon emissions of ~10.5 million metric tons per year. In addition to architectural windows, deposition technologies for nanostructured films can improve the performance of transportation windows, flat panel displays, and alternative gate oxides for advanced CMOS technology.

Title: SBIR Phase II: Supercritical Fluid Processing of Polymer/Clay Nanocomposites

Award Number: 0646447
Program Manager: William Haines

Start Date: January 1, 2007
Expires: January 31, 2009
Total Amount: $498,536
Investigator: Steve Horsch, steveedwh@hotmail.com
Company: nanoScienceEngineering Corporation
6942 Lakemont Circle
West Bloomfield, MI 48323
Phone: (313) 550-8523

Abstract:

This Small Businesss Innovation Reseach (SBIR) project will address a major technological barrier to producing superior nanocomposites by overcoming the difficulty of dispersing nano-fillers uniformly in a host matrix to derive the maximum surface area advantage. When effective filler dispersion is coupled with improved polymer-clay interactions, a significant technological gap in the field of polymer nanocomposites can be addressed. The company, nanoSEC has licensed, developed, and 'validated' (lab scale) a supercritical fluid-based dispersion (SCFP) technology, that produces significant clay dispersion using a simple, versatile, environmentally friendly process that utilizes the unusual properties of supercritical CO2. During Phase I, the clay dispersion conditions were optimized and showed significant property improvements in the resultant nanocomposites that were appreciably better than those in literature. During Phase II, these technical accomplishments will be translated towards commercial success by: (1) producing and benchmarking pilot-scale polystyrene/clay, polyethylene/clay, polypropylene/clay nanocomposites for mechanical and barrier property improvements, with applications in automotive and food packaging industries; (2) scaling up the pilot production process to produce 200 lbs/week of dispersed clay in Year 1, and to produce 1 million lbs/year of polymer-clay nanocomposites (at 10% clay loading) by Year 3; (3) developing specific joint development agreements with business customers for faster adaptation of nanoSEC's technology in actual products.

Commercially, nanoSEC's technology addresses a key need in nanocomposites, which could single-handedly revive the packaging technology applications of nanocomposites. Several companies have expressed strong interest in joint development agreements. Working closely with Wayne State, and end users like Ford, Daimler Chrysler, and GE Plastics will enable nanoSEC to advance both on research and commercial sides to produce a revenue of close to $ 8 million by the end of 2008. The Phase II project will enable pilot-commercial scale validation for rapid development and nanoSEC's location in the state-of-the- art NextEnergy building in Detroit, and the familiarity of the participants with the automotive and food packaging industry will enable unique applications to be achieved in a timely manner. The 'top down' strategy to partner with end users will enable fast implementation upon validation.

Title: SBIR Phase II: Titania-Loaded Silicone with High Refractive Index for Light-Emitting Diode Encapsulation

Award Number: 0646439
Program Manager: Juan E. Figueroa

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000

Investigator: Jong Kim, TroyResearch@nycap.rr.com
Company: Troy Research Corporation
18 Ledgewood Drive
Troy, NY 12180
Phone: (518)271-2044

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the development of a new class of materials, namely polymeric nanomaterials with a very high refractive index, which will closely match the refractive index of inorganic semiconductors. The encapsulant materials consist of titania-nanoparticle-loaded silicone and epoxy. Titania (TiO_2) has a refractive index of 2.68 and the admixture of TiO_2 with a polymer would result in an increase of the refractive index. The well-known problem of excessive optical scattering will be overcome by proper use of surfactants and an encapsulation structure that employs thin films, with a thickness that is less than the average distance between scattering events.

If successful the development of a new high-index encapsulant will have a tremendous impact on SSL technology because virtually all SSL devices made of inorganic semiconductors are packaged and encapsulated. A successful completion of the program will result in a worldwide paradigmatic shift in the packaging and encapsulation of optoelectronic devices. The broad deployment of efficient LED technology for general lighting applications would also result in electrical energy savings in the TWh range per year within the United States alone.

Photonics

Title: SBIR Phase II: Phase Locking of High Power Fiber Laser Arrays

Award Number: 0091378
Program Manager: Winslow L. Sargeant

Start Date: January 15, 2001
Expires: December 31, 2003
Total Amount: $499,987
Investigator: Peter K. Cheo, p.cheo@att.net
Company: PC Photonics Corporation
64 Windward Way
Waterford, CT 06385
Phone: (203)443-4356

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is aimed at achieving the first ever 350W (cw) output power in a high brightness and diffraction-limited laser beam from a multicore phase-locked fiber laser array. Under Phase I, the feasibility of the unique power combining concept has been demonstrated by phase-locking a group of 7 Yb-doped single mode fiber lasers, embedded in a common cladding. In addition, a theoretical model has been developed, providing a deeper understanding of physical mechanisms responsible for phase locking of a multicore fiber laser array. These results clearly indicate that this extremely challenging goal for Phase II can be accomplished. Nevertheless, there remain several obstacles that need to be removed before embarking on commercialization. First, a significant improvement of the laser performance must be made. This can be accomplished by exploring various parameters, which include fiber length, cavity finesse, gain saturation, temperature and stress distributions, as well as fiber structural parameters, such as core separation and the V-value. In addition, an order of magnitude improvement for efficient coupling of pump power into the clad must be made. To advance this technology, various pumping techniques will be explored, in particular the side pumping of the fiber laser from the cladding walls, instead of the fiber end facets. If successfully developed, this could be the most viable way to obtain the maximum output power without causing catastrophic damage. Finally, the reliability of the device when operating at very high power level must be established by raising the power-damaging threshold.

High power diode-pumped multicore fiber lasers can be very competitive in the market place as compared to high power diode-pumped solid-state lasers and C02 lasers presently employed by automotive, aerospace and ship-building industries for precision drilling, high-speed cutting and welding of metals and composition materials.

Title: SBIR Phase II: Electro-Optic Photonic Bandgap Materials and Devices

Award Number: 0522177
Program Manager: T. James Rudd

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,821
Investigator: Yingyin Zou, kzou@bostonati.com
Company: Boston Applied Technologies, Incorporated
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Phone: (781)935-2800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop electro-optic photonic bandgap (EO-PBG) Materials and Devices. During the Phase I project the feasibility of the proposed electro-optic PBG technology has been demonstrated. High quality EO film, La-modified PMN-PT (PLMNT), was successfully deposited using a unique metal-organic chemical liquid deposition (MOCLD) technique, a low cost and efficient manufacturing process. A large EO coefficient was achieved from PLMNT films. An innovative metallic/dielectric PBG structure was designed and studied for device applications. An electro-optic filter/modulator was developed. A two-dimensional PBG structure was demonstrated for efficient wavelength tuning through simulation. In Phase II based on this Phase I work, new generation tunable PBG material and devices, such as filters and modulators with state-of-the-art performance, will be brought to the marketplace.

Commercially photonic bandgap materials promise to give similar control of the flow of photons as there is over electrons in a semiconductor material but with even greater flexibility because there is far more control over the properties of photonic bandgap materials than the electronic properties of semiconductors. Given the impact that semiconductor materials have had on every sectors of society, photonic bandgap materials could play an even greater role in the 21st century, particularly in the optical-communications industry. Not only can this material be made into common PBG passive components, such as cavities, waveguides, or couplers, but also the active and dynamic ones, such as high-speed modulator and tunable filters. These advanced devices will have great applications in industrial, space, and military sectors

Title: SBIR Phase II: Efficient Light Out Coupling from AlGaN Light Emitting Diodes

Award Number: 0522067
Program Manager: T. James Rudd

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,961

Investigator: Hisham Menkara, hisham@phosphortech.com
Company: PhosphorTech Corporation
#154
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop novel graded-index (GIN) structures for blue/UV light emitting diodes (LEDs). Solidstate LEDs (SSLs) are among the most efficient converters of electrical energy into light and additionally have the advantages of long lifetime, excellent reliability, low power consumption, light weight, small size and excellent resistance to mechanical shock and
vibration. These significant benefits over conventional lighting explain why, according to a recent study, the average growth rate for the SSL market is expected to be around 200% per year for the next five years.Since LEDs are narrow-band emitters, they must be coupled to an efficient downconverting phosphor in order to achieve the broad emission necessary for the generation of white light. However, even for a perfect phosphor, high efficiency will not be achievable unless there is also efficient out-coupling of radiation from the LED into the phosphor and from the phosphor to air. The resulting losses associated with outcoupling are due to the difference in refractive indices (n) of adjacent material layers that cause Fresnel Reflections and total internal reflection (TIR). In Phase I the research team has developed unique material structures and electrophoretic (EP) deposition process that are expected to realize high out-coupling efficiencies from LEDs at low costs. During Phase I, the feasibility of the EP deposition process has been successfully demonstrated and the advantage of an index-matching structure has been shown to significantly (~50%) improve the light extraction efficiency in LEDs. This fact was demonstrated both experimentally and theoretically using ray tracing simulations. In Phase II the work will focus on refining these structures for blue/UV LED's to develop the efficient down- converting technology for enabling the new solid state lighting systems.

Commercially if SSL technology can achieve this projected goal, the lighting industry would be revolutionized. Potentially an efficiency of 200lm/W is possible, more than 2X better than that of fluorescent lamps (80lm/W), and more than 10X better than that of incandescent lamps (15lm/W). If current lighting, with an aggregate efficiency of roughly 50lm/W (in between the efficiencies of fluorescent and incandescent lamps), were replaced by semiconductor lighting with an aggregate efficiency of 150lm/W (somewhat less than the target), then the electricity currently used for illumination would decrease by a factor of three, from 2,350TWh to 780TWh. This would represent a decrease in global electricity use of 13%, and a decrease in global energy use and associated carbon emissions of 2.3%. In the U.S., the potential reduction in electricity consumption due to lighting is expected to be as high as 50% by the year 2025

Title: SBIR Phase II: Development of High Performance Ultraviolet Single Photon Detectors

Award Number: 0521973
Program Manager: Juan E. Figueroa

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000
Investigator: Petre Alexandrov, unitedsic@unitedsic.com
Company: United Silicon Carbide, Inc
100 Jersey Ave
New Brunswick NJ, 8901
Phone: (732)565-9500

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to carry out the major R&D work to fully develop a 4H-SiC Single Photon Avalanche Detectors (SPADs) capable of ultra-sensitive and reliable room temperature single photon counting in the ultraviolet (UV) range with high efficiency for a wide range of applications. Existing commercial semiconductor UV avalanche photo detectors (APDs) suffer from high-dark count due to the fundamental material limitation. Unlike other wide band gap semiconductors, 4H-SiC has intrinsically more than an order of magnitude disparity in the electron and hole impact ionization coefficients, making it ideally suited for APDs and SPADs which require, as a key performance parameter, ultra low excess noise. The major research efforts will be focused on the novel design of the 4H-SiC SPADs and the development of the processing technology to manufacture the SPADs in both single element and in linear array forms. The goals are to achieve drastically improved dark count rate, quantum efficiency, and photon counting rate in comparison to the results achieved in Phase I.

Success of the project will have significant impact to the scientific understanding of cryptography for secure UV free-space communication, of fundamental quantum mechanics of single photon-molecular interaction, and of astronomy and space exploration. The results of the project are expected to lead to commercial products including hand-held or field-portable compact UV analyzers with single-molecule unmatched sensitivity, UV spectroscopy and fluorescence systems for pharmaceutical /drug development, and biowarfare agent detection. Ultra-sensitive UV and Deep UV detectors will find immediate applications in both civilian and defense industries for radar and missile detection systems, for scientific and measurement instruments and OEM, for non-invasive underground oil and mine detection and profiling, for safety protection industry (food protection, utility and power system protection/electrical arc detection, engine and fire/flame sensing and control) and for UV imaging/UV camera as well as radiative and space applications

Title: SBIR Phase II: Vertical Electroabsorptive Modulated Laser (EML) Source for High-Speed Interconnects

Award Number: 0450619
Program Manager: Muralidharan S. Nair

Start Date: June 15, 2005
Expires: May 31, 2007
Total Amount: $428,440
Investigator: Majid Riaziat, mriaziat@oepic.com
Company: OEPIC Semiconductors, Inc
1231 Bordeaux Dr
Sunnyvale CA, 94089
Phone: (408)752-9139

Abstract:

This SBIR Phase II project aims to fabricate and commercialize a Vertical Electro-absorptive Modulated Laser (V-EML) for high-speed (up to 40Gbps) optical interconnects for chip-to-chip, board-to-board, and intra-rack optical applications. Compared to current electrical data buses using copper interconnects or conventional fiber optic links, the V-EML will enable the fabrication of higher speed, lower cost, lower power consumption and smaller optical transmitters for multi-channel fiber optic data buses in computer and communication networks. This technology virtually removes the modulation speed limit of VCSEL optical transmitters. At the same time it maintains high channel density at low cost. The low power consumption of the V-EML (~20 mW) and its potential low cost in volume (~$1.0) will provide a solution to the interconnect speed and power barriers in multiprocessor computers and servers. An array spacing of 50 to 100 microns will be possible with V-EMLs. This means that an 8x8 array with 2.5 Tbps of capacity has less than 1.0 mm2 of footprint. This offers substantial space savings over the existing copper interconnect technology and creates another strong incentive for transition.

This technology could provide societal benefits from the commercialization of this technology by enabling faster and more widespread deployment of broadband services. The potential for ultra-fast delivery of audiovisual information is enormous as the V-EML technology helps to remove data-com bottlenecks. Educational and scientific benefits of the V-EML development arise in the area of supercomputers with sufficient computing power for complex scientific simulations. Applications include climate modeling for better predictions, molecular level modeling such as protein folding in medicine, ecosystem modeling in agriculture, and large-scale analysis of business information and economic statistics. These computers could then operate much faster and much more efficiently when interconnect speed limits are increased.

Title: SBIR Phase II: Ultimate Sensitivity Photodetector

Award Number: 0450605
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $355,974
Investigator: Eric Harmon, harmon@lightspintech.com
Company: Lightspin Technologies, Inc
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Bethesda MD, 20815
Phone: (301)656-7600

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a solid state photodetector with ultimate sensitivity and wide dynamic range at room temperature, capable of efficiently seeing signals from a single photon to trillions per second, featuring high speed, zero dead-time, high reliability/reproducibility, solid state robustness/compactness, and a large photosensitive area. The Phase I project proved the practicality of compatibly combining these features, and demonstrated compound semiconductor materials 1000 times quieter electrically than silicon. The project plans to model, design, layout, fab, package, test, and analyze a series of prototypes, resulting in a complete photodetector prototype for detailed evaluation and customer review; and will engage students in for-profit industrial R&D.

This project aims to revolutionize the $10 billion industrial sector for ultra-low-light analytical instruments by obsolescing bulky glass, high voltage, photomultiplier vacuum tubes ($500 million) and microchannel plates ($400 million); improving scientific instruments dependent on them; enabling altogether new instruments; and making new applications of the instruments affordable and accessible.
This product has been sought as the holy grail of photodetection for fifty years. It could make detecting light with ultimate sensitivity so practical, affordable, and ubiquitous that important scientific research and industrial instruments needing to sense extremely low light levels could be microminiaturized to eliminate bulky, thousand volt, multi-thousand dollar, high-voltage vacuum tubes, written operating plans, and the expertise & proven track record of its managers

Title: SBIR Phase II: Wavelength-Division-Multiplexed Surface-Emitting Lasers with Two-Dimensional Photonic Lattice Outcouplers

Award Number: 0450560
Program Manager: Juan E. Figueroa

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $498,766

Investigator: Nuditha Amarasinghe, vamarasinghe@photodigm.com
Company: Photodigm, Inc
1155 E Collins Blvd 200
Richardon TX, 75081
Phone: (972)235-7584

Abstract:

This Small Business Innovation Research Phase II Project proposes to develop a commercially viable monolithic Wavelength Division Multiplexed (WDM) two-wavelength Grating-Outcoupled Surface-Emitting semiconductor (GSE) laser emitting near 1310 nm. Phase I demonstrated the concept of WDM GSE lasers in a cross-grating configuration emitting two wavelengths separated by 9 nm from a common two-dimensional photonic lattice (2D-PL) aperture that can be efficiently coupled to multi- and single-mode fiber. A low-cost package that can couple 2, 4 and 8 independent wavelengths from one or more 2D-PL GSE lasers directly to a single fiber without multiplexers will also be developed on this program. The knowledge required to develop these lasers requires expertise in materials, optics, gratings, nanostructures, semiconductor processing, thermal transfer, high-speed electronics, packaging, systems and telecommunications. Combining the desirable traits of both edge emitting lasers (high power, reliable material, low voltage, use of proven) and vertical cavity surface-emitting lasers (low cost, wafer level testing, simple packaging, high integration ability), the advanced research proposed is an innovative photonics technology that has broad applications in telecommunications, information processing, data communications, fiber to the business and home, scientific and medical instrumentation, and computations.

A broader impact of this project is the realization of very high data rates at very low cost, and the elimination of barriers to deploying fiber to the desktop and to (or closer to) the home, enabling ultra high bandwidth connections for business, distance learning, entertainment, and computing. Each wavelength of the 2D-PL GSE laser can presently be modulated at 3.125 Gbps and has the potential for 10 Gbps, enabling data rates of 6.25 to 80 Gbps over a single fiber from a single transmitter package. This research effort will provide an enhanced educational experience for students working on this project. Students will gain an increased understanding of materials, optics, gratings, nanostructures, semiconductor processing, thermal transfer, packaging, electronics, and telecommunications through both experimental and theoretical work

Title: SBIR Phase II: Development of Chiral Fiber Polarizer

Award Number: 0450551
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $499,997
Investigator: Dan Neugroschl, dann@chiralphotonics.com
Company: Chiral Photonics, Inc
115 Industrial East
Clifton NJ, 7012
Phone: (973)594-8888

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new class of in-fiber chiral polarizers based upon chiral fiber gratings. A double helix variation of the effective refractive index will be formed by twisting fibers with a noncircular core as they pass through a miniature oven. These chiral fiber polarizers will be created from specially prepared glass performs in a low-cost, versatile, continuous process, which will not require coherent irradiation of photosensitive glass commonly used to produce fiber Bragg gratings. Chiral polarizers are true fiber devices and do not require any substrates, bulk components, or rigid package. Their pitch profile will be engineered to minimize insertion loss for the passing polarization and maximize the extinction of the orthogonal polarization over a broad spectral range. The design will implement a multi-core optical fiber to match the low numerical aperture of standard fiber with the numerical aperture of the chiral polarizer at its input and output while maintaining a high numerical aperture in the polarizing zone. Chiral polarizers will have broad application in single polarization transmission, polarization mode dispersion compensation, and test and measurement instrumentation. Polarizers are also key elements in sensors relying on optical interference such as gyroscopes and current sensors.

Polarization and frequency selective chiral fibers have applications ranging from telecommunications to sensing. The use of external modulators for high bandwidth fiber telecommunication requires that the incident wave be linearly polarized. This necessitates use of a polarizer since laser sources used in telecommunications generally have random polarization. Further, any use of polarization maintaining fiber requires that polarized light be launched into the fiber. Polarizers are also key components in polarization mode dispersion compensation systems. Since chiral polarizers may be fabricated from refractory or radiation resistive glasses and involve only mechanical deformation of glass they may function in harsh environments with high levels of radiation, high temperature, or corrosive chemicals. The fabrication techniques developed for chiral fiber polarizers will spur the development of other devices based on chiral fiber gratings. These devices, ranging from sensors and filters to in-fiber lasers will become building blocks for a new platform for passive and active in-fiber devices. The understanding of glass behavior under extreme shear stress will push the frontier of glass forming technology and stimulate new applications. Understanding polarization-selective light scattering within the nonresonant band will open the way for new devices based upon microstructured fibers.

Title: SBIR Phase II: Efficient Multi-Spectral Holographic Filters

Award Number: 0450478
Program Manager: Juan E. Figueroa

Start Date: January 15, 2005
Expires: December 31, 2006
Total Amount: $499,190

Investigator: Christophe Moser, moser@ondax.com
Company: ONDAX Inc
850 E Duarte Rd
Monrovia CA, 91016
Phone: (626)357-9600

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will commercialize the holographic multi-spectral filter technology developed during the SBIR phase I project. The objective of this project will be the industrial fabrication of holographic multi-spectral filters by using the methods developed and demonstrated during the phase I SBIR research. There is a strong scientific and public push in astronomy to look deeper into the universe to discover and observe fascinating phenomena such as the birth of stars and exo-planets. In observations of celestial bodies from ground telescopes, the signal is faint and surrounded with unwanted optical noise from the atmosphere. The hydroxyl (OH) radicals present in the atmosphere emit light in hundreds of narrow lines that dominate the inter-line sky emission by many orders of magnitude. The multi-spectral rejection filter demonstrated in phase I discriminates the narrow spectral features of the OH emission lines from the atmosphere which increases the image sharpness by increasing the signal to noise ratio.

The narrow band grating filter technology is a core platform that has a scientific and economic impact on ground-based astronomy as well as in laser diode systems. To date $3.8 Billion has been spent deploying and maintaining the Hubble Telescope. An estimated $2.2 Billion is required to see it to its final scheduled retiring date of 2010. It is believed that the introduction of the these multi-line filters combined in some cases with adaptive optics, can boost the performance of ground based telescopes so that they can approach the performance of space telescopes at a price more than 1000 times lower.

Title: SBIR Phase II: Liquid-Crystal Waveguides for Optical Integrated Circuits

Award Number: 0450463
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $499,565
Investigator: Mike Anderson, anderson@vescentphotonics.com
Company: Vescent Photonics Inc
2927 Welton St
Denver CO, 80205
Phone: (303)296-6766

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will reduce mechanical external-cavity diode lasers to a centimeter-sized waveguide chip using a novel giant electro-optic effect. The device, a waveguide external-cavity semiconductor laser (WECSL), will be environmentally robust, compact, entirely electro-optic and capable of continuous, mode-hop-free tuning over 100 nm in fewer than 5 milliseconds. The laser will also exhibit a side-mode-suppression ratio of 40 dB and a (fast) linewidth of ~200 kHz. In Phase II we will demonstrate advanced prototype WECSLs, develop critical manufacturing processes, and perform basic environmental qualifications. We will also conduct research allowing the laser to sweep over a 50 nm band at a rate of 5 kHz.

The low-cost technology platform of WECSLs, and their precision performance specifications could enable laser-based sensors to assume a prominent role in commercial applications. In biophotonics, tunable lasers can replace broadband light sources and enhance the performance of optical coherence tomography instruments that measure the tissue layers in the human retina and the vascular system. Distributed fiber sensing arrays greatly benefit from tunable lasers that probe Bragg sensors spaced along the fiber. Distributed fiber sensors needing low-cost tunable lasers are being developed for chemical and biological sensing, pressure sensing, and vibration, strain and temperature sensing for a wide variety of monitoring applications such as homeland security; civil structures such as buildings, bridges, and dams; oil wells and pipelines; electrical power lines; aircraft and spacecraft; and all-optical shipboard sensing.

Title: SBIR Phase II: Photonic Crystal Coherent Thermal Emission for Sensors

Award Number: 0450397
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $495,949

Investigator: Irina Puscasu, ipuscasu@ion-optics.com
Company: Ion Optics Inc
411 Waverley Oaks Rd Ste 144
Waltham MA, 02452
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Abstract:

This SBIR Phase II project proposes to fabricate a photonic crystal, thermal mid-IR source with low divergence and low dispersion at about 0.1% the cost of competing technologies.
Phase 1 research resolved fine structure of the emission spectrum from 2-D photonic crystals showing that the high intensity, large bandwidth peak had many submodes with strong polarization and angular dependence. In a series of designed experiments the intensity and central wavelength of these submodes were varied with geometrical alterations of the photonic crystal, and theoretically were correlated to surface plasmon resonances. A computer model was developed that matched experimental data. Results imply optimization of photonic crystal structure in Phase 2 could isolate a single sub-mode resulting in very low dispersion, very low divergence emission that could be coherent. The project will support high-end computational research at a university for complex electro-magnetic modeling of photon - surface plasmon interactions. Improved structures predicted by these calculations will be fabricated at an NSF supported nano-fabrication facility. We will examine effects of altered symmetry, periodic defects, and detailed shaping of electrostatic fields.

All existing choices for coherent radiation in the mid-infrared spectral region are too expensive for widespread vapor detection. Examples are wavelength shifting of high power pulsed lasers using non-linear optical effects or quantum cascade lasers (now $5,000 each). The proposed source could sell for less than $10. Additionally, it could significantly reduce the cost of sensitive spectroscopic instrumentation allowing detection of vapors well below 1ppm concentration and application to widespread use as toxic vapor detectors for commercial, residential, and homeland defense applications. Compared to other technology, these detectors are temperature insensitive, rugged, and free of interference effects with zero maintenance and zero drift. This work will contribute towards understanding photon surface plasmon interactions within 2D photonic crystals. The field has huge implications for the microelectronics and optics industry as optical and electronic functions are combined onto single chips for applications to optical computing, communications, etc.

Title: SBIR Phase II: Integrated Dense Wavelength Division Multiplexing (DWDM) 3D Micro-Opto-Electro-Mechanical Systems (MOEMS) Optical Switch for Dynamically Reconfigurable Network

Award Number: 0422155
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2004
Expires: August 31, 2006
Total Amount: $499,925

Investigator: Roger Helkey, helkey@calient.net
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Abstract:

This Small Business Innovative Research (SBIR) Phase II project will integrate Dense Wavelength Division Multiplexing (DWDM) with Micro-electro-mechanical systems (MEMS) optical switching to make the critical network element needed for reconfigurable, transparent, high capacity fiber optic networks. This technological advancement will facilitate the transition from today's point-to-point opaque networks with optical to electrical to optical (OEO) electrical switches to transparent, dynamic all optical networks. The design involves free space optical design, fiber optic design, MEMS design and optical coating design in order to make a wavelength switch which has low loss, low polarization independent loss, low temperature sensitivity, low vibration sensitivity, properly shaped pass bands (flattop with good adjacent channel rejection) and low crosstalk.

The design will be developed, constructed and tested in Phase II, significantly advancing the field of optical switching from where it is today. This integrated wavelength switch should have numerous applications in commercial and government networks. The capacity is huge: 4 fibers with 40 wavelengths each carrying 40 Gbit/s of data results in 6 Terabit/s switching capacity. This allows continued growth in the Internet, and enables a much lower cost solution to higher capacity wavelength services. Continued expansion of access to information requires continued expansion of worldwide core optical networks.

Title: SBIR Phase II: Diode-Pumped, High-Power, Cr:LiSAF-Based Ultrafast Laser and THz Source

Award Number: 0422089
Program Manager: Muralidharan S. Nair

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,954

Investigator: Evgueni Slobodtchikov, slobodtchikov@qpeak.com
Company: Q Peak, Inc.
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Abstract:

This Small Business Innovation Research (SBIR) Phase II will develop the ultrafast laser system that could represent a significant advance in the technology of directly diode-pumped, solid state, ultrafast sources. In the initial Phase I effort, a record cw power level (> 2W) from diode-pumped Lasers were demonstrated through the use of an innovative, side-pumped design. In Phase II, this design will be further improved and utilized as the basis for a regenerative amplifier to generate high peak powers. The output of a passively mode-locked, diode-pumped laser should provide the seed pulses for the regenerative amplifier. The overall ultrafast source should be simpler, smaller and ultimately less expensive than present, power-equivalent, sapphire-based ultrafast laser systems. As a demonstration of the utility of the proposed technology, a time-domain terahertz (THz) spectrometer will be constructed, based on an optical-rectification THz source and an electro-optical detector, both driven by the laser system. The directly diode-pumped ultrafast laser represents an enabling technology, allowing ultrafast and THz systems to emerge from the laboratory and into the widespread scientific and industrial applications

The proposed ultrafast laser and THz spectrometer both could have the potential for significant scientific and commercial impact. With the lower cost (on the order of 50%) made possible by the simplicity of design, a wider range of research groups in academia and industry will be able to obtain ultrafast sources and THz instrumentation. The lower cost, simplicity, higher reliability and smaller size of the systems will also greatly expand and accelerate the use of ultrafast lasers and THz radiation in biotechnology, medical imaging, precision micro-machining, industrial process control and security systems.

Title: SBIR Phase II: Compact, High-Power, Terahertz (THz) Radiation Source

Award Number: 0422057
Program Manager: Muralidharan S. Nair

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $500,000
Investigator: Hans Bluem, hans_bluem@mail.aesys.net
Company: Advanced Energy Systems
27 Industrial Blvd, Unit E
Medford, NY 11763
Phone: (609)514-0316

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop a tunable, compact, high-power Terahertz (THz) radiation source. The unique discriminator of the source is the projected power level, which is orders of magnitude greater than available semiconductor sources, should enable for the first time both wide field of view (FOV) imaging and high-throughput spectroscopic interrogation from a compact package. The Phase II program will complete the final design of the THz source developed in Phase I and described in the final technical report, fabricate a prototype device and demonstrate its performance at a THz research laboratory. The goal of the project is to demonstrate that the concept can deliver tens of watts of THz power from a device that is sufficiently robust and compact to be transportable and operate in the field. The THz spectral region combines many desirable features for spectroscopic and imaging applications. However, higher-powered, compact sources, such as that here, are needed to deliver practical throughput rates and the signal-to-noise ratio required for many commercial applications.

The major medical imaging applications being developed are the detection of breast and basal cell carcinomas. Pharmaceutical industry applications include drug discovery and quality assurance, DNA analysis and proteomics. In the homeland security and defense arenas, the potential applications include standoff chemical and biological agent and explosive detection. THz systems are finding increasingly widespread use in scientific and University R&D environments for non-destructive evaluation and medical applications.

Title: SBIR Phase II: All-Optical Method to Detect and Diagnose Optical Faults in Advanced Optical Networks

Award Number: 0419104
Program Manager: Muralidharan S. Nair

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,226

Investigator: Paul Melman, melmanp@newtonphotonics.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype optical network monitoring system based on the enabling technology demonstrated in Phase I. Optical networks must be continuously supervised to ensure high availability and reliability. Advanced networks will use optical routing for cost savings and provisioning flexibility. This trend obsoletes current optical signal quality monitoring techniques. The proposed system, designed specifically for these advanced networks, utilizes an all-optical, in-channel detection method. It not only monitors performance but also performs on-line diagnosis of optical faults. This system operates in a real network environment including the presence of polarization mode dispersion, a phenomena which has frustrated other monitoring approaches.

This technology is targeted to develop advanced networks that cost 50% less to deploy and maintain than existing systems. This represents an enormous cost savings for telecommunications carriers and ultimately all data communications consumers. The demand for telecommunications bandwidth continues to grow rapidly. The market for optical networking equipment and strong growth is predicted.

Title: SBIR Phase II: The Interfractor - A New Optical Dispersive Component

Award Number: 0420331
Program Manager: Muralidharan S. Nair

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $500,000

Investigator: Stephen Senturia, sds@polychromix.com
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Abstract:

This Small Business Innovation Research Phase II project proposes to develop a new type of optical dispersion element that combines a relief grating with appropriately optimized dielectric films to achieve both high dispersion and high efficiency into one diffraction order, independent of polarization. Grating efficiency is critical for wavelength management in modern fiber-optic telecommunication systems that employ dense wave-division-multiplexing (DWDM) transmission. Dynamic gain equalizers, reconfigurable channel blockers, programmable optical add-drop modules, and wavelength-selective switches all require spatial separation of the wavelengths from an input fiber, typically with a diffraction grating, which is also typically the largest source of insertion loss. Further, because the polarization of the optical signal of any particular wavelength within a fiber may change over time, the net power loss through the device must be independent of polarization. It is very difficult to achieve high grating efficiency in both polarizations. The proposed technology achieves this goal with a proprietary combination of diffractive and thin-film interference effects, and can be fabricated to be robust Over the wide temperature range required of DWDM components

The proposed use of this optical dispersion element will be to improve the insertion loss in Free-space optical wavelength-management products, such as dynamic gain equalizers and Reconfigurable channel blockers, now being deployed in modern fiber-optic telecommunication Systems. This technology will implement in other products to change in its own wavelength-management products as soon as the product can be manufactured.

Title: SBIR Phase II: Low-Voltage Poling of Waveguides in Nonlinear Optical Materials

Award Number: 0349758
Program Manager: Muralidharan S. Nair

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $499,981

Investigator: Philip Battle, battle@advr-inc.com
Company: AdvR, Inc
910 Technology Blvd Suite K
Bozeman, MT 59718
Phone: (406)522-0388

Abstract:

This SBIR Phase II project will develop the processing steps for the fabrication of highly quality periodically poled waveguides in potassium titanyl phosphate (KTP). Periodically poled waveguides enable highly efficient, quasi-phase matched (QPM), nonlinear optical wavelength conversion of continuous wave and high-peak power quasi- continuous lasers. The fabrication process, established during the Phase I effort, utilizes low-voltage pulses combined with a novel electrode configuration to periodically pole channel waveguides embedded in a KTP chip. The use of standard off-the-shelf KTP channel waveguides will significantly increase yields, allow greater design flexibility, and decrease manufacturing expenses while providing a large QPM conversion efficiency that will enable a range of commercially significant applications. Specific products include the frequency doubling of pulsed and continuous wave infrared diode lasers for use in bio- analytical instrumentation and fluorescent spectroscopy, waveguide-based difference frequency mixing modules for generating tunable, narrow band near-infrared sources for environmental monitoring, spectroscopy at hard-to-reach wavelengths, and all-optical switching in communication networks.

This project should result in efficient frequency doubling of diode lasers, which will Have beneficial impacts in medical, environmental, and scientific applications. In the Medical field, the availability of small, low power consumption, cost-competitive visible Lasers will enable the creation of portable bio-analytical instrumentation (e.g. a bedside flow cytometry system). In the environmental field, small inexpensive spectroscopically useful infrared sources will enable new and improved remote sensing systems. Additionally, the KTP waveguide technology developed in this effort is expected to contribute to advanced research in a variety of fields including ultra short pulse wavelength conversion, development of waveguide optical parametric devices, and the efficient generation of correlated photon pairs for quantum optical studies.

Title: SBIR Phase II: Fiber Optics Confocal Module for Biomedical Application

Award Number: 9983313
Program Manager: Om P. Sahai

Start Date: April 1, 2000
Expires: September 30, 2002
Total Amount: $399,996

Investigator: Indu Saxena, sbirproposals@intopsys.com
Company: Intelligent Optical Systems Inc
2520 W. 237th Street
Torrance, CA 90505
Phone: (310)530-7130

Abstract:

This Small Business Innovation Research Phase II project is to develop a highly versatile fiber optics-based confocal system for biomedical applications. The proposed confocal fiber optics systems utilizes optical fiber technology to offer extreme compactness, multiple wavelength light excitation/detection (N X N coupling) minimal adjustment, and very low cost. One of the unique advantages of using optical fiber for confocal microscopy is that both the entrance and exit pinholes are, in fact, the endface of the core of an optical fiber, which guarantees that the system will always remain in alignment. During Phase I of the project, we designed and developed two laboratory optical configurations: one for retrofitting regular upright microscopes, and one for high density microarray scanners, we then successfully demonstrated the feasibility of these optical fiber confocal systems.

In Phase II, we will expand the fiber and wavelength multiplexity, maximize photon efficiency, optimize the confocal fiber optical module, develop a biochip-based confocal fiber probe array, and characterize and test the systems by performing bioassays. IOS's fiber optics-based will provide confocal microscopes with a capability that will significantly reduce the cost of the system, increase the versatility of the wavelength selection, and increase the popularity of using the confocal effect for many different important applications

Title: SBIR Phase II: Enhanced Organic Electroluminescent Display

Award Number: 9983435
Program Manager: Winslow L. Sargeant

Start Date: June 15, 2000
Expires: August 31, 2003
Total Amount: $392,272
Investigator: Shujun Wang, shujunw@reveo.com
Company: Reveo Incorporated
3 Westchester Plaza
Elmsford, NY 10523
Phone: (914)345-9555

Abstract:

This Small Business Innovation Research Phase II project continues Reveo's successful development of unprecedented high-brightness, polarized-light-emitting electroluminescent devices (ELD's) for the immediate applications of energy-efficient liquid crystal display (LCD) and dashboard backlights, as well as the longer-term applications of glare-free general room lighting and automobile headlights. Polarized light is essential to reduce distracting glare from indoor lights for LCD backlights. However, all current methods of producing polarized light rely on a bulky polarizing panel placed in front of an unpolarized light source. Some have the serious disadvantage of wasting half the energy by absorbing one polarization state, but even reflective panels that polarize the light without waste suffer from the intrinsic disadvantages of high cost, complicated manufacturing, and inconvenient packaging. Reveo's ELD promises to be the first commercially viable polarized light source, bypassing all the disadvantages of present reflective polarizing panels while offering dramatic energy savings of a factor of two in LCD and dashboard backlights by eliminating the need for a polarizer altogether. In Phase II, we will construct prototype demonstration backlights to attract funding commitments from strategic partners, placing this revolutionary technology firmly on the path to fruition for the benefit of the environment and humanity. The polarization properties of light are used ubiquitously in modern technology, as both enabling concepts for other technologies and as direct, important improvements in people's lives.

Reveo's polarized-light-emitting electroluminescent device has immediate applications as an LCD backlight, allowing energy savings of a factor of two without being significantly more expensive than current backlights. With further development, this technology offers the potential of functioning as a polarized "light bulb" for room light, reducing eyestrain and other health consequences of glare for millions of office workers. The advent of a low-cost, high-brightness polarized light source has far-reaching positive impact on the environment, the economy, and indeed American health.

Title: SBIR Phase II: Development of a Compact, Lightweight Millimeter-Wave Source

Award Number: 9983471
Program Manager: Winslow L. Sargeant

Start Date: May 1, 2000
Expires: July 31, 2002
Total Amount: $400,000
Investigator: Jose Velazco, jvelazco@microwavetech.com
Company: Microwave Technologies Inc
5716 Edgewater Oak Court
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Phone: (703)250-1440

Abstract:

This Small Business Innovation Research Phase II project will involve the experimental study of a novel millimeter-wave source (MWS) that will provide short-wavelength radiation for numerous civilian and military applications. The MWS is based on novel synchronous interactions between a pencil electron beam and rotating wave fields. Our Phase I studies confirm that the MWS will offer order of magnitude improvements in the overall size and weight when compared to conventional millimeter-wave sources which will make these new devices less complex, more affordable, and readily available for a diversity of applications. Some of the applications for these devices include high-resolution radar, satellite telecommunications systems, power beaming, and electron cyclotron resonance heating of fusion plasmas. Also, due to the fact that the MWS does not require a focusing magnetic field, it should be suitable for airborne and mobile applications, as well as other commercial applications where size, weight, and efficiency are critical. Detailed experimental analysis of this concept is proposed during Phase II in order to evaluate key issues such as beam transport, maximum output power, efficiency and gain.

Once successfully developed, the MWS will be the basis for a new generation of millimeter-wave sources capable of producing high-power ultrahigh frequency radiation with high efficiency in a very compact and lightweight package.

Title: SBIR Phase II: Fiber-Optic Magnetic-Field Sensor System Employing Highly-Efficient Photonic Signal Processing

Award Number: 9986120
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2004
Total Amount< $771,893

Investigator: Behzad Moslehi, bm@ifos.com
Company: Intelligent Fiber Optic Systems Corporation
650 Vaqueros Avenue, A
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Phone: (408)328-8610

Abstract:

This Small Business Innovation Research Phase II project expands the magnetic-field sensor system developed in Phase I into an optimized system containing an array of multiplexed two-dimensional sensors using mode-routing architecture for industrial process control systems, including physical-vapor-deposition (PVD) reactors containing magnetic orientation devices which are used in the manufacture of magnetic storage disks and recording heads. The uniformity and orientation of these magnetic fields need to be measured and controlled with high accuracy. In Phase I, IFOS demonstrated devices that virtually eliminate power losses that are characteristic of other known fiber-optic magnetic sensor arrays. IFOS has fabricated novel photonic mode-routing components, built a feasibility system prototype with new sensing materials and ultra-high-resolution demultiplexing, and conducted preliminary tests. IFOS, in collaboration with a federal laboratory, identified another appllication involving cryogenic systems to avoid thermal-leakage problems of electronic sensors. The IFOS solution enables achievement of the necessary accuracy and cost goals. The Phase II objective is to design and construct an optimized 5-point vectorial magnetic-field-sensor system for PVD reactor installation, as well as a 2-sensor system for cryogenic applications. IFOS' strategic partners will provide Phase-II and Phase-III-kind and cash contributions. Commercial applications include measurement of magnetic orientation and confinement fields for PVD systems, cryogenic systems, electric power utilities, hydrogen fusion chambers and linear acccelerators. Improving PVD industrial process control, will yield higher sensitivity and reliability. It will enable storage densities exceeding 60 Gbit/inch2 on rigid media.

This is a significant market opportunity identified by IFOS and its strategic partner, the market leader for data-storage PVD systems. Other applications exist in the measurement of leakage current and line sag in high-voltage transmission towers, and complex stresses in automotive, aerospace, and civil structures. The technology will have an impact in a wide variety of optical fiber sensor systems and optical components and subsystems, such as magnetically-actuated tunable optical filters and switches, add-drop multiplexers as well as mode-routing components. IFOS magnetic sensor systems are immune to electromagnetic interference, elecrically and chemically passive, compact, light weight and suitable for use in explosive environments

Title: SBIR Phase II: Ultra-Compact Driver Technology for Extending the Lifetime of High Power Laser Diode Arrays

Award Number: 0109913
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2001
Expires: August 31, 2003
Total Amount: $499,960

Investigator: Rodney A. Petr, rpetr@srl.com
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15 Ward Street
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop compact, all-solid-state, pulsed drivers coupled with solid-state protection circuitry for powering laser diodes/diode arrays and increasing their reliability and lifetime. New high-current semiconductor switch technology will be coupled with proprietary new diode protection circuits featuring fault-mode detection and high-speed current limiting to extend laser diode lifetime tenfold. This leads directly to a tenfold reduction in annual laser operating cost. Recent breakthroughs in high power semiconductor technology, namely the Gate Commutated Thyristor (GCT) switch, also offer significant improvement in speed, power, and compact size over existing commercial devices. Phase II will develop advanced, compact pulsed power modules based on these technologies.

GCT technology, coupled with a proprietary fast protection circuitry, offers a significant decrease in diode laser system size and weight and a tenfold decrease in laser cost-of-ownership made possible by increased diode lifetime. New commercial applications for the diode-pumped solid-state lasers are expected to include powering diodes for optical telecommunications and ultraviolet and X-ray point sources for Next Generation Lithography in the semiconductor industry, as well as in laser cutting and welding. Medical uses for this new fault-protected, solid-state driver technology will include oncology and gene therapy.

Title: SBIR Phase II: Material Processing for Optimizing the Performance of an Embedded Bragg Grating

Award Number: 0110490
Program Manager: Winslow L. Sargeant

Start Date: September 1, 2001
Expires: August 31, 2004
Total Amount: $499,540
Investigator: Philip R. Battle, battle@advr-inc.com
Company: AdvR
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enable the fabrication of waveguides in potassium titanyl phosphate (KTP) containing Bragg gratings with specified spectral and electro-optic characteristics. These characteristics include selectivity, bandwidth, central wavelength, and electro-optic tuning range. To achieve this goal, the relationship between the processing steps used to form the Bragg grating and its resulting spectral and electro-optic properties will be fully quantified. The ability to control the spectral characteristics and electro-optically tune these gratings will enable a broad range of new and commercially useful devices. Using the processing steps developed, an array of Bragg gratings will be fabricated with each grating optimized for stabilizing the wavelength of a laser diode. Translating the waveguide array with respect to the laser diode will tune its wavelength. This novel tuning technique will have significant technical and cost advantages over other tuning techniques.

Potential commercial applications include tunable filters for active dispersion compensation, high-speed add/drop filters for wavelength division multiplexing (WDM), and a broadly tunable source for test and evaluation of network components. Other applications include stabilizing laser diodes for spectroscopy, seeding high power lasers, and frequency doubled diode-based replacement lasers for low power Argon-Ion and helium cadmium (HeCd) lasers.

Title: SBIR Phase II: Novel Multi-Wavelength Time-Resolved Laser Induced Fluorescence Detector

Award Number: 0091507
Program Manager: Winslow L. Sargeant

Start Date: May 1, 2001
Expires: June 30, 2003
Total Amount: $500,000

Investigator: Daniel Engebretson, dengebretson@dakotatechnologies.com
Company: Dakota Technologies, Inc.
2201A 12th Street North
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Phone: (701)237-4908

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will lead to a breakthrough in the use of laser-induced fluorescence (LIF) for chromatographic detection. Commercial standalone LIF detectors are based on CW lasers and collect data at a fixed wavelength. Consequently, they add minimal capability for resolving complex mixtures beyond that inherent in the chromatographic separation itself. On-the-fly fluorescence lifetime measurements at a single emission wavelength have been proposed as a better way to resolve the signals of co-eluting species. Our approach is far more powerful because it provides lifetimes on-the-fly and at several wavelengths simultaneously. A new prism flow cell fiber optically coupled to the emission spectrograph was introduced in Phase I. In addition, two different algorithms strategies for analyzing the multi-dimensional fluorescence data were developed and demonstrated. In Phase II a diode-pumped laser will replace the flashlamp pumped excitation laser, thereby providing 100 times higher pulse repetition frequency, 10 times shorter pulse duration, and 10 times better shot-to-shot stability. New digitizer technology will be incorporated to accommodate the laser's high repetition frequency. Important Phase II activities include fluorescence methods development to extend the range of applications to drugs and drug metabolites and elaboration of the chemometric algorithms.

The instrumental approach to be realized through the Phase II research will have a profound impact on QA/QC assessments of drug purity, bioequivalence and pharmacokinetic studies, and research investigations in humans and animals. Sales of several hundred units per year to pharmaceutical manufacturers, contract research organizations, and universities are anticipated. The technology will later be adapted for faster and more accurate DNA sequencing.

Title: SBIR Phase II: Multi-Channel Fluorescence Lifetime Measuring Instrument Using a Novel Low-Cost Digitizer

Award Number: 0321573
Program Manager: Winslow L. Sargeant

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $500,000

Investigator: Mark J. Pavicic, mpavicic@dakotatechnologies.com
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Phone: (701)237-4908

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will deliver a low-cost, multi-channel digitizer that can revolutionize applications of fluorescence sensing with its ability to accurately capture over 10,000 complete fluorescence decay curves (waveforms) per second per channel. This novel low-cost digitizer exploits a unique 'flash capture' approach to analog-to-digital (A/D) conversion to achieve an exceptional combination of speed (>1GS/s), resolution (10 bits), and low power. Fluorescence sensing measurement underlies an immense array of cutting-edge applications because it provides a sensitive and versatile probe into nano-scale behavior and properties. The project will develop a full-featured instrument-grade engineering prototype of the digitizer and integrate it into a portable demonstration instrument to showcase capabilities such as distinguishing biological or chemical agents by their spectral and temporal signatures.

This custom digitizer will match the capabilities of laser-induced fluorescence (LIF) to deliver accurate, cost effective, and complete data collection. The digitizer will be the first low-cost compact digitizer suitable for the specific front-end LIF analysis of biological agents. Among the weapons of mass destruction that threaten people around the world, biological agents are perceived to be the main hazard facing us today. The system's ability to capture more information, faster and more accurately will reduce the high occurrence of false alarms suffered by today's systems, resulting in a more reliable system with the potential to save lives. When integrated with biomedical instrumentation, the digitizer will have scientific and educational benefits through the use at academic institutions for research and discovery.

Title: SBIR Phase II: Laser Direct-Writing Technique to Produce Integrated Optical Amplifier/Splitter

Award Number: 0216288
Program Manager: Winslow L. Sargeant

Start Date: July 15, 2002
Expires: June 30, 2004
Total Amount: $499,998

Investigator: Douglas J. Taylor, djtaylor@tplinc.com
Company: TPL, Inc.
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Phone: (505)342-4471

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will continue the successful work from the Phase I project and develop integrated amplifier/splitters through laser direct writing of wet-chemically derived, erbium-doped coatings. Precursor solutions will be mixed on the molecular level to produce pure and homogeneous materials. Waveguide structures will be written into the erbium-doped fluoride coatings with a laser, which raises its index of refraction to confine light. The erbium-doped channel waveguides will be pumped with a 980 nm source to amplify 1550 nm signals.

Markets in which integrated optical devices, such as amplified splitters, can be used total several $100 million. This device will expedite bringing fiber the last mile because it will replace the current serial arrangement of discrete splitters and amplifiers, which is bulky and expensive due to the number of components and interconnects. The proposed integration techniques will also enable optical integrated circuits and next-generation computing. Prototypes will be fabricated during Phase II. TPL has extensive experience in wet-chemical processing and demonstrated ability to commercialize its technologies. The PI is a pioneering researcher of laser-fired, sol-gel derived films. LightPath Technologies will assist TPL with device and marketing development.

Title: SBIR Phase II: Microsphere-Based Optical Spectrum Analyzer

Award Number: 0091557
Program Manager: Winslow L. Sargeant

Start Date: April 15, 2001
Expires: March 31, 2003
Total Amount: $499,409

Investigator: Joel Roark, jroark@nomadics.com
Company: Nomadics Incorporated
1024 S. Innovation Way
Stillwater, OK 74074-1508
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build upon the exciting results of Phase I, which demonstrated that whispering gallery mode (WGM) resonances of a microsphere can be tuned over a significant range by sweeping the microsphere's temperature. It is intended to employ this effect to produce a temperature-tunable optical filter suitable for development of a next-generation optical spectrum analyzer (OSA) for remotely monitoring dense wavelength division multiplexed (DWDM) networks. Such a device will greatly benefit the telecommunications industry by providing a means of embedded real-time monitoring of system operation and signal quality. This capability has the potential to virtually eliminate costly system failures. The plan for reaching the project goal is to develop a first-generation prototype and use this prototype to demonstrate the expected capabilities of a next-generation OSA.

The initial application for the technology is as an embedded test and monitoring system for telecommunications fiber networks. The major customers are optical network installers and service providers.

Title: SBIR Phase II: Ultraviolet-Polarizing Chiral Film

Award Number:	0091551
Program Manager:	Winslow L. Sargeant
Start Date:	February 15, 2001
Expires:	January 31, 2003
Total Amount:	$499,939

Investigator: Bunsen Fan, fan@reveo.com
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3 Westchester Plaza
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Phone: (914)345-9556

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is designed to develop and commercialize high-durability UV polarizer optics with unprecedented performance. The breakthrough polarizers are made from stacks of oriented, birefringent thin film layers, which are obtained by vacuum deposition at an oblique angle. The film material itself is optically isotropic, but the birefringence arises from the nanostructure of the layers in the film stack. Films can be constructed from a single material, relieving the conventional constraints on material transparency and enabling a wider operating wavelength range. Using LiF as the film material, for example, could extend the operating range down to 110 nm. Extension to the far UV and extreme UV appears possible with materials such as silicon carbide or boron carbide. The deposition technique thus offers an exciting opportunity to engineer unique film properties. In Phase II, the investigator proposes to enlarge the database of film materials for UV chiral film polarizers and design, fabricate (using a customized deposition system), and characterize UV chiral film polarizers for practical applications. The investigator will then develop high-speed deposition techniques to ensure the polarizers are low-cost. Commercialization activities will accelerate in Phase III.

The inorganic UV polarizer films may have several advantages over conventional polarizer components, and become key devices in many important industrial-manufacturing processes, including systems for chemical synthesis, drug development, and liquid crystal alignment for LCDs.

Title: STTR Phase II: High Twisting Power Chiral Materials for Nanostructured Bragg Reflective Displays

Award Number: 0091522
Program Manager: Winslow L. Sargeant

Start Date: February 1, 2001
Expires: January 31, 2003
Total Amount: $497,063

Investigator: J. William Doane, bdoane@kentdisplays.com
Company: Kent Displays, Inc.
343 Portage Blvd.
Kent, OH 44240
Phone: (330)673-8784

Abstract:

This Small Business Technology Transfer (STTR) Phase II Project develops a new class of chiral materials, the dioxolanes, which provide unprecedented helical twisting power. When added to a nematic liquid crystal, a concentration of only a few percent is required to twist the nematic phase into a tight helix with a periodicity of the wavelength of light. Because of the low concentration, the chiral additive does not dilute important physical properties of the nematic material required to optimize Cholesteric displays for brightness, contrast, speed and low operating voltages. Being simple molecular structures, dioxolane derivatives can be synthesized in both left and right hand moieties to enable, for the first time, Cholesteric displays that nearly double the reflective brightness to where it approaches that which we are used to seeing from paper. Phase II research has both a basic and an applied component. The basic component studies the helical twisting power and its relationship to the molecular structure of the chiral compounds and host mixtures. The applied component uses this information to design and develop chiral additives for advanced Cholesteric displays for use in electronic books and other handheld devices.

The chiral materials will be used in display products primarily used in handheld devices whee low power, sunlight readability, and wide-angle viewing of high resolution, full color images are important. Devices targeted are electronic book, cell phones, pagers, etc.

Title: SBIR Phase II: Rare Earth-Aluminum Oxide Glass Photonic Devices

Award Number: 0216324
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $499,997

Investigator: J.K. Richard Weber, weber@containerless.com
Company: Containerless Research Inc.
910 University Place
Evanston, IL 60201-3149
Phone: (847)467-2678

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop photonic devices based on a new and proprietary family of rare earth oxide - aluminum oxide glasses, the real glasses, doped with Yb, Tm, and Er oxides. Phase I research showed exceptionally broad emission from Yb 3+, efficient energy transfer in co-doped glasses, and fluorescence lifetimes and spectra of Tm and Er that meet device requirements at high dopant concentrations. Feasibility of scaled-up production of the glasses was demonstrated. The Phase II activities include: collaboration with firms engaged in the glass and optical device business; scaled-up glass synthesis; optimization of dopant concentration and optical properties for devices; and construction and characterization of prototype laser devices.

Markets for optical device products are extremely large, multinational, and growing though expanded applications and displaced technologies. The Phase II R&D is focused on lasers, amplifiers, and optical devices for communications, laser surgery, and emerging military applications. The patent position and the absence of complex proprietary interests in the technology place this work in a strong commercial position.

Title: SBIR Phase II: Development of a New High Intensity Pulsed Light Source System

Award Number: 0645824
Program Manager: Juan E. Figueroa

Start Date: March 1, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Raymond Schaefer, rschaefer@phoenixsandt.com
Company: Phoenix Science & Tech Inc
27 Industrial Ave
Chelmsford, MA 01824
Phone: (978)367-0232

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to conduct further research on the erosion properties of electrode materials under high-current pulsed operation, and demonstrate extended lifetime for a new pulsed lamp, making it economically practical. With increased lifetime, the new lamp can become the industry standard for UV water treatment and enable a new photolytic paint stripping process. Materials used for pulsed power electrodes were originally formulated for continuous or alternating current at low peak current. In Phase I a tungsten composite fabricated with a specific process eroded at one-sixteenth of the erosion of the standard electrode material. Phase II continues the research on this tungsten composite and its fabrication processes to demonstrate low erosion, with the objective of demonstrating increased lamp life that meets requirements for commercialization.

If successful the proposed research will enhance scientific understanding of the erosion of electrode materials under repeated high-current pulsed cycling. New electrode materials will expand the use of pulsed power and provide better alternatives to thoriated tungsten, which is banned in Europe because of its radioactivity. The primary goal is to enable a new commercial pulsed lamp. The lamp will replace mercury lamps, reducing mercury use and exposure of the public. The lamp also will enable commercial photolytic paint removal, replacing chemical and abrasive techniques that are labor intensive, create dust and debris, and generate toxic byproducts. The photolytic process will provide a lower cost and cleaner method of removing lead paint. This will allow abatement to replace "interim measures" currently in vogue, and support national goals to eliminate childhood lead poisoning. The commercial market for the new lamp encompasses all of UV water treatment and a wide range of paint removal applications.

Title: SBIR Phase II: Voltage Tunable Micro-Ring Resonators: Low-Cost, Reconfigurable Optical Add-Drops

Award Number: 0646357
Program Manager: Juan E. Figueroa

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $499,953
Investigator: Scott Davis, davis@vescentphotonics.com
Company: Vescent
4865 E. 41st Ave
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Phone: (303)296-6766

Abstract:

This Small Business Innovation Research (SBIR) Phase II project entails the design and building of polarization independent, fiberdized, wavelength selective switches using patent pending EO-waveguide micro-ring technology developed and demonstrated as a result of work carried out under Phase I. The approach is electro-optic, rather than thermo-optic, and operates with negligible power consumption (< 30 microwatts per ring demonstrated in phase I), fast switching (< 100 microseconds demonstrated), larger index modulation (dn > 0.01 demonstrated, more possible) and importantly, will enable active polarization dependent loss (PDL) compensation. This will replace thermo-optically tuned ring resonators, which have provided only limited tunability (dn/dt =~ 1.5 x 10-5/oC), slower tuning times (> 3 milliseconds typical), high polarization dependency (no active PDL compensation possible), and are prohibitively power consumptive (~~ 0.5 Watts per ring).

In the last century the low power transistor replaced the power hungry vacuum tube, thereby ushering in the age of integrated electronics. In a similar fashion, low-power LC-waveguides have the potential to replace high-power thermo-optics (providing a power savings of >10,000), thereby opening up applications and markets for integrated optics. In phase II we will transition our phase I feasibility demonstration into a fully functioning and packaged prototype. As computing power and bandwidth continue to grow (e.g., streaming media), low-cost electro-optical filtering and switching systems will be required to satisfy pending fiber-to-the-home and "last mile" deployment needs. Since 2002, United States and European deployment of long-haul dense wavelength division multiplexing (DWDM) systems have been almost entirely constructed from reconfigurable optical add-drop multiplexers (ROADM). A typical deployed system works by reading incoming optical signals and converting them to electrical signals, which can then be routed. Conversion back to optical is performed by an array of tunable lasers. This brute force method, while providing useful performance, is cost prohibitive for small network deployment. According to Infonetics, a leading market research firm, the ROADM-enabled equipment market size nearly reached $600 million in 2005, tripling earlier forecasts. Over all growth will be determined by affordability and reliability of ROADMs technology, especially within the metro and access space. The technology outlined in this proposal if successful will contribute a new and inherently agile all optical solution by reducing cost while maintaining performance and reliability. In addition to ROADMs, the voltage tunable micro-rings will enable a wide array of useful devices, ranging from spectral filters, to optical cross-connects, to routers, to name only a few.

Title: SBIR Phase II: Compressing and Measuring Ultrashort Laser Pulses in Imaging and Spectroscopy

Award Number: 0724370
Program Manager: Juan E. Figueroa

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Aliakbar Saman Jafarpour, linda.trebino@swampoptics.com
Company: Swamp Optics
6300 Powers Ferry Rd #600-345
Atlanta, GA 30339
Phone: (404)547-9267

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop two novel ultrashort-laser-pulse devices. Each will solve an important problem for researchers that use exciting new ultrashort-laser-pulse techniques for imaging, micro-machining, surgery, telecommunications, chemical-reaction control, time-domain spectroscopy, and many other applications. Such applications work best with the shortest pulse - but currently operate with much longer ones because such pulses naturally lengthen as they pass through the many optical components on the way to their final destination. Pulse compressors, which use four prisms (or two prisms and a mirror), solve this problem, but they are unwieldy and have a tendency to introduce other distortions, making them difficult to commercialize. This research will develop an elegant, easy-to-use single prism pulse compressor, which is much simpler, more compact, and much less expensive, and is also naturally immune to the problematic distortions of current two- and four-prism designs.

The pulse compressor will greatly benefit multi-photon microscopy - in use in over 1000 biological labs worldwide, and where it will significantly improve image sensitivity and resolution. Micromachining efforts and new ophthalmologic surgical techniques that now use ultrashort pulses also require the shortest possible pulses. In addition, telecommunications and chemistry researchers who shape their pulses into potentially extremely complex waveforms, currently cannot measure them, but this spectral interferometer, which can also measure complex shaped pulses, will fill this need, as well.

Title: SBIR Phase II: Wavelength-Selective Lasers for Photonic Integrated Circuits

Award Number: 0724237
Program Manager: Juan E. Figueroa

Start Date: October 1, 2007
Expires: September 30, 2009
Total Amount: $499,998

Investigator: Alan Sugg, arsugg@vegawave.com
Company: Vega Wave Systems
1275 W. Roosevelt Rd Ste 112
West Chicago, IL 60185
Phone: (630)562-9433

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will address the commercial need for novel, wavelength-selective laser diodes for 10 Gigabit Ethernet applications. The distributed feedback lasers currently used in 10 Gigabit Ethernet transceivers are fabricated using an expensive, low-yield, epitaxial re-growth process. The drawbacks of this method are the high cost of the capital equipment and of the manufacturing process. In addition, the lower yields encountered with the multiple regrowths required to fabricate complex photonic circuits make cost-effective integrated photonic components difficult to achieve. A novel laser diode design and high-yield manufacturing method that will enable the fabrication of low-cost wavelength-selective and tunable laser diodes for optical communications has been developed. This research will refine the design and fabricate both discrete and integrated devices for 10 Gigabit Ethernet applications.

The major scientific and technical benefit of this work is an improved method for fabricating lasers and other optoelectronic devices. The work should also result in arrays of novel, wavelength selectable lasers suitable for use in high-speed data communications applications. The main societal impact will be the increased availability of low-cost, high-speed data communications, which is a significant contributor to economic development. Making lower cost lasers will enable a significant reduction in the cost of transceivers, which will increase the rate at which high speed Ethernet penetrates the data network.

Title: SBIR Phase II: Novel Monolithically Integrated Wavelength-Range-Selectable and Widely-Wavelength-Tunable Semiconductor Lasers with High Functionalities

Award Number: 0646478
Program Manager: Juan E. Figueroa

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Jing Ma, jma@optonetinc.com
Company: OptoNet Inc.
828 Davis Street
Evanston, IL 60201
Phone: (847)425-7585

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is focused on the use of new technology for the development of a novel wavelength selectable or wavelength tunable laser. Such lasers are central to next-generation photonic technologies and optical networks, and have a wide range of applications including instrumentations, optical sensing, medical, military, imaging, and high bandwidth DWDM optical networks. The company has recently developed a powerful integrated super-high-resolution compact curved diffraction grating (SCG) on InP chip with the highest spectral resolution and the smallest size. Applying to lasers, SCG allows combining the simple-control and high-performance advantage of "external cavity laser" with the high ruggedness and low-cost advantage of monolithic integration. The Proposed wavelength-selectable or tunable lasers will result in extended tunable laser capabilities, not achievable currently, such as simpler control electronics, direct modulation capability up to 2.5Gb/s, 10Gb.s modulation with integrated modulator, ultra-compact laser module size, lower power consumption, and lower costs via monolithic integration.

The proposed wavelength-selectable or wavelength-tunable SCG lasers will involve a number of new technological approaches such as the high-resolution Integrated Curved Diffraction Grating, Cavity-Grating Frequency Offset detector, and other integrated functionalities (e.g. integrated shutter/amplifier, integrated modulator etc). These are combined capabilities that can only be realized with chip-scale monolithic integrations, and are not available currently. IF successful the proposed solution, a single wavelength selectable SCG laser, will replace the use 40x fixed wavelength DFB lasers to cover the 40 DWDM ITU Wavelength Channels. Thus the proposed solution, WS-SCG laser, will reduce the DWDM laser inventory by 10-40x while having substantially simpler control electronics, more compact module size, lower power consumption, and higher functionalities than those of current tunable lasers, and could be engineered to give higher output and higher spectral purity. The potentially new capabilities of SCG lasers will open up many application areas including: (1)DWDM/CWDM/OCDMA Networks; (2) WDM On Chips; (3) Instrumentations; and (4) Optical sensing and medical equipments. Applications to these areas require wavelength selectable or tunable lasers with higher output, higher spectral purity, wider wavelength tunability, and lower cost.

Title: SBIR Phase II: A New Class of Complex Ferroelectric Liquid Crystal Mesogens for Advanced Electro-Optic Devices

Award Number: 0646460
Program Manager: William Haines

Start Date: June 15, 2007
Expires: May 31, 2009
Total Amount: $499,999
Investigator: Yongqiang Zhang, zhang@displaytech.com
Company: Displaytech Incorporated
2602 Clover Basin Dr
Longmont, CO 80503
Phone: (303)772-2191

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to exploit novel dimer ferroelectric liquid crystals (FLCs) to develop a new class of materials for electro-optics (EO) and non-linear optics (NLO) that offer previously unobtainable properties. This will enable advanced optoelectronic products across multiple markets, from lasers for projection television to 100GHz integrated electro-optic modulators and switches for optical interconnects and telecommunications. For over 100 years, predominant liquid crystal molecules have been variants on simple rod shapes. This innovation exploits new dimers - a side-by-side pair of conventional rod-shaped FLC molecules connected by a pi-conjugated bridge engineered to be part of a strong NLO chromophore. It is difficult and expensive to build integrated optoelectronic devices using lithium niobate, today's dominant NLO material. Organic poled-polymer NLO materials offer significant advantages for integration, but suffer performance and stability limitations due to being thermodynamically unstable and non-centrosymmetric (required to be NLO active). FLCs are intrinsically non-centrosymmetric and thermodynamically stable, offering an ideal scaffolding for creating high densities of strong, oriented, NLO chromophores. Our Phase II objectives are to develop and demonstrate prototype materials for projection television laser light sources and electro-optic modulation, and to design a product that will be used in projection television lasers.

Commercially, this SBIR Phase II project will advance the scientific and technological understanding of a new class of dimer ferroelectric liquid crystals, and will produce the first commercially significant liquid crystals not based on simple rod-shaped molecules. Consumer products will include higher image quality, lower cost, rear projection televisions and practical, bright, micro-projectors for portable electronics. Integrated electro-optic devices enabled by the NLO materials will help to expand the bandwidth of computer and telecommunication networks, and of interconnects within coming generations of faster computers.

Title: SBIR Phase II: New Ceramic Sub-Microchannel Plates

Award Number: 0724478
Program Manager: Juan E. Figueroa

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Dmitri Routkevitch, droutkevitch@synkera.com
Company: Synkera
2021 Miller Dr Unit B
Longmont, CO 80501
Phone: (720)494-8401

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project proposes to develop and commercialize advanced high- resolution ceramic microchannel plates (s-MCPs) for applications in low- and night vision devices, scientific detectors and biomedical imaging. Conventional glass-fiber MCP technology has reached its fundamental limits in spatial and temporal resolution, fixed pattern noise, high count rate capabilities, thermal performance, yield and reproducibility, stability and lifetime. This is a unique approach based on nanoporous ceramics, which allows reaching ultra-high sub-micron resolution. Due their ceramic nature, the proposed s-MCPs are capable of processing temperatures up to 1000 degrees celsius, enabling direct integration of advanced photocathodes for expanded spectral range and sensitivity, and are also expected to have greater lifetime than those produced with existing methods. In addition ceramic s-MCPs can be produced at a much lower cost than glass MCPs. A robust ceramic structure with the required dimensions and resistance has been developed. The remaimimg challenge is to fabricate functional s-MCP prototypes from this structural material, along with validation of s-MCP performance.

The expected result of the proposed work is a manufacturing technology for production of commercially viable sub-microchannel plate intensifiers with better performance, longer lifetime and lower cost. This could open up new opportunities in the development of the next generation particle and photon detection systems for the infrared, UV, x-ray and gamma ray astrophysics applications. Spin-off applications for ceramic MCPs include "lobster eye" optics for x-ray detectors as well as gas avalanche detectors. Commercial applications include detectors for high-energy physics, scientific instrumentation, biomedical imaging, commercial satellite mapping, vision augmentation, as well as consumer night vision products.

Robotics

Title: SBIR Phase II: Methodology for Applying Haptic Robotics to Agile Manufacturing

Award Number: 0646448
Program Manager: Muralidharan S. Nair

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $500,000

Investigator: William Townsend, wt@barrett.com
Company: Barrett Technology Inc
625 Mount Auburn St
Cambridge, MA 02138
Phone: (617)252-9000

Abstract:

This Small Business Innovation Research (SBIR) Phase-II research project addresses safety, user - interface, and performance challenges uncovered in Phase I while adapting a haptic robot to the manufacturing environment for medium-production-run paint spraying. Haptics is an exciting field, but industry adoption has been slow. Yet without haptics in applications like medium-run paint spraying, the two alternatives (fully automated or fully manual) are unappealing. Robots are prohibitively expensive to program for short runs, and fully manual operations endanger worker health.

The technologically revolutionary haptics field has not yet revolutionized manufacturing. Some manufacturing tasks lack good alternatives, especially in medium run production, where one must choose between high-cost, time-consuming robot programming versus poor worker health. Physical robot-craftsperson interaction will benefit these middle applications, if safe and intuitive.

Title: SBIR Phase II: Robotic Material Removal System

Award Number: 0646438
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2009
Total Amount: $500,000

Investigator: Steven Somes, ssomes@adelphia.net
Company: Western Robotics Co
8840 Eagle Road
Willoughby, OH 44094
Phone: (440)256-2004

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project explores the innovation of a robot that, like biological creatures, operates by applying and sensing contact forces. Today's position-controlled robots have limited applicability to many manufacturing tasks, especially those related to material removal and surface finishing. Emulating a human's free-hand motion capability greatly advances robot capability. Such a robot could trace part contours to smooth and polish. It could feelfor part edges to discover a part's location, and compare measured geometry to a modeled ideal to detect finishing requirements. The robot could follow finishing strategies, acquiring needed information by touch as it worked.

Applications for force capable robots are ubiquitous across industry. Virtually all parts made from casting, forging, machining, or molding require some degree of surface finishing to arrive at a final desired shape and smoothness. Other prospective applications include: mechanical assembly, sorting and packaging irregular objects, and dual-arm manipulation of heavy and bulky items.

Semiconductor & Other Materials

Title: SBIR Phase II: Flexible and Transparent Coating Polymers for Flat Panel Displays

Award Number: 0110105
Program Manager: Winslow L. Sargeant

Start Date: September 1, 2001
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Silvia D. Luebben, silvia@tda.com
Company: TDA Research, Inc
12345 West 52nd Avenue
Wheat Ridge, CO 80033-1917
Phone: (303)940-2301

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new optically transparent intrinsically conducting polymer (ICP) that can be processed from organic solutions. Despite much information on ICPs in the technical literature, the number of commercial applications of ICPs is still very small because of their intrinsically poor stability and the lack of reasonable processing methods. Phase II will address the problem of processability. Phase I successfully prepared ICPs that are soluble up to 15% weight in alcohols. Cast films are optically transparent, have conductivity of 1-100 Siemens per centimeter, and maintain constant conductivity when elongated up to 30%. ICPs were made from commercially available monomers. Phase II will bring the polymers developed in Phase I from a feasibility stage to commercial products by optimizing their composition and synthesis and scaling up production and purification.

These materials could be used to replace indium tin oxide in flat panel displays and other electronic applications. ICPs are expected to find application in the manufacture of electronic components, inks, biomedical materials, electronic devices, and specialty coatings.

Title: SBIR Phase II: Integration of Advanced Power Electronics through the Packaging of High Temperature Silicon-Carbide (SiC) Based Multichip Power Modules (MCPMs)

Award Number: 0522272
Program Manager: T. James Rudd

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $441,918

Investigator: Alexander Lostetter, alostet@apei.net
Company: Arkansas Power Electronics International, Inc.
700 W Research Center Blvd
Fayetteville AR, 72701
Phone: (479)799-6578

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will develop highly miniaturized power converters by developing a functional, scaled-down hardware prototype of a high-temperature multichip power module (MCPM). To achieve this goal, the company has taken advantages of the key benefits of silicon carbide (SiC) semiconductors which include high-temperature operation, high switching frequencies, low switching losses, and high power densities. While Phase I of the project was focused upon successfully proving the feasibility of high-temperature MCPM's, Phase II will be focused on developing full prototype modules. The Phase II project will further develop high-temperature packaging techniques and investigate long term reliability issues associated with high-temperature operation. At the conclusion of Phase II, the company will deliver two high-temperature MCPM modules. The first prototype delivery will be a fully functional 4-hp 3-phase motor drive MCPM capable of 250 degrees C operation, and the second prototype will be a 30 kW 3-phase motor drive that demonstrates an order of magnitude miniaturization over modern state-of-the-art silicon based systems. Since current silicon electronics are typically limited to approximately 150 degrees C maximum temperature of operation, the high-temperature research proposed in this project has the potential to greatly enhance scientific understanding of high-temperature failure mechanisms, thermal induced electronic packaging stresses, and long-term interconnect reliability issues, in addition to technical advancement of state-of-the-art power electronics systems.

The commercialization of SiC based MCPM's has the potential to find benefit in nearly every electric motor drive, power supply, or power converter conceivable. The application of such MCPM's could save electrical energy consumption worldwide, due to the improved electrical efficiency of SiC power switches alone. Furthermore, an immediate commercialization application is possible in the development of high-temperature geological petroleum exploration instrumentation and also in industrial motors. Other long term benefits would be found with application to complex weight critical power systems (such as in spacecraft), high-temperature systems (such as fuel cell electronics or electric vehicle motors), and other high efficiency power systems.

Title: SBIR Phase II: Miniature Cooling System for Laptop Computers

Award Number: 0522126
Program Manager: T. James Rudd

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $500,000

Investigator: Daniel Schlitz, dschlitz@bellsouth.net
Company: Thorrn Micro Technologies, Inc.
2345-2 Yeager Road
West Lafayette IN, 47906
Phone: (770)931-8528

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a compact, light-weight and noiseless cooling system for laptop computers. The product will be an air cooled, micro-channel heat sink with an electro-hydrodynamic (EHD) pump integrated within the channels. Research will focus on the development of a heat sink with a large parallel array of micro-channels to provide optimal thermal resistance. The second major area of development will be the EHD air flow device; a modification to the corona wind technique will be used to provide air flow through the heat sink. Other tasks include power supply development, system integration, manufacturing process development and reliability improvement. As the speed and performance of laptop computers increases, the power density in the microprocessors rises and they dissipate more heat. The proposed project addresses the fact that laptop computer cooling systems will be required to dissipate upwards of 40 Watts while maintaining the microprocessor below 85 degrees C.

Commercially, the proposed cooling system is being developed for the growing laptop computing market. More than 235 million personal computers will be sold in 2007; roughly one-third of which or about 80 million will be laptop computers. The proposed product's small size and excellent heat dissipation capabilities will enable laptop computer manufacturers to incorporate faster processors while simultaneously reducing the overall size and weight of their products. Besides cooling applications, electro-hydrodynamic pumping technology can be used as a means of providing precise control of small amounts of liquid. This has application as an insulin delivery mechanism for diabetics and in the so-called laboratory-on-a-chip

Title: SBIR Phase II: High Surface Area Tantalum Powder for Capacitor Applications

Award Number: 0450598
Program Manager: T. James Rudd

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $500,000
Investigator: Harvey Gershenson, kappastl@aol.com
Company: AP Materials, Inc.
4041 Forest Park Ave
Saint Louis MO, 63108
Phone: (314)633-1806

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will scale-up a new technology for producing high-surface area tantalum powders for the electronic capacitor industry. The existing technology is over 30 years old and cannot keep pace with the needs of smaller electronics, which require tantalum particles in the nanometer size range. In addition, environmental factors are driving the industry away from the fluorinated precursors that are presently used to make tantalum. The proposed technology employs the Sodium Flame Encapsulation (SFE) technology to address this problem by producing nano-tantalum powders encapsulated in sodium chloride. In-situ encapsulation allows for control of morphology and prevents oxidation of the nano-tantalum by air or moisture. The technology has been shown to produce state-of-the-art capacitor materials with an environmentally-friendly process. Nonetheless, the present process is a two step process involving post-processing of the nanopowders into the agglomerated structure needed by capacitor manufacturers. This program will specifically develop the flame technology so that the post-processing step is unnecessary. In this way powders can be produced with the appropriate morphology such that they only need to be washed and re-encapsulated to be a drop in replacement for existing materials. The results will be a less expensive, higher efficiency, higher surface area material that is produced by a green technology.

Commercially, this technology will enable smaller, more versatile electronics by ensuring that the tantalum capacitor industry can continue to reduce its package size in line with the rest of the industry.

Title: SBIR Phase II: Yb:KGW for High Power and Ultrafast Lasers

Award Number: 0450570
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $499,979
Investigator: Barry Wechsler, bwechsler@novaphase.com
Company: Nova Phase Inc
43 Sparta Ave
Newton NJ, 7860
Phone: (973)579-6682

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on developing methods to improve the power and performance of an exciting new diode-pumped solid-state laser crystal. Laser crystals are superior to any other candidate material in the emerging and rapidly developing field of ultrafast lasers by their ability to generate high power femtosecond pulses. The proposed program will involve crystal growth in order to select the material with optimum operating performance and power handling capabilities. Issues to be addressed include the optimum concentration in the crystals, the uniformity of dopant incorporation during crystal growth, the preferred orientation of the crystal for laser rod fabrication, and methods to improve the quality and reliability of these crystals.

The first commercial ultrafast laser system based on this technology was recently introduced. In order to ensure the rapid development of this new technology and the myriad applications in material processing, medicine and basic science it will undoubtedly enable, considerable development effort is required. This research effort is directed toward bringing the material system on which the laser is based to a point of performance, reliability and producability necessary for the commercial success of this new device.

Title: SBIR Phase II: Iptymer Low-k Dielectric Materials

Award Number: 0450507
Program Manager: T. James Rudd

Start Date: April 15, 2005
Expires: March 31, 2007
Total Amount: $500,000
Investigator: Lawrence Hancock, lhancock@nomadics.com
Company: Nomadics, Inc
1024 S Innovation Way
Stillwater OK, 74074
Phone: (405)372-9535

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop and introduce new low-dielectric constant polymers as a new dielectric material for the fabrication of interconnect systems in integrated circuits. The continuing drive for denser integrated circuits and faster interconnects requires the development of new interlayer dielectric materials. The proposed materials rely on newly defined, so called Iptymer molecular design concepts, to create intrinsic free volume within the material. This approach is distinctly different than the current methods under investigation that introduce extrinsic pores into a material to lower its dielectric constant. The standout thermal stability, mechanical strength, and processability of Iptymer materials will enable facile integration into semiconductor fabrication processes. The research objectives of the Phase II program will introduce and supply Iptymer materials into semiconductor fabrication process development programs. This effort builds on Phase I results that demonstrated scaled synthesis of key Iptymer monomers and polymers and validated the dielectric performance, mechanical strength and processability of Iptymer polymers. The Phase II program will demonstrate pilot production of Iptymer materials that possess a dielectric constant less than 2.0 and have superior mechanical and thermal integrity. In addition integration of Iptymers in semiconductor fabrication processes will be demonstrated.

Commercially, the impact of reliable low-k dielectric materials is considerable. Higher bandwidth processing and communication for the same cost will be possible with improved materials. Present day microprocessors have a range of clock speeds determined from post-fabrication testing. Superior low-dielectric materials will not only increase the ultimate clock speeds, but will also improve the yield of the highest speed devices. Every country, economic group, and industry will benefit from such advances. The societal benefits realized through the extension of electronic tools into areas where their use is now impractical or not affordable will be tremendous. Widespread availability of computers throughout primary and secondary education will reap tremendous gains in education

Title: SBIR Phase II: High Resolution Infrared Imager

Award Number: 0450487
Program Manager: Juan E. Figueroa

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $484,140

Investigator: Conor Rafferty, conor.rafferty@nobledevice.com
Company: Noble Device Technologies Corporation
211 Warren St.
Newark NJ, 7103
Phone: (973)242-0979

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to leverage new materials technology to drive a revolution in infrared imaging. Silicon imagers are widely used, from supermarket scanners to the ultra-sensitive charge-coupled devices (CCDs) used in astronomy. Germanium is photo-sensitive over a wider spectrum, from visible to well into the infrared. Combining this new spectral capability with fine-line silicon manufacturing brings high resolution, high reliability and lower costs to infrared imaging, enabling new applications, especially in dentistry and medicine. Short-wave infrared (SWIR) imagers today using exotic materials have limited resolution and are too costly for widespread use. This SBIR Phase II project proposes to design a prototype silicon-imaging array for use with integrated germanium pixels.

The proposed project has broad impact. The short-wave infrared (SWIR) spectral range from 800 to 1600 nanometer (nm) holds considerable scientific and applied interest. The human eye does not focus wavelengths past 1.4 micron, so that infrared imaging using active illumination with bright flashes is possible without endangering safety. The most promising immediate application is dental imaging, where the transparency of tooth enamel at 1300 nm allows improved diagnostics through infrared imaging.

Title: SBIR Phase II: Lead-Free Solder Process

Award Number: 0450408
Program Manager: T. James Rudd

Start Date: April 15, 2005
Expires: March 31, 2007
Total Amount: $501,925
Investigator: Holly Garich, hollygarich@faradaytechnology.com
Company: Faraday Technology, Inc
315 Huls
Clayton OH, 45315
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Abstract:

This Small Business Innovation Research Project (SBIR) Phase II project will advance the development of an electrochemical process, addressing the need for elimination of the use of lead-based finishes and solders in the printed circuit board, electronics packaging and semiconductor industries. This technology utilizes pulsed electrolysis to deposit a lead-free tin solder with the desired grain size, matte finish and control of internal stresses, to avoid whisker growth which can lead to component failure. The Phase II objectives/research tasks include: 1) pilot-scale facilities design and modification for electro-deposition of lead-free solder onto full size printed circuit boards and wafers, 2) demonstration and optimization of the process to deposit lead-free solder for chip and wafer scale packaging, 3) development of analysis methods to characterize deposit properties and evaluate the correlations between the process and deposit properties, 4) demonstration of qualification and reliability tests for tin whisker evaluation and characterization of corresponding acceleration factors, and 5) comparison of the data to that obtained by other alternatives lead-free materials, e.g. tin-silver. The anticipated results of the Phase II program are a marketable manufacturing process/manufacturing tool in the form of an electrochemical module incorporating the lead-free process.

Commercially the project addresses the needs of the printed circuit board and semiconductor industry, to minimize chemical waste and environmental impact and at the same time increase cost-effectiveness.

Title: SBIR Phase II: Microdisplays Based on III-Nitride Wide Band Gap Semiconductors

Award Number: 0450314
Program Manager: T. James Rudd

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $479,672

Investigator: Zhaoyang Fan, zyfan@3N-Tech.com
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Manhattan KS, 66503
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Abstract:

The goal of this SBIR Phase II project is to bring the demonstrated Gallium Nitride (GaN) microdisplay technology to industrial maturity and to final commercialization levels. The project's goal will be accomplished by further optimizing the microdisplay device structural design and fabrication process based on the demonstrative results obtained in Phase I. Based on high-efficiency semiconductor micro-light-emitting diode (microLED) array technology, the GaN microdisplay is the first of its kind based on semiconductor LEDs. Specifically, by the hybrid integration of GaN microLED arrays with Si CMOS driver circuits through flip-chip bonding, active matrix addressable GaN microdisplays will have a compact size and will be able to support more information content and movie display due to their high pixel filling factor, uniformity, luminance, and power efficiency. The unique intrinsic properties of GaN microLEDs - high brightness (> 10 microwatt optical output power for microLEDs of 18 micrometer in diameter), wide viewing angle (~ 160 degrees), fast response time (< 1 ns), and high thermal and vibrational resistance, make GaN microdisplays a perfect solution for environmentally demanding applications such as head-up displays (HUD) in modern vehicles and aircrafts, head-mounted displays (HMD) for firefighters and other rescue operatives, and hand-held mini-projectors for field applications.

Microdisplays have a small size (typically less than 1 inch diagonal) with a resolution from low end to above XVGA format. They are magnified by optics to form enlarged virtual or projected images for viewing by a user. Microdisplays can be used in a variety of devices such as head-mounted displays, video headsets, camcorder viewfinders, projection TV, head-up displays, etc. and have many commercial applications. GaN microdisplay, with its superior performance over other microdisplay technologies, is especially suitable for environmentally demanding applications that require high brightness, high reliability, and wide operating temperature range. With a slight modification of the material composition, GaN microLED arrays developed here can vary the emitted wavelength from the green to the ultraviolet range, which is very suitable for fluorescence analysis used in new type chemical-biology agent detector array or DNA/protein microchips. The GaN microLED array also has the potential for applications such as optical links and parallel computing. Other applications also include spatially resolved optical studies of biological, medical, and health care systems. The research will also enrich the general knowledge of wide bandgap semiconductor micro- and nano-photonics

Title: SBIR/STTR Phase II: A Semiconductor Device for Direct and Efficient Conversion of Radioisotope Energy

Award Number: 0450338
Program Manager: T. James Rudd

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $510,050
Investigator: Larry Gadeken, larrygad@betabatt.com
Company: BetaBatt, Inc.
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Houston TX, 77077
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will fabricate a prototype betavoltaic battery in a form factor the size of a quarter coin. The goal will be to generate approximately 100 microwatts of electrical power in a volume less than half a cubic centimeter from a tritiated energy source. Research conducted for the Phase I portion of this project established the feasibility of constructing a semiconductor device that directly and efficiently converts the energy released from radioactive decay directly into electric current. Three dimensional (3D) diodes were constructed in macroporous silicon by placing p-n junctions along the walls of all the pores. These junctions formed the betavoltaic conversion layer for beta particles (electrons) emitted by gaseous tritium (the radioisotope of hydrogen with a half life of 12.3 years) that was distributed throughout the pore space. Measurements of the current-voltage responses for this novel 3D geometry demonstrated an order of magnitude efficiency increase compared to conventional 2Dplanar diodes. In the 3D diode nearly every decay electron entered the p-n conversion layers. The focus of the Phase II research will be to enhance the performance of the 3D diodes to maximize conversion efficiency. Also, the source energy density will be increased markedly by developing a tritiated solid that can be easily and routinely dispersed in the pore space. This research will lead to the development of a practical nuclear battery.

Commercially, betavoltaic batteries will be useful in a wide variety of sensors and devices used for remote and extended missions in many inaccessible locations. Successful commercialization of this nuclear battery with its order of magnitude increase in useful life is to increase significantly the utilization of self-powered devices and sensors. Stringent efforts will be made to ensure the radiological safety of these nuclear batteries at every step in the development, manufacturing and commercialization processes

Title: SBIR Phase II: Power-Aware Statically Speculative Microprocessors

Award Number: 0450165
Program Manager: Muralidharan S. Nair

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000

Investigator: Csaba Moritz, andras@bluerisc.com
Company: BlueRISC Labs
28 Dana Street
Amherst MA, 1002
Phone: (413)545-2442

Abstract:

This SBIR Phase II research project will develop energy-aware compiler techniques to reduce power and energy consumption in microprocessors, without affecting performance. A key principle behind this approach is to use speculative information available at compile time to reduce power and energy consumption. The key qualifier is speculative: the information does not have to be provably correct. Speculative information that turns out to be correct will enhance energy reduction; if it is incorrect, the worst that will happen is that a penalty (in terms of energy) will have to be paid. The use of such speculative compile-time information opens up a largely unexplored dimension in compilers and computer architectures, to target energy efficiency.

Over the past few years, energy consumption by computers has emerged as a major area of intellectual and commercial activity. These techniques if successful will permit substantial savings in energy consumption. The outcome of the proposed effort will not merely be a set of products, but also a vastly increased understanding of the means by which compile-time information can be exploited for energy savings. With the increasing prevalence of battery-powered computing devices such as PDAs, mobile telephones, and notebooks, power-aware computing is becoming increasingly important commercially

Title: SBIR Phase II: Novel Fluoropolymer Material

Award Number: 0422104
Program Manager: T. James Rudd

Start Date: December 1, 2004
Expires: November 30, 2006
Total Amount: $499,997
Investigator: Brian Strecker, bstrecker@nomadics.com
Company: Nomadics, Inc
1024 S Innovation Way
Stillwater OK, 74074
Phone: (405)372-9535

Abstract:

This Small Business Innovative Research (SBIR) Phase II project is to develop a novel material to enable improved performance of surface enhanced Raman spectroscopy (SERS). Availability of this material could result in the manufacture of pollution monitoring, industrial process monitoring, and defense-related products for the identification and quantification of analytes of importance to these markets. Currently available Raman spectroscopy systems provide detection of a broad range of analytes and have met with commercial success but are limited in sensitivity due to the inherent weakness of the Raman scattering phenomenon. They are also limited in their ability to differentiate analytes in complex matrices. SERS offers a means of overcoming these limitations but has been plagued by poor repeatability and limited availability of suitable substrates. Suspending noble metal particles in an inert matrix could allow their functionalization for analyte sensitivity.

The use of free floating and matrix-bound noble metal particles as SERS substrates has been demonstrated by other researchers but has not yet provided the reliability that is required for industrial and military applications. SERS has remained an "almost-commercial" technology for a number of years. It is believed that this material is a platform technology for the widespread investigation and commercialization. These enhancements and the increased understanding and control of the SERS effect provide should result in dramatic improvements in the sensitivity, selectivity, and cost of monitoring and detection systems for many Raman-active analytes of military and industrial importance.

Title: SBIR Phase II: High Conductivity Photoprintable Conducting Polymers for Polymeric Electronics

Award Number: 0420397
Program Manager: T. James Rudd

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $500,000
Investigator: Brian Elliott, belliott@tda.com
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12345 W 52nd Ave
Wheat Ridge CO, 80033
Phone: (303)940-2301

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop organic dispersible and photoprintable conducting polymers based on polyethylenedioxythiophene (PEDOT). PEDOT is the conducting polymer of choice for electronic displays and devices due to its high conductivity, stability and transparency as a thin film. However, it is only available as an aqueous dispersion, and no one else has been able to render PEDOT dispersible in organic solvents. It is important to make PEDOT dispersible in organics because water is incompatible with many semiconductor processing steps. This SBIR project will develop printable conducting polymers that are initially organic dispersible, can be cast a thin films, and conducting patterns can be made permanently fixed by selectively exposing the film to ultraviolet light. The material that is not exposed to the light can be easily removed. This project will develop printable PEDOT-based conducting polymers that contain no water, and that can be used in the production of electronics such as organic light emitting diode (OLED) displays.

This project hopes to increase knowledge of organic dispersible conducting polymers. Sample size quantities of organic dispersible conducting polymers developed in this project will be made available to researchers by sale through a major chemical distributor. This will promote a more rapid dissemination of the base technology and quicken the pace of additional discoveries and applications using our materials. The benefits of this research to society include a reduced environmental impact due to electronics manufacturing. The printing technology presented in this proposal results in fewer chemical waste streams than inorganic electronics production. Inorganic electronics fabrication facilities produce large amounts of toxic waste including arsenic and heavy metals. The lack of ground water pollution from toxins in the decomposition process is a plus for municipalities who struggle with this issue today. Furthermore, this printing technology will result in a reduction in the cost and a greater variety of electronic devices available to consumers. This technology should have a positive impact in areas where weight sensitivity represents a gating factor.

Title: SBIR Phase II: Geiger Mode Avalanche Photodiodes for Photon Counting from 0.9 Micrometers to 2.0 Micrometers

Award Number:	0422110
Program Manager:	Muralidharan S. Nair
Start Date:	August 1, 2004
Expires:	July 31, 2006
Total Amount:	$355,578

Investigator: John Dries, jcdries@sensorsinc.com
Company: Sensors Unlimited, Inc
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Princeton, NJ 08540
Phone: (609)520-0610

Abstract:

This SBIR Phase II project is to develop an InGaAs/InP avalanche photodiodes for use in Geiger mode photon counting with wavelength response extended from the conventional cutoff wavelength of 1.7 microns to 2.1 microns. Commercial InGaAs/InP avalanche photodiodes developed for linear operation in optical fiber communication systems have limited quantum detection efficiency and relatively high dark count rates when operated in Geiger mode, and are unable to detect radiation from important laser sources such as Tm/Ho near 2 microns. Using our experience as manufacturers of commercial linear-mode avalanche photodiodes and our epitaxial growth facility, we will design and fabricate avalanche photodiodes optimized specifically for Geiger-mode operation. The goal will be to obtain enhanced quantum detection efficiency, reduced dark count rate, and extended wavelength response to 2.1 microns. The two primary impacts of this work will be to enhance the understanding of the physics of Geiger-mode avalanche photodiodes, and to provide the broader research community with improved detectors that will significantly enhance the usefulness of photon-counting techniques in the near-infrared spectral region. Although the basic theory of Geiger-mode operation of avalanche photodiodes is several decades old, there continues to be a significant quantitative discrepancy between the quantum detection efficiency predicted by the theory and the quantum detection efficiency observed experimentally. Part of this study will pursue this discrepancy, not only to design improved devices but also to better understand the fundamental performance limits.

By developing improved near infrared photon-counting detectors this study will take a major step toward making such detectors commercially available to the larger research community, which will enable photon-counting techniques to be more widely applied in the near-infrared spectral region.

Title: SBIR Phase II: Crystalline Ferroelectrics Combined with Transistor Technology

Award Number: 0349729
Program Manager: T. James Rudd

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000
Investigator: Zhiyong Zhao, zzhao@ngimat.com
Company: CCVD, Inc dba MicroCoating Technologies (MCT)
5315 Peachtree Industrial Blvd.
Atlanta, GA 30341
Phone: (678)287-2400

Abstract:

This Small Business Innovative Research Phase II project will focus on developing tunable microwave devices that utilize ferroelectric thin films for their electronic properties. Specifically, barium strontium titanate (BST) thin films are being used to develop new classes of tunable microwave devices, including phase shifters, delay lines and frequency-agile filters. Currently, these ferroelectric devices suffer from two drawbacks: easily formed planar devices demand very large tuning voltages on the order of 100 Volts , while easily tuned parallel plate devices require sophisticated processing techniques. These problems have inhibited the development of commercially viable components. The current project proposes combining silicon based circuitry with ferroelectric devices on the same substrate. For example, a silicon charge pump circuit can be integrated on-chip to provide high tuning voltages for a ferroelectric phase shifter. The voltage will be isolated to the chip and less than 3 Volts would be needed to externally drive the device. Combining silicon semiconductor technology with ferroelectrics will enable development of devices which take advantage of ferroelectric's dielectric properties and overcome the current roadblocks in the way of commercializing these devices.

Commercially, a great deal of interest has emerged in the use of ferroelectric thin films in the wireless industry because of the material's ability to dramatically improve the functionality of existing devices. For example, a ferroelectric duplexer is possible which has one third the size of existing duplexers, while using 40% less power. Today's multiband handsets use up to four filters, so the potential for ferroelectrics is tremendous. A key wireless handset manufacturer identified at least six applications for tunable devices inside their telephones. Overall, the wireless telecommunications market has spawned the need for small, low power, high bandwidth microwave components. Over $50 billion of wireless handsets were sold in 2002, with $6 billion being spent on RF semiconductor components. With the trend towards highly functional wireless appliances like PDA's, the demand for wireless components will continue skyrocketing.

Title: SBIR Phase II: High Performance Lead-Free Piezoelectric Ceramics

Award Number: 0349673
Program Manager: Cheryl F. Albus

Start Date: December 1, 2003
Expires: November 30, 2005
Total Amount: $500,000
Investigator: Edward Sabolsky, sabolsky@nextechmaterials.com
Company: NexTech Materials Ltd
404 Enterprise Dr
Lewis Center, OH 43035
Phone: (614)842-6606

Abstract:

This Small Business Innovation Research Phase II project proposes to focus on the formation of grain-oriented (textured) lead-free piezoelectric and dielectric ceramics for various electroceramic and transducer applications. The overall objective of this project will be to produce lead-free ceramics with high piezoelectric performance, and demonstrate that these materials can be used in existing actuator/transducer designs, especially for applications currently using lead-based ceramics. The broader impacts will be the elimination of lead-based compositions, such as lead zirconate titanate (PZT), there are no commercially available lead-free compositions that possess comparable properties to PZT.

Beyond the commercial effect, lead is known to be toxic, so commercial products containing lead present serious health and environmental hazards at both a local and global level. Therefore, there is a substantial need for a high performance, lead-free piezoelectric ceramic with properties comparable to lead-based compositions in order to sustain the growth of piezoelectric transducers and sensor market, while meeting the many environmental and health needs.

Title: SBIR Phase II: Ultra-Broadband Ferrite Circulators/Isolators

Award Number:	0349610
Program Manager:	T. James Rudd
Start Date:	March 1, 2004
Expires:	February 28, 2006
Total Amount:	$500,000

Investigator: Hoton How, hotonhow@hotech.com
Company: Hotech, Inc.
262 Clifton Street
Belmont, MA 02478
Phone: (617)484-8444

Abstract:

This Small Business Innovative Research Phase II project addresses the development of Innovative Ultra-Broadband Ferrite Circulators/Isolators. A conventional 3-port ferrite stripline junction circulator involves a low-Q ferrite stripline resonator so that at the circulation frequencies standing-wave resonant modes are excited dumping microwave energy from the input port to the output port but not the isolation port. Operation of a conventional ferrite circulator is nonreciprocal, and the transmission bandwidth is roughly proportional to the inverse of the Q-factor of the resonator, due to the standing-wave nature of the excited resonant modes. A new picture of ferrite-circulator operation utilizing traveling-wave coupling of microwave signals at the circulation frequencies haa been discovered. This is in contrast to the operation of the conventional circulators employing standing waves for coupling. As such, ultra-broadband operation of the circulators results, whose bandwidth has been measured in Phase I to cover from 1.6 to 16 GHz for a prototype device. It is not possible to acheive this bandwidth with a conventional circulator. This leads to a new generation of ferrite circulators or isolators.

Using the LTCC technology facilitates mass production in large quantities. As such, generic microwave circulators and isolators can be fabricated at low costs suitable for universal applications covering across many frequency bands. Ferrite-circulator operation does not require a ferrite resonator anymore. This requirement has been constantly enforced by the operation of a conventional circulator for more than 50 years. There is always a tremendous need for circulators or isolators which are able to provide signal-path separation or protection over many frequency bands, as demanded by the measurement of a broadband signal and by a narrow electromagnetic pulse.

Title: SBIR Phase II: Multimodal High-Conductivity Filler for Epoxy Molding Compounds

Award Number: 0349517
Program Manager: T. James Rudd

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,422

Investigator: Jared Sommer, jsommer@alum.mit.edu
Company: Sommer Materials Research
587 North Main Street
North Salt Lake, UT 84054
Phone: (801)397-2000

Abstract:

This Small Business Innovation Research Phase II project will focus on developing more efficient semiconductor packaging materials, which is one of the key challenges of the electronics industry where increasing power and reduced size of integrated circuits is creating heat dissipation challenges. Most epoxy molding compounds used to encapsulate semiconductors contain fused silica (55-70% by volume) to maintain a compatible thermal expansion coefficient and impart moisture resistance. However, the resulting thermal conductivities of the composite compounds are very low (<1 W/mK). The low thermal conductivity of the epoxy molding compound increases the operating temperatures, which in turn decreases the reliability and processing speed of microprocessors. As semiconductor clock speeds continue to increase and chip sizes decrease, the need for higher thermally conductive molding materials has become a stark necessity. In Phase I of this project multi-modal distributions of high-conductivity diamond powder where optimized to obtain high packing densities (over 72% by volume) in epoxy molding compounds. The resulting thermal conductivities of diamond/epoxy composites were almost 8 times higher than conventional silica-filled epoxies and almost 30 times higher than the epoxy matrix. The thermal expansions of silica and diamond filler are similarly low, thus allowing better matching to silicon. In this Phase II project significantly higher thermal conductivities are to be achieved by optimizing the epoxy/hardener system with the diamond filler to improve bonding and thereby improving the heat transfer mechanism. The diamond filler will be used as a direct substitute for commercially available silica filler, requiring little or no modification of existing equipment or processing. The diamond/epoxy molding compound will effectively act as a heat-spreader. The diamond filler will allow higher switching speeds, thinner oxide gates and increased reliability of electronics. The project team will work with an epoxy molding compound (EMC) manufacturer to introduce the diamond filler into the commercial market towards the end of Phase II.

Commercial markets for this EMC technology include high-performance aerospace, automobile and microelectronic packaging applications, where heat dissipation from the packaging material outweighs the increased material cost. The increased thermal conductivity offered by the diamond filler will benefit the business and scientific community by increasing computing speed and hardware reliability. Studies indicate that heat dissipation and associated thermal problems are the most critical factors in determining the efficiency and reliability of electronic devices. In terms of scientific and educational value, EMC's incorporating the optimized diamond filler will exhibit the maximum thermal conductivity obtainable and serve as the upper-limit benchmark in thermal conductivity for the composite material.

Title: SBIR Phase II: Investigation of Ferroelectric Materials with Properties Optimized for Electron Emission

Award Number: 0078556
Program Manager: Winslow L. Sargeant

Start Date: September 1, 2000
Expires: August 31, 2003
Total Amount: $399,880

Investigator: Lek Len, lklen@fm-technologies.com
Company: FM Technologies Inc
4431-H Brookfield Corporate Driv
Chantilly, VA 20151
Phone: (703)818-9400

Abstract:

This Small Business Innovation Research Phase II project was motivated by recent research demonstrating that ferroelectric cathodes using commercial ferroelectric materials that were optimized for transducer applications can produce current densities in excess of 30 Amperes per square centimeter at 500,000 Volts, and can sustain an emission pulse (at 50,000 Volts) for a time in excess of 2 microseconds. Under the Phase I project ferroelectric materials optimized for use as cathodes were fabricated and tested, and promising materials were identified for further testing and optimization. The objective of the Phase II project will be to demonstrate a ferroelectric material with emission characteristics and lifetime meeting industry-defined requirements for application as a cathode in a commercial electron tube. Phase II research will include cathode testing at 20,000 volts, 1 microsecond with hundreds of pulses per second, characterization of the electron beam produced by the ferroelectric cathode according to size, energy and emittance, and validation testing of the cathode at an electron tube manufacturer's facility under commercial operating conditions.

It is anticipated that these tests will demonstrate the efficacy of the ferroelectric cathode materials developed under this project for use in commercial electron tubes. Cathodes are used in a wide variety of microwave tubes. Applications include radar, communications, radio and TV transmission, accelerators for medical, waste treatment, environmental and research applications

Title: SBIR Phase II: Development of AlGaN Field Emission Cathodes

Award Number: 0078637
Program Manager: Winslow L. Sargeant

Start Date: September 1, 2000
Expires: August 31, 2002
Total Amount: $399,995
Investigator: Nalin Kumar, kumarmaple@aol.com
Company: UHV Technologies Inc
113B West Park Drive
Mount Laurel, NJ 08054
Phone: (609)608-0977

Abstract:

This Small Business Innovation Research Phase II project focuses on optimization and scale-up of an aluminum gallium nitride (AlGaN) field emitter technology that could be used for practical applications. Materials have been identified that are very promising to deal with the wide-band-gap for field-emission applications. These materials have low to negative electron affinity. The Phase I project demonstrated various AlGaN compositions that possessed different doping levels for field emission properties. The Phase II project will carry out a detailed and systematic parametric optimization using closely-coupled theoretical modeling and experimentation to produce rugged, low-voltage III-V nitride field emitters. The project will utilize the company's deposition chamber and will demonstrate the effects of composition, doping, ion implantation, substrate temperature and other parameters. Effects of microstructure and conductivity of grain boundaries will also be investigated to develop better understanding of the AlGaN cold cathode technology.

The commerical potential for this technology is a compact addressable X-ray source. Additional applications will include electronic coolers, electron guns, solar-blind UV detectors, large-area lighting and flat-panel displays.

Title: SBIR Phase II: Thresholdless Ferroelectric Liquid Crystals

Award Number: 0078722
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2000
Expires: March 31, 2003
Total Amount: $328,372
Investigator: William Thurmes, thurmes@displaytech.com
Company: Displaytech Incorporated
2602 Clover Basin Drive
Longmont, CO 80503
Phone: (303)772-2191

Abstract:

This Small Business Innovation Research Phase II project's goal is a commercial quality liquid crystal exhibiting V-shaped switching with no hysteresis. This LC will be used in gray-scale displays and telecommunications optical switches. Ferroelectric liquid crystals (FLCs), due to their fast switching speed and wide viewing angle, have inherent advantages over the more commonly used nematic liquid crystals. However, when used in displays, they have a disadvantage - they generally can be driven to only two states, on and off. Since displays require intermediate gray states, FLCs currently attain gray scale by rapidly switching on and off. This project uses a new type of FLC which, in addition to its speed and viewing angle advantage, also shows analog switching. This type of material, previously known as a "thresholdless antiferroelectric", is now known to be an FLC with a linear optical response to applied field (also known as "V-shaped switching"). This project's objective is to make new liquid crystal compounds and mixtures that exhibit V-shaped switching. Towards that end, a variety of cores, chiral tails, and achiral tails, all of which are either known or suspected to promote a de Vries-type smectic A, have been proposed. About 50 - 100 liquid crystals will be synthesized by combining these various components. These new LCs will be combined with LCs made in the Phase I or earlier, giving mixtures that ideally will have not only a de Vries smectic A phase, but also a wide room-temperature smectic C phase, good low-voltage analog electrooptic response, good alignability, and fast hysteresis-free switching. An optimal alignment layer configuration will be determined. The newly formulated mixtures will be placed in cells containing this alignment layer to give V-shaped switching displays.

This project could be instrumental in advancing our knowledge of the root causes of V-shaped switching in FLC and, by extension, add insight into the responses of self-assembling molecules to applied forces. In addition, since the interaction of the alignment layer with the liquid crystal is crucial for V-shaped switching, much more so than for typical FLCs, this project will provide a better understanding of the alignment layer-LC interactions.

Title: SBIR Phase II: High Performance Vertical Heterojunction Bipolar Transistor (HBT) on SiC Using Novel III-Nitride Technology

Award Number: 9983390
Program Manager: Rosemarie D. Wesson

Start Date: April 1, 2000
Expires: March 31, 2002
Total Amount: $399,737

Investigator: Peter Norris, peternorris@compuserve.com
Company: Corning Applied Technologies Corporation
8A Gill Street
Woburn, MA 01801
Phone: (617)935-2030

Abstract:

This Small Business Innovative Research Phase II Project is aimed to develop a novel vertical geometry Heterojunction Bipolar Transistor (HBT) based on III-nitride heterostructures grown on SiC (silicon carbide). There is a strong need for high power HBTs for highly linear, high power microwave amplifiers. The innovation of this proposal is to demonstrate WBG (wide band gap) HBTs on SiC that will take advantage of the vertical geometry, and high thermal conductivity of SiC through the use of highly conductive novel nitride buffer and base structure to enhance p-type lateral conductivity with improved vertical transport properties through the base.

The proposed vertical WBG HBT device is a critical component for a new generation of satellite and base stations for wireless communication networks. Another application area is DC switch components for high power electronics.

Title: SBIR Phase II: Gas-Cluster Ion Source for Mass Spectrometer and Microelectronic Applications

Award Number: 0078580
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2000
Expires: August 31, 2002
Total Amount: $398,416

Investigator: David Fenner, dbfenner@fastdial.net
Company: Epion Corporation
37 Manning Road
Billerica, MA 01821
Phone: (978)670-1910

Abstract:

This Small Business Innovation Research Phase II project will design, fabricate and test a prototype gas-cluster ion-beam (GCIB) sputtering tool for depth profiles with monolayer-specific surface analysis of thin films. Applications will be to multilayer thin films of key importance in the microelectronics industries including semiconductors, metals in magnetic sensors, and dielectrics in photonic and micro-optical devices. The sputtering tool is expected to meet aggressive performance specifications including depth resolution of less than 1 nm in conjunction with mass spectrometry. This GCIB tool will be designed particularly for in-situ sputtering with surface-analytical instruments including the secondary-ion mass spectrometer (SIMS), the Auger electron spectrometer (AES) and the x-ray photoelectron spectrometer (XPS). The overriding motivation is the critical need in microelectronics for techniques to obtain accurate sputter depth measurements. The Phase-I effort demonstrated those GCIB methods with argon clusters sputter with near-atomic smoothness, high depth resolution and high secondary-ion yields. Minor instrumental design issues limited the cluster beam exposure uniformity and this artificially limited the average depth resolution measured. Straightforward engineering solutions are well known and are expected to yield improvements in Phase II that will provide depth resolution of well below 1 nm.

The proposed technology will enable analysis of next-generation microelectronics devices having much thinner films. Epion is the first and only to manufacture GCIB systems. The tool to be prototyped will enable and have a wide applicability to many areas of the electronic materials processing and manufacturing industry.

Title: STTR Phase II: Electrochromic Devices Fabricated from Self-Assembled Polyelectrolytes for Flat Panel Displays

Award Number: 0110370
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2001
Expires: October 31, 2003
Total Amount: $499,913

Investigator: Janice Stevenson, stevensonp@lunainnovations.com
Company: Luna Innovations, Inc.
PO Box 11704
Blacksburg, VA 24062-1704
Phone: (540)953-4267

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will continue development of a new electrochromic device based on self-assembly of organic nanomaterials. Phase I used these materials to create laboratory scale devices. Precise control of the material composition at the nanometer (nm) scale, combined with the thin layers deposited (40 nm thick), allowed switching speeds of 25-50 milliseconds for the first time, which are nearly fast enough for display applications. Further, it was found that these materials, fabricated in the solid state, could be switched by applying only 1.0 volt. Phase II will focus on optimizing device performance, developing tri-state and multi-color devices, and evaluating performance under environmental conditions necessary for commercial product development.

Markets for the technology are very large and range from automotive self-dimming rear-view mirrors to smart windows for residential and commercial buildings, smart glasses, and display products. Phase III is planned for manufacturing scale-up and will be conducted in an industrial partnership.

Title: SBIR Phase II: Novel Use of Microspheres In Plasma Display Device

Award Number: 0216106
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $499,330
Investigator: Timothy M. Henderson, hendersonmsi@earthlink.net
Company: Imaging Systems Technology, Inc.
329 N. 14th
Toledo, OH 43624-1454
Phone: (419)536-5741

Abstract:

This Small Business Innovation Research Phase II project continue the development and commercialization of novel plasma display panels which utilize gas filled microspheres (Plasma-spheres) as the pixel elements. The project has six objectives: (a) improve process control of the Plasma-sphere production system, (b) produce Plasma-spheres with optimum properties and characteristics, (d) develop reliable microsphere-electrode configurations, (e) develop a semi-automated process for fabricating Plasma-sphere panels, (f) construct and evaluate prototype plasma-sphere panels, and (g) determine techniques for a fully automated production process. The Plasma-spheres will be produced with a prototype production system built in Phase I. The Plasma-sphere panels will be characterized for operating voltages, current and brightness. As part of the prototype panel construction a reliable method of applying the Plasma-spheres to substrates will be developed.

The use of Plasma-spheres will dramatically increase manufacturing throughput, reduce materials cost by half, and eliminate many process steps and expensive specialized machinery which are part of the current plasma panel technology. These cost reductions along with new applications which will result from the availability of an open flexible substrate (e.g., large conformal and panoramic displays), will provide Plasma-sphere panels with a significant competitive edge.

Title: SBIR Phase II: Electrochemical Method to Fabricate Flexible Solar Cells

Award Number: 0321736
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $500,000
Investigator: Shalini Menezes, interphases@att.net
Company: Interphases Rsch Co
166 N. Moorpark Rd, Suite 204
Thousand Oaks, CA 91360-4420
Phone: (805)497-2677

Abstract:

This Small Business Innovation Research Phase II project is developing an innovative flexible photovoltaic technology based on n-copper indium diselenide (n-CIS). Phase I research devised a new approach to synthesize large-grained films, and a new device configuration with only 3 layers on a metal foil. The research also devised a simple 4-step fabrication method for the n-CIS photovoltaic cell. This process uses high throughput, high yield roll-to-roll electrodeposition on a continuous metal foil. The n-CIS photovoltaic technology will evolve into a stable and efficient flexible prototype device in Phase II, with pilot line production in Phase III.

The research will lead to an affordable, non-polluting, renewable n-CIS PV technology to meet the growing demand in the global energy market. Its applications include: remote industrial and recreational power, off-grid and grid-tied residential and commercial power, generation systems, central power plants, spacecraft and satellites. Technology commercialization will make a tangible contribution to the nation's energy supply, the environment and the welfare of the society.

Title: SBIR/STTR Phase II: A Low Cost Semiconductor Metallization-Planarization Process

Award Number: 0131791
Program Manager: Rosemarie D. Wesson

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $500,000

Investigator: E. Jennings Taylor, jenningstaylor@faradaytechnology.com
Company: Faraday Technology Inc
315 Huls Drive
Clayton, OH 45315-8983
Phone: (937)836-7749

Abstract:

This Small Business Innovation Research Phase II Project will establish market demand for a novel electrically mediated leveling technology and position the technology for market launch via a joint venture. The specific Phase II objectives are: 1. Scale-up and demonstration of the electrically mediated process on eight-inch wafers, 2. Development of a process library for feature sizes 1-5 down to 0.17 microns, and lower, and 3. Design of a "proof of concept" plating tool. Preliminary concept design of a plating tool incorporating the electrically mediated process will be performed by an outside firm.

The sustainable competitive advantage associated with the project for leveling is cost. Minimal overplate will eliminate or minimize the need for chemical/mechanical planarization (CMP) by reducing the copper waste slurry compared to the state-of-the-art copper metallization processes. This in turn would eliminate the associated control, environmental, and cost issues.

Title: SBIR Phase II: A Source for High Rate Growth of Gallium Nitride Films
Award Number: 0132055
Program Manager: Rosemarie D. Wesson

Start Date: March 1, 2002
Expires: February 29, 2004
Total Amount: $493,649

Investigator: Michael E. Read, read@psicorp.com
Company: Physical Sciences Inc
20 New England Business Center
Andover, MA 01810-1077
Phone: (508)689-0003

Abstract:

This Small Business Innovation Research Phase II Project will develop a neutral, high flux/fluence nitrogen atom beam source for application to the high rate growth of III-V nitride semi-conducting materials over large areas. The proposed source is based on proprietary MID-JET technology. This technology employs an electrode-less discharge contained by vortex flow, rather than a dielectric tube commonly used in traditional sources. MIDJET technology utilizing a temperature of 5000 C to produce1021 nitrogen atoms has been demonstrated. This is 2-3 orders of magnitude higher than that generated by currently available sources. It is particularly applicable to Metal Organic Chemical Vapor Deposition (MOCVD) systems, where it will allow both high growth rate and the elimination of the use of ammonia. The MIDJET will be adapted for use in a MOCVD reactor and a demonstration made of the system's ability to grow gallium nitride at a rate of at least 10 microns per hour.

This project will develop a charge-free, high flux/fluence nitrogen atom beam for the growth of III-V nitride materials, which can replace existing plasma-based tools. With higher growth rates of high quality material over larger areas, systems based on the MIDJET will have with application to the fabrication of high power/high temperature semiconductor devices and blue illumination sources (including those for flat panel displays).

Title: SBIR Phase II: Advanced Carbon Electrodes to Reduce Ultracapacitor Size and Cost

Award Number: 0132078
Program Manager: Cheryl F. Albus

Start Date: March 1, 2002
Expires: February 29, 2004
Total Amount: $500,000

Investigator: Michael R. Wixom, tjultracap@aol.com
Company: T/J Technologies, Inc
PO Box 2150
Ann Arbor, MI 48106-2150
Phone: (313)213-1637

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop advanced carbon electrode materials for ultracapacitors. Presently, ultracapacitor voltages are limited to 2.3 - 2.7 V/cell. New carbonaceous electrode materials are expected to increase cell potential limits to >3.6 V. Given the quadratic dependence of energy density on cell potential, these materials will increase ultracapacitor energy storage by >100%. The increased cell potential will reduce device size and cost by reducing the number of cells required to attain a given voltage rating. Phase II will demonstrate that these materials can withstand extended charge/discharge cycling to high voltage. A scalable process will be developed to produce the new carbon electrode materials. Prototype ultracapacitors will be produced to support customer demonstrations.

The commercial potential of this project is for ultracapacitors that are used in portable electronic devices, power conditioning (UPS), and electromechanical actuators. Additional applications include hybrid electric and conventional vehicles to service intermittent high power loads (e.g. regenerative braking, engine start, electromechanical valves, and electric power steering).

Title: SBIR Phase II: Germanium Liquid Crystals for Perfect Displays

Award Number: 0522304
Program Manager: James Rudd

Start Date: December 13, 2005
Expires: October 31, 2007
Total Amount: $400,000

Investigator: Michael Wand, mdwand@gmail.com
Company: Displaytech Incorporated
2602 Clover Basin Drive
Longmont, CO 80503
Phone: (303)772-2191

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop germanium-containing ferroelectric liquid crystals (Ge-FLC's), a fundamentally new class of LC materials that enable migration of microdisplays into camera and automotive applications with billion-dollar available display markets. Ge-FLC mesogens synthesized during Phase I demonstrated breakthrough layer shrinkage properties that will solve the longstanding bistability problem in FLC's, thereby raising the achievable brightness of FLC-based projection displays to commercially viable levels. Phase II research tasks include: (1) the synthesis and characterization of a library of approximately 100 new Ge-FLC compounds, (2) the formulation from this library of FLC mixtures engineered for three specific approaches to bistable switching, and (3) development of alignment layers conforming to the device physics requirements of the three bistable approaches. These tasks support the overall project objective of demonstrating robust engineering-prototype bistable FLC devices with characteristics appropriate for commercial microdisplay products.

Commercially, the project furthers the emerging technology of silicon-based microdisplays with very large potential commercial impact. The company's previous success commercializing SBIR-funded technology into a rapidly-growing $40-million business provides a foundation for growth into billion-dollar markets for camera and automotive microdisplays enabled by the Phase II innovation. Success in these markets will generate outstanding returns for the company's shareholders, and will provide higher-performing, lower-cost electronic cameras and safer and more convenient automobiles to U.S. consumers.

Title: SBIR Phase II: A Novel Microwave Technique for Rapid Thermal Processing of Silicon Carbide Wide Bandgap Semiconductor

Award Number: 0646184
Program Manager: William Haines

Start Date: March 1, 2007
Expires: February 28, 2009
Total Amount: $500,000
Investigator: Yonglai Tian, ytian@cox.net
Company: LT Technologies
3819 Charles Stewart Drive
Fairfax, VA 22033
Phone: (703)620-0963

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a unique solid-state microwave technique capable of reaching ultra-high temperature (up to 2150 deg C) and ultra-fast thermal processing of large wide band gap semiconductor wafers. It is widely recognized that the existing post-implant anneal process is a bottleneck limiting the performance and reliability of wide band gap semiconductor devices. This technique lowers the sheet resistance and surface roughness of the implanted semiconductor, enabling the fabrication of higher performance, more power efficient devices at lower cost. As part of the Phase I research, the microwave annealed samples showed a record low sheet resistance and surface roughness in both p-type and n-type implanted SiC. The Phase II research is to extend microwave-based rapid thermal processing (RTP) to other wide band gap materials such as GaN and to allow for RTP of larger sized wafers. The prototype system will be upgraded from a single-heating-head system to a system with an array of multiple heads and multiple sensors. Computer-based automated control will be developed to regulate wafer temperatures uniformity and stability. The research is anticipated to show feasibility of microwave-based RTP in commercial use for large SiC wafers. The technology improves post-implant anneal process to minimize sheet resistance and surface roughness of SiC and GaN, which consequently reduces the device power consumption and lowers the thermal budget. Lower surface roughness improves SiC sub-micron device reliability, consequently improving yield and reducing manufacturing cost.

Commercially, this is an enabler technology that will make better and lower-cost compound semiconductor devices in areas such as power devices, light emitting diodes (LEDs), high temperature and high frequency electronics. The societal and commercial impact of the technology can be enormous. LED technology, for example, can potentially reduce the percentage of energy required for lighting in the U.S. from 22% to 7%, saving $17 billion per year and reduce CO2 emissions by 155 million tons. Manufacturers of LED devices are looking for enabler technologies such as RTP to reach this goal. Recognizing the technological and the commercial significance of the research, Cree, GE Research and ARL are supporting the research effort by providing the technological expertise, test wafers, access to equipment, and other in-kind services.

Furthermore, the technology can be extended to other applications such as RTP of ultra-shallow junction for nano-scale CMOS devices, wafer bonding, MEMS as well as processing of SiC nano-materials.

Title: SBIR Phase II: Thick Film Garnet Materials for In-Plane Propagation Magnetooptic Devices

Award Number: 0646272
Program Manager: William Haines

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $500,000
Investigator: Vincent Fratello, vjfratello@integratedphotonics.com
Company: Integrated Photonics Inc.
2920 Commerce Blvd
Birmingham, AL 35210
Phone: (908)281-8000

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the device and market opportunity for in-plane propagation of light in-planar anisotropy magnetic garnet films for high sensitivity, high speed magneto-optic sensors, switches and modulators. Traditional perpendicular propagation devices require perpendicular magnetic fields and magnetization processes. These are limited in speed and sensitivity by the current materials and the energy required to magnetize the garnet in the perpendicular direction. In the plane of the film, there is almost no energetic barrier to domain rotation. In this project, Integrated Photonics, Inc. (IPI) proposes to reduce that barrier to near zero to make devices of unprecedented sensitivity and speed. The goal is to attain pico-tesla field sensitivities in sensors and gigahertz device frequencies. The latter will enable small, low-power magneto-optic light modulators that are truly a disruptive technology by comparison to current large dimension electro-optic technologies. In Phase I, a materials growth and characterization capability was established and limitations on speed and sensitivity were removed by optimizing material parameters. In Phase II the process will be optimized to achieve the highest optical quality for commercial devices and sensor, switch and modulator devices will be realized in collaboration with customer-partners.

Commercially, in-plane propagation in planar thick film Faraday rotators would enable unique new devices. High speed magneto-optic modulators open the door to system integration architecture for wideband communications and software defined radios. In-plane propagation materials have much higher switching speeds than conventional perpendicular Faraday rotators and as such would permit a magneto-optical approach to packet switching. Reduced costs would permit wide deployment in FTTP. High speed, low field magneto-optic switches are attractive for military applications. In-plane propagation magnetic field sensors can be optimized to give unprecedented high sensitivity speeds much higher than can be attained with conventional perpendicular propagation. These sensors would have applications such as wheel and turbine rotation, electric power distribution, monitoring, metering and control and battlefield sensors. The electric power application in particular has potential to revolutionize catastrophic failure prevention in the power grid and reduce power costs at a variety of levels by enabling autonomous reconfiguration. The lack of electrical connectors in fiber optic sensors for explosive, flammable and high voltage environments represents a significant improvement in safety. Smart ships and buildings would find utility both for conservation and efficiency.

Title: SBIR Phase II: New N-Type Polymers for Organic Photovoltaics and other Electronic Devices

Award Number: 0724875
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Silvia Luebben, silvia@tda.com
Company: TDA Research, Inc
12345 W 52nd Ave
Wheat Ridge, CO 80033
Phone: (303)940-2301

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new family of n-type conjugated semiconducting polymers for use in plastic photovoltaics and other organic electronic devices. New n-type semiconducting polymers with good solubility, environmental stability, and high charge carrier mobility are needed to fabricate efficient organic solar cells and other electronic devices. During the Phase I project several n-type semiconducting polymers were fabricated via simple reactions. In Phase II the polymers will be optimized to improve their solubility and charge mobility. Partnership with a major developer of organic photovoltaics will allow the materials to be optimized for use in organic solar cells.

The further development of these n-type semiconducting polymers will result in the manufacture and sale of these materials as specialty chemicals to the organic electronic industry for the fabrication of a variety of organic devices including photovoltaic devices, thin film transistors, organic light emitting diodes, and others. The novelty of this chemistry over the chemistry of current n-type organic semiconductors has the potential for significant academic and scientific value and could lead to a cascade of new discoveries and technology advancements, in addition to the primary objective of creating a new business.

Title: SBIR Phase II: Diffractive Electrode Structure for on Chip Embedded Passive Components.

Award Number: 0724467
Program Manager: William Haines

Start Date: October 1, 2007
Expires: September 30, 2009
Total Amount: $499,027
Investigator: Ronald Kubacki, kubacki@ionic.com
Company: Ionic Systems Inc
2161 Otoole Ave Ste H
San Jose, CA 95131
Phone: (408)435-2680

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a method for tuning the capacitance of on-chip capacitors. The Phase I effort demonstrated an optical diffractive electrical electrode structure that permits the penetration of deep ultra-violet (DUV) radiation into an underlying dielectric. This was used to precisely tune dielectric constant and capacitance. The DUV radiation incites a photochemical reaction altering the dielectric constant of the spacer material in the capacitor.

This project, if successful, will enable compact, precision capacitors embedded on chip to replace external discrete capacitors in electrical circuits. Moving passive components on chip in the same fabrication process is a reduction of manufacturing effort. By precisely trimming electrical values with resistor trimming equipment a significant simplification of the manufacturing process may be achieved. The successful results of Phase II will result in the demonstration of a molecularly engineered nanocomposite for use in millimeter and micro wave monolithic integrated circuits that can be photo-optically tuned for precise value to embed precision capacitors on chip. Incorporation of this technology can result in reduced size and cost for a wide variety of high frequency applications.

Title: SBIR Phase II: Ultra Low Cost, p-i-n OLED Lamps for Specialty Lighting

Award Number: 0724204
Program Manager: Juan E. Figueroa

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $497,242
Investigator: Melissa Kreger, melissak@add-vision.com
Company: Add-vision
1600 Green Hills Rd. Suite #100
Scotts Valley, CA 95066
Phone: (831)438-8192

Abstract:

This Small Business Innovation Research (SBIR) Phase-II project will analyze the limiting factors in performance and commercialization obtained through printed polymer organic light emitting diode (P-OLED) research and development as well as customer engagement. Utilizing this basis, a set of materials, device and process development tasks have been devised. These include continued lifetime improvements and development of an encapsulation process. During Phase-I, the impact of light-emitting layer morphology and cathode interactions on device performance was identified. This has allowed a prioritization of these issues for final development. Technical objectives include exceeding the commercialization threshold and achieving greater than 1000 hour product lifetimes with a flexible encapsulation process adaptable to small and large scale manufacture. This includes advanced light-emitting polymers (LEP) formulations, cathode development, and device structure optimization to meet performance milestones along with encapsulation adhesive, getter materials and lamination process trials and optimization.

If successful the outcome of this project includes benefits for mobile electronic product designers and consumers using low cost and low energy manufacturing in the U.S. display and lighting industries. Furthermore, the science and engineering work compliments R&D efforts in related materials technologies. The proposed technology is uniquely attractive among OLED lighting technologies currently under development in that it allows for low manufacturing set-up and operating expenses, and therefore early commercial adoption. Because of this cost structure, which is radically different from conventional, high capital, glass-based OLED processing, there is a significant early commercialization opportunity in mobile backlighting products and other specialty lighting applications. In these product areas, the proposed technology''s voltage, brightness, DC drive, and form factor makes it preferable to existing inorganic approaches. The low capital cost structure and dependence on advanced materials technology also provides opportunities for distributed manufacture in the U.S. away from the centralized Far East display manufacturing base. Outside of the organic display and lighting industries, this research would enhance the scientific understanding for other emerging printable and organic electronics technologies including organic photovoltaics, thin film transistors and memory, where low cost manufacturing of high-efficiency devices are paramount for commercial success.

Title: STTR Phase II: Improved Boron Nitride Materials for Enhanced Thermal Management

Award Number: 0646556
Program Manager: William Haines

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: John Ferguson, john.ferguson@aldnanosolutions.com
Company: ALD NanoSolutions, Inc.
580 Burbank St, Unit 100
Broomfield, CO 80020
Phone: (303)318-4145

Abstract:

This Small Business Technology Transfer (STTR) Phase II project builds upon the successful Phase I results to develop surface modified boron nitride (BN) filler materials for electronic thermal management applications. Novel Atomic Layer Deposition (ALD) nanocoating is used to selectively functionalize edges only or edges/basal planes to improve wetting of BN platelets with resin encapsulants. The improved wetting allows for reduced viscosity of BN/resin mixtures during processing so that increased BN filler particle loadings can be achieved, resulting in higher thermal conductivity electronic packages. These improvements are best realized using an ultra-thin (nm thick), conformal, pin-hole free, chemically bonded silica nanofilm selectively placed on the edges of primary BN platelets. Coating the edges of platelets only provides for a low cost impact since edges being nanocoated represent less than 10% of the available platelet surface area. Higher BN loadings in filled composites allow for improved heat dissipation in electronic packaging materials, particularly in the case of glob top coatings and potting compounds. Proposed Phase II R&D is focused on working with potential customers to develop applications of particle ALD surface modified BN fillers for their specific moulding compound systems. Film chemistry and thickness will be developed for their specific applications.

Commercially, the ALD nanocoating of individual ultrafine particles to control their surface chemistry is enabling technology that is unparalleled compared to more conventional CVD, PVD, PE-CVD, or wet chemistry solution processing. The process allows for individual ultra-fine particles to be nanocoated, rather than coating aggregates of ultra-fine particles. It is independent of line of sight and provides for chemically bonded films to the substrate particle surface. It is easily scalable. It is a forgiving process where the nanocoating thickness is controlled by self-limiting surface reactions (not flux, temperature, or time of processing like CVD, etc.). ALD films are pin-hole free and conformal. The potential impact of successful large scale processing extends far beyond this proposed microelectronics packaging application. It is now possible to produce ultrafine particles with designed electrical, magnetic, optical, mechanical, rheological, or other properties. Markets for such functionalized ultra-fine powders include microelectronics, defense, hardmetals, cosmetics, drug delivery, energetic materials, and polymer/ceramic nanocomposites, among others.

Title: SBIR Phase II: A New Production Method for Ta Fibers for Use in Electrolytic Capacitors with Improved Performance and Packaging Options

Award Number: 0646417
Program Manager: William Haines

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000
Investigator: William Nachtrab, wnachtrab@supercon-wire.com
Company: Supercon Inc
830 Boston Tpke
Shrewsbury, MA 01545
Phone: (508)842-0174

Abstract:

This Small Business Innovative Research (SBIR) Phase II project is intended to develop a new process for manufacturing tantalum (Ta) metal fibers for use in producing tantalum capacitors, and advance this process to the stage of commercialization. This technology, which has been demonstrated in Phase I, could lead to capacitor products having higher performance and greater volumetric efficiency than any currently available. The use of fibers in place of metal powder allows the production of thin anode bodies leading to improved packing options and component performance. The innovation underlying the technology is bundle drawing of Ta filaments in a copper matrix. A composite consisting of Ta filaments in a copper matrix is drawn is a series of reduction steps until the filaments are less than about 10 microns in diameter. The drawn wire is rolled to produce ribbon-type filaments that are 1 micron or less in thickness. The copper composite matrix is chemically dissolved without attacking the Ta to produce metallic Ta high surface area, ribbon-fibers. The fibers are formed into thin mats, which are sintered to produce porous metal strips from which high surface area capacitor anodes are made. A significant aspect of this approach is that fiber morphology can be varied over a wide of fiber thicknesses unlike powder. This allows the morphology of the fibers to be optimized for the particular voltage rating and use requirements in order to maximize the performance of the capacitor.

Commercially, nearly all medical, automotive, military and many consumer electronic devices utilize Ta electrolytic capacitors due to their outstanding performance, reliability and volumetric efficiency. Solid electrolytic capacitors are currently made from Ta metal powder. Several million pounds per year of Ta powder are consumed in manufacturing Ta capacitors for these applications. The trend in electronics is toward high powder
components and increased miniaturization. Combined with the need to lower materials
and manufacturing costs, these considerations have created an opportunity for new
method of producing solid electrolytic capacitors. Fiber metal technology has the potential to both lower manufacturing costs, improve capacitor performance, and improve
packaging options, which could enable the development of new product that are either
currently very difficult or very expensive to make using current technology base on metal powder.

Spintronics

Title: SBIR Phase II: Sub-Nanosecond Spin Dependent Tunneling Devices

Award Number: 0091564
Program Manager: Winslow L. Sargeant

Start Date: February 15, 2001
Expires: January 31, 2004
Total Amount: $499,993

Investigator: Dexin Wang, dexinw@nve.com
Company: NVE Corporation
11409 Valley View Road
Eden Prairie, MN 553443617

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop prototype Spin Dependent Tunneling (SDT) devices by combining high-speed magnetic thin films and low-RC SDT structures achieved in Phase I. These devices will be fabricated using standard microelectronic photolithography and packaging techniques, suitable for volume production. Sub-nanosecond switching will be demonstrated with these devices, which are integrated with integrated circuit (IC) electronics. Fast IC electronics will be implemented using low voltage differential signaling (LVDS). SDT devices exhibit large signal, low switching field, and high resistance, which lead to high sensitivity, low power consumption, and small size and weight, when compared with giant magnetoresistive (GMR) devices. Fast SDT devices will require improvements in both magnetic speed and electronic speed, while existing attractive static properties need to be maintained. Phase II is expected to produce integrated SDT devices with state-of-the-art properties and switching time less than one nanosecond.

Potential commercial applications for this research are expected in high-speed isolators, high-speed magnetic field and current sensing devices, fast magnetic random access memories (MRAM), reconfigurable magnetic logic, read heads, and gigahertz (GHz) inductor/transformers, as well as their derivative products.

Title: SBIR Phase II: High-Temperature Magnetic Rotary Encoder Based on a Spintronic Sensing Array

Award Number: 0522160
Program Manager: Muralidharan S. Nair

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $434,090
Investigator: Gurpreet Singh, singh@micromagnetics.com
Company: Micro Magnetics Inc
421 Currant Rd
Fall River MA, 02720
Phone: (508)672-4489

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will continue the development of an incremental magnetic rotary encoder based on magnetic tunnel junction (MTJ) sensor technology. This device uses sensitive MTJ devices to sense the magnetic field created by a patterned magnetized scale, and converts the resulting information into an accurate reading of angular position. The dual advantages of high-temperature operation (up to 200 degrees C) and contamination resistance will separate this device from the optical encoders that currently dominate the market for motor encoders. Current motor encoders are rarely capable of operation above 115 degrees C, a problem that requires motors in many market segments to operate in non-optimal configurations, costing end users in terms of time and efficiency. In addition, optical methods are sensitive to dust in the measurement path.

This development effort will create a new measurement technology with greatly enhanced capabilities for use in many critical segments of America's manufacturing sector. The creation of cost-effective encoders capable of operation at high temperatures will increase efficiency and enable further progress in a number of areas where hot environments are unavoidable, such as in the turbines of power-generating windmills. This research will advance the state of understanding of the emerging spintronic technology of magnetic tunnel junctions, a class of devices which forms the central component of a number of important commercial products in the high-tech semiconductor and data storage industries.

Title: SBIR Phase II: Flux-Gated Spin-Dependent-Tunneling Sensors

Award Number: 0321554
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $499,973
Investigator: Catherine Nordman, cathyn@nve.com
Company: NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344

Abstract:

This Small Business Innovation Research Phase II project seeks to fabricate a novel nanotechnology spin-dependent tunneling (SDT) magnetic field sensor device with increased signal-to-noise performance at low frequencies. The increased resolution at low frequencies is greatly desired in a large number of application markets. The proposed device is based on innovative methods of modulating the permeability of, and/or the flux through, integrated flux concentrators. These methods of "flux gating" (chopping or sweeping the magnetic field which is sensed by the SDT transducers) are employed using on-chip, microfabricated coil structures. The project explores the nature of frequency-dependent (or 1/f) noise that is intrinsic to SDT devices, and offers an integrated low-power method of noise reduction. SDT technology is at the leading edge of magnetoresistive transducer development due, in part, to the fact that its magnetoresistance can be more than 3 times that of the best giant magnetoresistive devices, and more than 15 times that of the anisotropic magnetoresistive sensors on the market today. The devices for this Phase II is based on novel and proprietary concepts for the advancement of small, solid-state, low-cost, low-power magnetic field sensors. The primary need is for high-resolution magnetic field sensors that are more fieldable and cost effective. SDT technology offers this high-resolution potential as well as the low-cost advantages of silicon fabrication methods used for SDT micro-sensors.

Applications for these sensors include non-destructive testing, security and surveillance, and magnetic media validation. Each of these very diverse applications share a common need for the small, highly sensitive, low power magnetic field sensing devices being proposed. The new devices will enable each of these areas to expand into small portable applications and into areas where cost effective low-field sensing has not been possible.

Title: SBIR Phase II: Ultra Low Hysteresis Giant-Magnetoresistive (GMR) Bridge Sensor

Award Number: 0091563
Program Manager: Winslow L. Sargeant

Start Date: February 15, 2001
Expires: January 31, 2004
Total Amount: $399,983
Investigator: John Anderson, johna@nve.com
Company: NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop giant-magnetoresistive (GMR) sensing devices that yield superior hysteresis performance over existing bridge sensors and GMR signal isolators and provide intrinsic self-biasing without using affixed magnets or power consuming coils. Phase I demonstrated that edge pinning techniques can be used to fabricate low hysteresis push-pull and shielded bridge sensors with designed bias points. Before the technology can be commercialized, Phase II research must: (1) develop hard edge resistor elements that minimize hysteresis and maximize signal; (2) optimize hard edge processing and implementation; (3) determine the viability of alternate pinning strategies; (4) develop specification, architecture, and physical designs for prototype sensor or isolator products; (5) fabricate target devices; and (6) characterize devices for magnetic and electrical responses. A fully developed magnetic field sensor and/or signal isolator is expected, one that is ready for commercialization.

Potential commercial applications are discrete low hysteresis bridge sensors and isolators, improved digital magnetic switches, and ultra-low field sensors employing integrated circuit (IC) based feedback amplifiers.

Title: SBIR Phase II: Reduction Of The Critical Current In Spin Transfer Switching Through Anisotropy Engineering

Award Number: 0646327
Program Manager: William Haines

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $497,550
Investigator: Alex Panchula, alex.panchula@grandisinc.com
Company: Grandis
1123 Cadillac Ct
Milpitas, CA 95035
Phone: (408)945-2165

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will address the critical steps needed to manufacture a fast, non-volatile, magnetic random access memory (MRAM) based on spin transfer torque (STT-RAM). STT-RAM which uses spin polarized current to switch individual bits is predicted to have better scaling properties than conventional MRAM which uses magnetic fields. This Phase II project will focus on sub-100nm device manufacturability, device performance testing, and circuit design to develop a set of results which will enable the creation of a 1 Mb demonstration chip. The STT-RAM test chip is needed to prove the technology for customers. The results obtained from this project will include the development of arrays of sub-100nm bits, with the appropriate thermal stability, read/write characteristics and distributions. Also addressed will be the reliability of reading and writing such small devices. The project will develop processes for manufacturing sub-100nm structures. Finally, a simulation of read and write circuitry based on STT-RAM will be produced allowing for tape-out of a 1 Mb test chip.

Commercially, as microelectronics scales to smaller sizes and higher speeds, more features are added to typical consumer electronic devices and the demands on memory continues to grow. These demands and the inherent limitations of existing technologies create opportunities for new memory technologies to fill. As a leading candidate for a future universal memory that incorporates all the desired characteristics; non-volatility, high speed, low power, unlimited rewriting capability, extendibility to future semiconductor nodes; STT-RAM is in a strong position to take advantage of these opportunities.

Wafer & Sensor Production/Lithography

Title: SBIR Phase II: Monochromatic Micro X-ray Fluorescence Analysis Using Toroidal Crystal Optics

Award Number: 0091570
Program Manager: Winslow L. Sargeant

Start Date: March 15, 2001
Expires: February 28, 2003
Total Amount: $498,565

Investigator: Zewu Chen, zchen@xos.com
Company: X-Ray Optical Systems, Inc
15 Tech Valley Drive
East Greenbush, NY 12061
Phone: (518)880-1500

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will meet the demand from the microelectronics industry for an improved micro x-ray fluorescence instrument for thin film measurements. A new technique, monochromatic micro x-ray fluorescence (MMXRF) analysis using doubly curved crystal optics can meet this significant market need. A toroidal crystal can focus characteristic x-rays from a microfocus x-ray source based upon diffraction. The focused beam is monochromatic and the beam size is expected to be significantly smaller than that of current MXRF systems. This technique will provide high sensitivity and enhance excitation of low Z elements with the selection of beam energy. In addition, this technique will significantly increase the speed of high-energy x-ray measurements. A prototype MMXRF system will be developed that incorporates a modular dual beam system to probe samples with two energies simultaneously.

The initial application of the technology is in the area of semiconductor manufacturing. As semiconductor manufacturing moves to larger wafers and higher levels of integration, a single wafer may require hundreds of steps. These wafers are expensive to produce and very difficult to repair. The instrument under development would provide elemental and thickness analysis to identify defective thin film deposition at the earliest opportunity, avoiding the considerable loss associated with rejections at the end of the production line.

Title: SBIR Phase II: An Ultra-High-Speed Cleaning Process for Electronic Device Manufacturing

Award Number: 0522329
Program Manager: T. James Rudd

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,992

Investigator: David Boyers, dboyers@phifersmith.com
Company: Phifer Smith Corporation
2181 Park Blvd.
Palo Alto CA, 94306
Phone: (650)328-8200

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop process technology for removing photoresist from semiconductor wafers at high speed while not damaging underlying materials. This process technology can be readily integrated into existing single wafer wet processing tools. The development of higher performance semiconductor devices with smaller feature sizes has driven the adoption of copper and low-k dielectric materials that are susceptible to damage by traditional oxygen plasma based resist removal processes. While other low temperature plasma processes are being explored as low damage alternatives, appreciably lower resist removal rates (1,000 to 2,000 A /min) are a significant limitation. In response to this challenge the company successfully developed a new ozone-water based single wafer process chemistry which does not damage low k dielectric materials such as Black Diamond (TM), and does not corrode copper. In phase I this process achieved an etch rate greater than 8,000 A /min. The phase II research will concentrate on the early integration of the process hardware and process technology into a commercial single wafer spin processing system, the further development of process capabilities using 300 mm customer wafers, and the placement of three systems at customer sites for evaluation.

Commercially, the successful completion of this research program will culminate in the development of a new single wafer process technology for use in the manufacture of the high-density semiconductor devices with feature sizes below 90 nm. Nearly all of the new manufacturing capacity is built for 300 mm wafer fabrication at the leading edge technology node. In addition to direct sales of $60 to $120 million per year of new wafer processing equipment incorporating this technology, this project will enable the productivity benefits and reduction in unit manufacturing costs provided by the early migration to the next technology node. In addition, the innovative copper compatible cleaning chemistry developed here holds promise for corrosion free cleaning and surface treatment of copper in other electronic device manufacturing applications. Finally, this process uses an environmentally benign "green" chemistry.

Title: SBIR Phase II: Novel Wafer Fabrication Technology for Semiconductor Sensors

Award Number: 0522039
Program Manager: T. James Rudd

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $465,833
Investigator: Rabi Bhattacharya, rbhattacharya@ues.com
Company: UES, Inc.
4401 Dayton Xenia Rd
Dayton OH, 45432
Phone: (937)426-6900

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is directed toward the development of cadmium zinc telluride (CdZnTe) single crystal films by using an ion beam layer separation process from bulk single crystals. The separated layers will be transferred and bonded on to silicon (Si) wafers for applications as substrates for epitaxial growth of mercury cadmium telluride (HgCdTe) films. HgCdTe films are of interest in infrared detectors. The ion beam layer separation process will allow the fabrication of a large number of films from a single bulk crystal, thus providing an economical wafer production technology for infrared detector materials. High-energy (MeV) light ions will be used to produce a buried damaged layer in the bulk crystal. Thermal annealing at elevated temperatures may generate lateral crack enabling the layer separation. Phase I has shown the feasibility of this approach. Phase II research objectives are to optimize the process parameters for wafer-scale separation without breaking and develop the process to transfer the separated films on to Si wafers. The wafers thus fabricated will be used for epitaxial growth of HgCdTe and fabrication of IR detectors. CdTe and (Cd,Zn)Te alloy crystals have been grown by various techniques including zone refining, vertical gradient freeze (VGF), liquid encapsulated Czochralski (LEC) methods, horizontal and vertical Bridgman techniques. Due to variable yields, none of these methods have produced enough material with the quality needed for today's infrared (IR) detector applications.
The proposed method has been developed to overcome these limitations.

Commercially, the proposed technique has the advantage of producing many good quality substrates from a single bulk crystal by ion beam slicing, thus providing an economic way of producing reliable and reproducible quality material. Also, large area CdZnTe substrate for the growth of HgCdTe will be possible by stacking smaller slices in a floor tile pattern on cheaper Si substrates. Bonding with Si substrate will also allow the integration of IR detectors with electronics on a single chip. IR photodetectors and focal plane arrays are of interest in many industrial and scientific applications including environmental monitoring, chem-bio detection, medical and space sensors.

Title: SBIR Phase II: High-resolution, high-precision 193-nm photomask phase metrology system

Award Number: 0450620
Program Manager: T. James Rudd

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000
Investigator: Andrew Merriam, merriam@actinix.com
Company: Actinix
2521 S. Rodeo Gulch Rd.
Soquel CA, 95073
Phone: (831)440-9388

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to design and construct an ultra-high-resolution, high-precision phase-shift integrated measurement system suitable for metrology of advanced phase-shifting photomasks. A number of semiconductor manufacturers now expect to progress from the 90 nm through the 45 nm nodes using an exposure wavelength of 193 nm. Advanced photolithographic techniques are necessary to print these sub-wavelength features. Phase-shifting photomasks, i.e. those in which the optical
thickness, as well as the opacity is controlled, are a key reticle enhancement technology. Fast and accurate metrology of critical-layer phase-shift masks is becoming necessary both for process control and repair validation, but the enabling tools do not yet exist. The goal of this Phase II program is to integrate the actinic high-repetition rate laser built in Phase I into an interferometric laser microscope involving the design, construction, and integration of a stable
phase-shifting interferometer and laser microscope, and the incorporation and optimization of phase-shifting interferometry signal processing algorithms. The integrated optical system will enable phase metrology on advanced photomasks, with the measurement precision and spatial resolution required by the International Technology Roadmap for Semiconductors (ITRS), mask makers and mask users.

Commercially, the primary beneficiary of the Phase II photomask phase metrology system is the semiconductor optical lithography industry. The ITRS 'roadmap' for the 90-nm node and beyond requires measurements of photomask optical path difference with sub-0.4 degree precision. This metrology must be performed at spatial resolution scales consistent with feature sizes of the respective technology nodes, and for both isolated and densely-packed structures. No commercial metrology tools yet exist which satisfy these demands. The Phase II high-precision metrology system will enable manufactures to characterize, predict, and control mask-loading effects and other repair and process control issues essential to the reliable fabrication of phaseshifting masks. It is also likely that the integrated phase metrology system will find utility in the area of nano-MEMS testing and other nano-scale interferometry

Title: SBIR Phase II: Direct Measurement of Wafer Temperature in White/UV LED Manufacture

Award Number: 0450516
Program Manager: T. James Rudd

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $449,635
Investigator: Jeffrey Bodycomb, jeffreyb@technologist.com
Company: Bellwether Instruments, LLC.
1214 Sherwood Road
Columbia SC, 29204
Phone: (803)738-9965

Abstract:

This Small Business Innovation Research (SBIR) project will develop a highly accurate temperature measurement system that can be used in optimizing the growth of high brightness light emitting diodes for solid state lighting applications. This product does not currently exist due to technical difficulties in measuring the substrate or gallium nitride (GaN) epilayer in a region where they absorb energy. During Phase I of this program the company showed possible solutions to this problem that it can implement as the work progresses to Phase II. This SBIR Phase II program will address scientific and technical issues that has hindered the adoption of the Reflectivity Compensated Pyrometry (RCP) in the growth of GaN light emitting diodes (LEDs), the basis of solid state lighting sources. This program will result in a commercial instrument for directly measuring surface temperature during manufacture of visible and UV LEDs. Typical temperature variations during the growth of GaN-based LEDs results in a product which, even over a 2dimensional substrate, requires the LEDs to be separated into those with similar characteristics. Existing temperature measurements do not allow the accurate measurement of the substrate or the GaN epilayer because they are transparent at the measurement wavelength of ~1 micron.

Commercially, this project will increase manufacturing productivity in wide-bandgap materials and LED manufacture by providing better process control data. The improved manufacturing yields of LED's enabled by this work will lead to more widespread adoption of LEDs for solid state lighting with the accompanying economic and environmental benefits. For example, the use of LEDs has already saved the US economy nearly 10 TWh per year (equivalent to one large power plant) of energy in the niche applications implemented so far

Title: SBIR Phase II: Advanced Detectors for X-Ray Diagnosis

Award Number: 0450483
Program Manager: Juan E. Figueroa

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $500,000

Investigator: Michael Squillante, MSquillante@RMDInc.com
Company: Radiation Monitoring Devices Inc
44 Hunt Street
Watertown MA, 02472
Phone: (617)668-6801

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to produce a new, high-resolution x-ray detector for fluorescence measurements of lighter elements. For x-rays generally near 30 keV and below, there exist several tradeoffs between today's choices of lithium drifted silicon (Si/Li)) detectors and high purity germanium (HPGe) detectors. Si/Li) detectors offer simple spectral decomposition but have limited active volumes. Conversely, HPGe detectors can offer larger sizes, but pulse height analysis is complicated by short x-ray penetration and overlapping escape peaks. The technical goal is to develop a detector from high purity silicon, with a contact structure that allows for increasing detection volumes without high capacitance -antithetical to high-count rates. The work will entail device design and computational modeling, developing new electrical contact fabrications on high purity silicon, manufacturing numerous test detectors and evaluation under various conditions, including temperature.

The impact of this technology could be how the detectors will be utilized and the basic science learned through the fabrication process. These detectors are used in many applications for the identification of completely diverse samples. Just a few examples include materials science, surface science, environmental analysis, industrial process and quality control, forensic sciences and archaeology, and geological and extraterrestrial exploration. In virtually any of these applications, a new detector providing greater counting efficiency yields more productive and definitive results.

Title: SBIR Phase II: Development of High Performance, Environmentally Benign Lapping Fluids for Hard Disk Drive Manufacturing Applications

Award Number: 0450441
Program Manager: T. James Rudd

Start Date: May 1, 2005
Expires: April 30, 2007
Total Amount: $522,000

Investigator: John Lombardi, ventanaresearch@msn.com
Company: Ventana Research Company
831 North Camino Miramonte
Tucson AZ, 85716
Phone: (520)325-0440

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop novel, water soluble, environmentally benign, aspartate co-aspartamide copolymers for use as aluminum titanium carbide (AlTiC) Giant Magnetoresistive (GMR) Read Write Head lapping fluid additives. Efforts will be directed towards refining the composition of these copolymers such that they exhibit maximum adsorption & electrostatic charging effects upon AlTiC surfaces. This will enable rapid removal of AlTiC swarf formed during lapping producing GMR Heads of superior surface quality and uniformity compared to those manufactured currently. Furthermore, the adsorption properties of these copolymers upon AlTiC ceramic GMR Head surfaces as well as their metallic sensor layers will also be characterized in greater detail using Zeta Potential & Electrochemical Techniques. An optimized procedure for synthesizing these copolymers will be established enabling them to be economically produced in bulk quantities. Finally, the company will work closely with hard drive manufacturers and will integrate the aqueous lapping fluids formulated from these copolymers into its current GMR Head manufacturing operations.

Commercially and from an industrial standpoint, lapping fluids formulated from these copolymers will enable the last vertically integrated domestic hard drive manufacturer to produce GMR Read Write Heads more economically & efficiently thereby enhancing the company's competitiveness within the marketplace. Future data storage technologies may also benefit from these fluids since they will in all likelihood still require high precision lapping or a related super finishing technique to polish their drive components.

Title: SBIR Phase II: Hydrothermal Growth of Ultra-High Performance Nd:YVO4 Laser Crystals

Award Number: 0421946
Program Manager: T. James Rudd

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $409,807

Investigator: Henry Giesber, hgiesber@apcrystal.com
Company: Advanced Photonic Crystals, LLC
377 Carowinds Blvd
Fort Mill SC, 29708
Phone: (803)547-0881

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will focus on the development of a commercial process for the growth of Neodymium Yttrium Vanadate (Nd: YVO4) single crystals for use in solid-state lasers. This research will generate the commercially viable conditions for growth of large boules of single crystals suitable for use in diode pumped solid-state lasers. The hydrothermal method is a low temperature growth technique that leads to crystals containing less thermal strain, much fewer defects and greater homogeneity than conventional methods. These defects combine to cause considerable optical loss and concomitant reduction in performance. The hydrothermal technique has slower growth kinetics and requires chemical development for economically viable growth. In the Phase I project, preliminary growth conditions that lead to suitable single crystals were identified. These conditions include approximate thermal ranges, a variety of starting materials, seed crystals and mineralizer concentrations. In the Phase II project growth conditions will be systematically optimized to provide suitable transport rates and crystal quality. Once an acceptable growth is developed, the resulting boules will be evaluated for performance efficiency and loss.

Commercially benefits will emerge as the company introduces new higher performance crystal materials to the market that cannot be grown by existing crystal growth methods. In addition, new laser materials will be donated to Clemson University for design of new laser devices and cavities supporting the University's participation in the emerging photonics Coalition of the Carolinas that includes Clemson, the OptoElectronics Center at UNC-Charlotte, COMSET at Clemson University, and the Carolina MicroOptics Consortium

Title: SBIR Phase II: Non-Contact/Zero-Stress Surface Polishing Process for Copper/Low Dielectric Constant Semiconductors

Award Number: 0421638
Program Manager: T. James Rudd

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $516,963

Investigator: E. Jennings Taylor, jenningstaylor@faradaytechnology.com
Company: Faraday Technology, Inc
315 Huls
Clayton OH, 45315
Phone: (937)836-7749

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will advance the development of a non-contact electro-polish process, addressing the need for a non-contact/stress-free polishing method for planarization of Cu/low-k interconnects required for the fabrication of nanochip integrated circuits. This technology utilizes pulsed electrolysis and a moving electrolyte front to effect complete electrochemical removal of copper overplate from a semiconductor wafer. The Phase II objectives/research tasks include: 1) design and fabrication of a module for the non-contact electro-polish process, 2) demonstration and optimization of the process on full size wafers, 3) development of a theoretical model defining a process library for the non-contact electro-polish process, and 4) characterization of the polishing performance and relationship to the mechanical properties of the materials used.

Commercially, the anticipated results of the program are a marketable manufacturing process/manufacturing tool in the form of an electrochemical module incorporating the non-contact electro-polish process. This product/process technology is enabling to other emerging industries such as MEMS and/or NEMS. In general, the project addresses the needs of the semiconductor industry, which is an important aspect of the US commercial economy and will play an increasing role in the US as well as world society. Furthermore, the process minimizes chemical waste and environmental impact.

Title: SBIR Phase II: A New Class of Ferroelectric Liquid Crystals for High Performance Optical Phase Modulation

Award Number: 0422196
Program Manager: T. James Rudd

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $499,994

Investigator: Michael Wand, wand@displaytech.com
Company: Displaytech Incorporated
2602 Clover Basin Drive
Longmont, CO 80503
Phone: (303)772-2191

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new class of ferroelectric liquid crystal (FLC) materials and novel operating mode to produce fast, analog, electro-optic phase modulation. This innovation exploits two recent developments in liquid crystal science: a new liquid crystal phase made from novel bent-core "banana" molecules, and electrostatically controlled analog modulation of high polarization FLCs. The new modulators will offer the fixed-optic-axis phase modulation capability of a nematic liquid crystal in combination with the much faster speed and lower drive voltage of a ferroelectric. Present day FLCs modulate light through electrically driven optic axis rotation. Phase modulation range is limited to less than 180 degrees unless complex multi-element device designs are used. What's so novel about the new FLC is that it modulates light through changes in its index of refraction; the direction of the optic axis remains fixed. Furthermore that modulation can be analog, unlike conventional FLCs, which are binary. This enables simpler device structures and phase ranges greater than 360 degrees. The new FLC should be compatible with liquid-crystal-on-silicon technology (LCOS), allowing the ability to construct inexpensive wavelength-tunable devices and wavefront modulators for diverse application including telecommunications, holographic and conventional optical data storage, and microdisplays.

This production on an electro-optic technology could be useful in an existing market (microdisplays), and could enable large new markets in the near future (active optics, optical data storage, telecommunications). Advantages over alternative technologies due to the nature of a lower cost manufacturing processes, and the ability to easily implement complex functionality because of the integration of this electro-optic technology with standard CMOS VLSI technology. Society could benefit through job creation, enhanced telecommunications, and improved data storage technologies.

Title: SBIR Phase II: MatchBox Display Systems

Award Number:	0422099
Program Manager:	Muralidharan S. Nair
Start Date:	October 1, 2004
Expires:	September 30, 2006
Total Amount:	$499,935
Investigator:	Chongchang Mao, cmao@setechinv.com
Company:	Southeast TechInventures PO Box 13714 Durham, NC 27709
Phone:	(919)624-1352

Abstract:

This Small Business Innovation Research (SBIR) Phase II project, matchbox projection systems, addresses a major opportunity in the multi-billion dollar projection display market. . The main goal for the phase II project is to develop a Matchbox projector based on one liquid crystal on silicon (LCOS) panel using the field sequential color (FSC) method. The development includes the fabrication of full custom and mixed signal integrated circuit (IC), LCOS panel, optical light engine, and mechanical assembly. The silicon backplane will contain 1280 x 768 frame buffer pixels that remove charge sharing and charge inducement noise, increase charge storage memory time, enhance display brightness, and increase image contrast ratio. The data loading will use frame-at-a-time approach, allowing an image to be displayed at full contrast while the next image is buffered onto the backplane. LCOS panel assembly process will be developed for implementing panels with high thickness uniformity, high contrast ratio, fast switching, and high reliability. The optical engine design will focus on compact FSC system. The display market is multi-billion dollar market with a wide range of products.

The commercial and military markets rely on highly specialized display products such as microscope and head mount displays. The LCOS system hopes to enable low power, high-resolution products in the market place.

Title: SBIR Phase II: Ge-Free Strained Silicon Via dTCE Bonding (Differential Thermal Coefficient of Expansion Bonding)

Award Number:	0421948
Program Manager:	T. James Rudd
Start Date:	July 15, 2004
Expires:	June 30, 2006
Total Amount:	$499,997

Investigator: Rona Belford, belford@hargray.com
Company: Belford Research, Inc.
386 Spanish Wells Road
Hilton Head Island, SC 29926
Phone: (843)681-7688

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop a process that integrates wafer bonding technology with a novel straining process to create a new ultra fast silicon substrate: Strained-Silicon-On-Insulator (SSOI). This substrate can undergo normal IC fabrication and resulting circuits will be 30% faster at half the power required for comparative non-strained- SSOI architectures. The process is a direct approach and entirely surpasses the nearest competition as there is no germanium in any part of the processing. As a result the strained silicon is free from the high concentration of treading dislocations (>105 cm-2) always present when strained-silicon is grown on "strain-relaxed" silicon germanium virtual substrates. The silicon strained by the proposed method is maintained within its mechanically elastic region and thus is free from structural imperfections. The proposed method engages wafer bonding procedures already in place within the industry and modifies those processes to give a combined result of wafer bonding and SOI straining within a single step. The direct approach and single process makes the technique very inexpensive. The discipline evoked is fundamental surface science which involves investigation of both physical properties such as surface energies along with chemical aspects such as maintaining surface hydration and active surface species required for wafer bonding.

Commercially, the substrates available via this effort will make possible ultra fast silicon electronics. The proposed process also allows for non-intrusive radiation-hardening, giving initial commercial outlet in the military sector. Further markets include mainstream silicon-based electronics; effectively new host materials with speeds more characteristic of materials such as gallium arsenide and most salient, very low power electronics.

Title: SBIR Phase II: A Simple and Practical Solid-State 157nm and 193nm Coherent Light Source for Applications in Lithography Development

Award Number: 0349601
Program Manager: T. James Rudd

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $465,249

Investigator: Sterling Backus, sbackus@kmlabs.com
Company: Kapteyn-Murnane Laboratories LLC
4699 Nautilus Ct. Unit 204
Boulder, CO 80301
Phone: (303)544-9068

Abstract:

This SBIR Phase II project will develop a new generation of fully-coherent, solid-state, vacuum-Ultraviolet (UV) light sources at 157nm and 193nm, to support the next generation of semiconductor fabrication and metrology, as well as for applications in basic research. Currently available UV excimer sources have limitations such as poor spatial coherence, making them unsuitable for metrology. Therefore, the most promising route to generate fully-spatially-coherent VUV sources is to up convert light from the visible-infrared region of the spectrum, where coherent laser sources already exist. However, a significant technical obstacle towards this goal is the lack of reliable solid-state nonlinear-optical crystals that work in the deep-UV. Unavoidable residual absorption at wavelengths <200nm can lead to long-term damage of nonlinear optical crystals, requiring constant replacement. Furthermore, for frequencies <193nm, no suitable nonlinear optical crystal currently exists. Therefore, gaseous nonlinear-optical media are an attractive alternative to crystals for generating light at wavelengths <200nm. This SBIR Phase II project will use four-wave mixing in gas filled hollow waveguides to develop a tabletop VUV laser capable of generating 10's of mW, and possibly 100's of mW of light at 157nm and at 193nm, in a fully coherent beam, at the very high (10kHz) repetition rates necessary for applications in metrology.

This project has the potential to have a very broad impact on the semiconductor and electronics industries, as well as in basic science. Progress in both the complexity and the speed of microprocessors, DRAM memory, and other integrated electronics has been driven by the ability to make increasingly dense IC's, with ever-smaller feature sizes. This has been enabled by the development of higher-resolution lithographic "steppers" and the use of ever-shorter wavelengths of light for lithography. Because no bright, tabletop, sources currently exist, most short-wavelength materials, nano- and chemical science must take place at synchrotron sources, where access is limited and the sources are not optimized. Therefore, significant gains in productivity could occur with the availability of such a source.

Title: SBIR Phase II: Nanoporous Silica Slurries for Enhanced Chemical Mechanical Planarization (CMP) of Low k Dielectrics

Award Number:	0349609
Program Manager:	T. James Rudd
Start Date:	March 1, 2004
Expires:	February 28, 2006
Total Amount:	$464,889

Investigator: Deepika Singh, singh@sinmat.com
Company: SINMAT INC
2153 Hawthorne Rd
Gainesville, FL 32641
Phone: (352)334-7237

Abstract:

This Small Business Innovation Research Phase II project aims to develop unique chemical mechanical planarization (CMP) slurries based on nanoporous silica particles that will meet or exceed CMP needs of low k dielectrics for the 80 nm and beyond semiconductor manufacturing nodes. The integration of low k dielectrics (dielectric constant 2.2 < k < 3.3) with copper metal lines is expected to considerably reduce RC (resistance x capacitance) delay for > 10 GHz CMOS expected devices in the next 3-5 years. One of the key issues plaguing the semiconductor industry is the chemical mechanical planarization (CMP) of copper/tantalum/low k dielectric materials. The low k dielectrics are fragile and are susceptible to both delamination and scratching (increased defectivity). Standard slurries employing hard abrasives may not meet the requirements for sub-80 nm CMOS devices which are expected to employ low k dielectric materials. The program proposes to develop & commercialize gentle CMP slurries based on nanoporous silica particles which exhibit reduced hardness and better stability. Combined with unique chemical formulations, these slurries are expected to achieve lower defectivity (surface scratching) and lower stress polishing than standard slurries. In this Phase II project extensive experiments will be conducted both in-house and with our partners (semiconductor chip manufacturers) to optimize performance and integration issues.

Commercially this research activity has significant impact not only in the semiconductor manufacturing areas, but also in may other areas such as biotechnology and nanotechnology, which are the key areas identified by the government for the future viability of US business. First and foremost it will ensure US can maintain its lead in CMP, even though semiconductor manufacturing jobs have been migrating overseas. As CMP slurries is the largest value added application of the nanoparticle technology (> 50%) excellence in this area will provide employment to nanotechnology graduates in the near future and could be a direct application of the skills they have acquired. This research will lead to the creation of faster electronic devices, which will in turn benefit the society to become more economically productive. The development of nanoporous particle technology can have applications in several other areas including controlled drug delivery systems.

Title: SBIR Phase II: Millimeter Wave Transceivers on Large Metamorphic Wafers

Award Number: 0321728
Program Manager: Winslow L. Sargeant

Start Date: November 15, 2003
Expires: October 31, 2005
Total Amount: $511,971

Investigator: Timothy Childs, tim@tlcprecision.com
Company: TLC Precision Wafer Technology
1411 W. River Road N
Minneapolis, MN 55411
Phone: (612)341-2795

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative low-cost W-band (70-80 GHz) single chip transceiver using the metamorphic wafer technology developed in Phase I, and efficiently integrating the various MMIC components. The low cost non-electronic beam FET processes, MM HEMTs, and initial chip designs developed in Phase I will be used for the development of the fully integrated transceiver in Phase II. The resulting new technology will enable the MMW industry to be cost effective to expand the commercial market to achieve the low cost and high performance required in the industry.

This project will enable enhanced performance and low cost consumer compatible volume production of automotive collusion avoidance radar systems, MMW tracking systems, and security radar and detection systems.

Title: SBIR Phase II: Vacuum Ultraviolet Spectroscopic Ellipsometer for Semiconductor Lithography

Award Number: 0321715
Program Manager: Winslow L. Sargeant

Start Date: December 1, 2003
Expires: November 30, 2005
Total Amount: $500,000
Investigator: Daniel Hampton, hampton@containerless.com
Company: Containerless Research, Inc.
910 University Place
Evanston, IL 60201
Phone: (847)467-2678

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide a novel, patented sensor of the polarization properties of light for operation in the vacuum ultraviolet spectral range, from ~ 120 to 200 nm. The instrument is a complete polarimeter that measures all four of the Stokes parameters of polarized light. It enables new semiconductor metrology applications and measurements with high precision and accuracy that are not achievable by rotating analyzer ellipsometry. The $30B semiconductor equipment market is continuously challenged to meet changing requirements with decreasing dimensions and thickness of structures on chips.

The G-DOAP instrument meets key requirements of the industry for vacuum ultraviolet metrology tools. It also brings new capabilities to surface science investigations in many fields through the product for this market that we will offer. This technology can accelerate progress along the International Roadmap for Semiconductors, which cites VUV tools as a key need.

Title: SBIR Phase II: Liquid Phase Epitaxy of Potassium Tantalum Niobate on Low Dielectric Constant Substrates

Award Number: 0321608
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: Vincent Fratello, vjfratello@integratedphotonics.com
Company: Integrated Photonics, Inc.
1110 Commerce Drive
Richardson, TX 75081
Phone: (972)690-0099

Abstract:

This SBIR Phase II project proposes to develop the Liquid Phase Epitaxy (LPE) of potassium tantalum niobate (KTN) on a cubic perovskite substrate. In this manner both components of the film/substrate composite may be optimized for device performance. KTN has almost two orders of magnitude higher electrooptic coefficients than current generation lithium niobate waveguides, which would permit shorter path lengths, lower bias voltages or some combination of the two. The new, low dielectric constant substrate material developed in Phase I will enable better matching of the effective microwave dielectric constant to the optical dielectric constant of the film material and achieve lower bias fields. In Phase II, the researchers will develop the new substrate material to commercial quality and size. LPE of KTN will be developed from a new innovative flux system that allows excellent control of growth and superior film properties. Both film and substrate will be fully characterized and optimized as a composite. The process and product will be scaled up to full commercial size. IPI will interact with strategic partner device manufacturers to optimize the material and realize device applications. Electrooptic devices are used in any photonics application where an electrical signal can be used to change the state of a beam of light. While the best-known applications for electrooptic devices are in telecommunications, customers can be found wherever light is used to move information including optical computing, analog and digital signal processing, information processing and sensing. Devices include phase and amplitude modulators, Q-switches, multiplexers, switch arrays, couplers, polarization controllers, deflectors, correlators, sensors, potential transformers and optical parametric oscillators.

Potential customers are noticeably found in both the electric power industry and the military. Initial applications in sensors will have an immediate potential for impact in reliability of electric power distribution through failure anticipation and prevention and conservation of electric power through monitoring and control. The proposed work will enable electrooptic modulators, switches and innovative new photonic device applications with lower costs, smaller footprints and lower power budgets. All this contributes to improvements of the infrastructure of the Internet and more rapid, lower cost deployment, especially in the local loop.

Title: SBIR Phase II: Low Cost Visible Blind Ultra Violet Photodetectors on Glass and Polyimide

Award Number: 0321465
Program Manager: Winslow L. Sargeant

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: Ratnakar Vispute, rd@bluewavesemi.com
Company: Blue Wave Semiconductors Inc.
6208 Three Apple Downs
Columbia, MD 21045
Phone: (410)312-2999

Abstract:

This Small Business Innovation Research project proposes commercialization of innovative oxide based visible and solar blind ultra-violet light detectors successfully fabricated and tested. The studies clearly indicate the possibility of growing good quality wide band gap tunable oxide thin films on low cost substrates such as glass, quartz, silicon, and polyimide for photoconductive and Schottky UV photodiodes. The detectors fabricated on these substrates show comparable performance to those of AlGaN on sapphire, and SiC with a high responsivity and UV to visible rejection ratio of more than three orders of magnitude. The feasibility of tuning the detector performance at selective UV regions is also successful which is achieved through innovation of the composition control in the wide band gap oxide layer.

The company will extend this technology to commercialize the low cost UV detectors and large format detector arrays for UV radiation monitoring systems for personal safety and consumable products, and exploit additional capabilities beyond the scope of the existing Si, GaAs, and AlGaN technologies.

Title: SBIR Phase II: An Optical Sensor for Semiconductor Back-End Processes

Award Number: 0320062
Program Manager: Winslow L. Sargeant

Start Date: November 15, 2003
Expires: October 31, 2005
Total Amount: $500,000
Investigator: Jim Hang, jimhang@newdri.com
Company: New Dimension Research
400 West Cummings Park
Woburn, MA 01801
Phone: (781)933-1165

Abstract:

This Small Business Innovation Research (SBIR) project is to develop innovative miniature con-focal laser scanning sensors for semiconductor packaging processes by using diode laser detector array chips. There are no moving parts in this sensor for scanning, unlike other con-focal devices. This sensor with a fast imaging rate will be integrated with chip IC placement robot machines, to inspect solder bump co-planarity of Flip Chip Bonding (FCB) and the ball of Ball Grid Arrays (BGA) before packaging. BGA and FCB are used in mission critical devices in airplanes and medical devices. To ensure quality of the packaging, semiconductor-packaging companies demand lower cost, smaller, fast imaging optical sensors in the automatic optical co-planarity inspection instruments to ensure the reliability and quality of package assembly.

The electronics industry's demands for increasing circuit density, higher levels of integration and improved cost/performance capabilities have led to the proliferation of the use of BGA and FCB. This will reduce chip failures and system failures. These high reliability devices may eventually save lives and improve the quality of life.

Title: SBIR Phase II: Acoustic Microcavitation Assisted Fine Cleaning of Post-Chemical Mechanical Planarizing (CMP) Wafers

Award Number: 9983485
Program Manager: Rosemarie D. Wesson

Start Date: May 1, 2000
Expires: April 30, 2003
Total Amount: $750,000

Investigator: Mark McKenna, mark@ritecinc.com
Company: RITEC Inc
60 Alhambra Road, Suite 5
Warwick, RI 02886
Phone: (401)738-3660

Abstract:

This SBIR Phase II project is to continue the investigation in the removal of particulates from silicon wafers. It is a problem which can only become more important as the evolving circuit complexity demands greater miniaturization and multi-storied 'architectural' chip designs. Miniaturization poses a increasing challenge because any particulate which is one-third to one-half the size of the smallest chip circuit feature (i.e. the line width) is deemed a killer defect. As the line width gets thinner, the particle-intolerance because correspondingly greater. Up to 40% of all silicon wafer rejections are due to unremoved particulates. The challenge of maintaining ultra-clean wafer surfaces is further exacerbated by the more complex, multi-storied chip designs. Each new 'floor' of circuitry requires that a high degree of wafer flatness and smoothness be restored using the chemical mechanical planarizing or polishing (CMP) process. Each CMP procedure involves a fine, fumed silica slurry and therefore introduces new particulates. Several CMP operations are typically necessary in wafer processing and each wafer must be perfectly cleaned after each operation.

This project is to develop a precision cleaning unit to rapidly clean post-CMP silicon wafers using only 'Silent Sound and Clean Water'. Based on Acoustic Coaxing Induced Microcavitation (ACIM), the process requires no chemicals--only silent sound and clean water. The Silent Sound and Clean Water (SSCW) wafer cleaner to be developed through this SBIR Phase-II grant will face none of the conventional limitations with regard to particle size and it will be wholly environmentally friendly.

Title: SBIR Phase II: Whole Wafer Thermal Imaging for Real-Time Process Monitoring and Control

Award Number: 0078444
Program Manager: Winslow L. Sargeant

Start Date: December 15, 2000
Expires: May 31, 2003
Total Amount $399,991

Investigator: Joseph Cosgrove, cosgrove@afrinc.com
Company: Advanced Fuel Research, Inc.
87 Church Street
East Hartford, CT 06108
Phone: (860)528-9806

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a real-time, whole wafer sensor for process monitoring and fault detection in advanced semiconductor and thin film fabrication processes. The production of future semiconductor and optoelectronic devices will depend critically on continued advances in process sensing and control. In present-day manufacturing, process yield and productivity are limited by the high sensitivity of layer properties to process conditions, and by an inability to control process conditions adequately throughout the process sequence. Current technology relies primarily on open-loop control using indirect sensor signals; a costly practice resulting in significant scrap and equipment downtime for preventative maintenance. To address this problem through improved closed loop control, this project will develop a high performance imaging radiometer with advanced thermographic and wafer mapping algorithms. Phase II includes hardware, software, and applications development that addresses important components of the sensor technology for monitoring blanket and patterned substrates. The sensor will provide near video-rate, spatially resolved whole wafer measurements of temperature and film properties from a model-based analysis of thermal radiance images. In-house testing on a rapid thermal processing tool and field testing on a MOCVD reactor will be performed. Potential commercial applications are anticipated in optimization and control of many advanced semiconductor fabrication processes such as rapid thermal processing (RTP), molecular beam epitaxy (MBE), and metal-organic chemical vapor deposition (MOCVD). Improved whole wafer sensors have potential for significant increase in the number of process steps performed by RTP and thus increase the RTP as a generic process method.

The commercial benefits of an in-situ wafer state sensor include reduced scrap, reduced equipment preventative maintenance, improved process efficiency, and improved device uniformity and performance.

Title: SBIR Phase II: Material for Efficient Laser Diode-Pumped Laser and Upconversion Phosphor Technology

Award Number: 0078551
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2000
Expires: December 31, 2002
Total Amount: $398,330
Investigator: Arlete Cassanho, acm4@earthlink.net
Company: AC Materials Incorporated
2721 Forsyth Road
Winter Park, FL 32792
Phone: (407)679-3395

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will focus on improving solution growth of Nd and Yb,Pr-doped $NaYF_4$ single crystals. Two alternate techniques are proposed: top seeded solution growth and traveling solvent zone. Phase I results indicate that spectroscopically Nd:NYF is superior to YAG and YLF and as good or better than YVO_4 as a laser diode-pumped laser; and that Yb,Pr:$NaYF_4$ is a 1.3 micron emitter with favorable properties for use in telecommunications. In a parallel effort to crystal growth, laser evaluation of NYF will continue through laser tests and by measurements of NYF's thermo-optic properties. In Phase I a very efficient single phase green emitter Yb,Er :NYF phosphor was demonstrated. A second thrust of this Phase II effort will then be to develop synthesis processes of granular doped NYF materials for their use in 2-D and 3-D displays.

Combinations of Yb,RE-doped NYF will be prepared to extend the range of colors to red and blue. Nd:NYF is seen as a superior material to YLF and YAG for compact diode pumped lasers and an economical alternative to Nd:YVO_4 currently used. Yb, Pr: NYF can be used as amplifiers for telecommunications in the important 1.3 micron wavelength range. NYF phosphors, dispersed in plastic hosts can be used in 2 and 3-D transparent displays for head mounted applications such as air traffic control, medicine, autos and aircraft.

Title: SBIR Phase II: X-ray Microscope

Ward Number: 0091519
Program Manager: Winslow L. Sargeant

Start Date: March 15, 2001
Expires: February 28, 2003
Total Amount: $500,000

Investigator: Steven W. Smith, steve@spectrumsdi.com
Company: Spectrum San Diego, Inc.
15950 Bernardo Center Dr. Ste
San Diego, CA 92127
Phone: (619)676-5382

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is directed at improving the capabilities of high-resolution x-ray imaging systems. The enabling technology in this approach is a novel x-ray detector formed from transparent scintillation crystals. A prototype developed in Phase I demonstrates a spatial resolution of six microns. This surpasses the resolution of commercial systems based on microfocus x-ray sources, and is 4-6 times better than current x-ray detectors. Based on these results it is anticipated that a resolution of 1-2 microns can be achieved in Phase II. If fully successful, the end result of Phase II will be a commercialized x-ray microscope with five to ten times the resolution of existing products.

High-resolution x-ray imaging is used in many fields, including manufacturing, medicine, and scientific research. The product developed in Phase II will have better technical performance and be lower in cost that presently available systems.

Title: STTR Phase II: Nanostructure Fabrication Using Near-Field Scanning Optical Microscopy

Award Number: 0110486
Program Manager: Cheryl F. Albus

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $500,000

Investigator: Russell E. Hollingsworth, rhollingsworth@itnes.com
Company: ITN Energy Systems Inc
8130 Shaffer Parkway
Littleton, CO 80127-4107
Phone: (303)420-1141

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will further develop a revolutionary approach to nanostructure fabrication. This Near-Field Scanning Optical Nanolithographic approach, which we have already shown to be capable of writing 100nm width lines, utilizes a direct, optical write technology in conjunction with optical photoresists. The direct optical writing is performed with a customized Near-Field Scanning Optical Microscope (NSOM) tool. The major goal of the proposed work is to design and construct a commercially viable NSOM lithography tool and demonstrate processes for flexible pattern generation on 4" wafers. Phase I work demonstrated the preliminary design of the NSOM lithography tool and photoresist processes using a novel inorganic hydrogenated amorphous silicon resist, as well as conventional polymer resists. Best line widths of approximately 100nm, comparable to the probe diameter, were obtained.

The commercial benefits from this project will be the construction and demonstration of the NSOM lithography tool for rapid prototyping of nanostructures in university and corporate research labs.

Title: SBIR Phase II: Mechanism of the Layer Transfer Process for Silicon-on-Insulator

Award Number: 0216676
Program Manager: Winslow L. Sargeant

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $500,000
Investigator: Alex Usenko, usenko@si-sandwich.com
Company: Silicon Water Tech., Inc.
240 King Blvd
Newark, NJ 07102-2100
Phone: (973)297-1410

Abstract:

This Small Business Innovations Research (SBIR) Phase II project builds on demonstrated and patented new hydrogenation-based processes for producing silicon-on-insulator (SOI) wafers for the semiconductor manufacturing industry. It has been demonstrated that this new techniques can be bonded for improved activation of the surfaces of silicon wafers. The innovation also serves to suppress layer transfer faults. The improvement in yield and the reduction in cost in the SOI production process have also been achieved. The process is expected to scale down to the formation of SOI surface films of thickness well below 0.1 micron. During Phase I, an RF plasma treatment was developed which optimizes the amount of adsorbed activating species on surfaces resulting in an improved layer transfer yield over previous wet chemical activation techniques. The process optimization was based on molecular dynamics simulation of the sub-monolayer hydroxylized surface. In Phase II the simulation-based process design continues with experimental characterization of the resulting probability of the layer transfer faults. The Phase II work plan includes more detailed process design and optimization leading to a characterization of best effort SOI wafers by the venture partners.

The impact of the proposed commercialization activity on the existing $10B worldwide silicon starting-wafer industry is potentially huge. The increasing usage of SOI by the leading semiconductor manufacturers is optimistically projected to grow from 1% to 10% of the worldwide silicon market. If successful, a ramp up to commercialization SOI pilot production will begin immediately upon the completion of this Phase II contract.

Title: SBIR Phase II: Silicon Chip Antenna for Radio Frequency Identification Devices

Award Number: 0109003
Program Manager: Winslow L. Sargeant

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $499,752
Investigator: Klaus Dimmler, klaus@hi-point.com
Company: HiPoint
19 Leaming Rd.
Colorado Springs, CO 80906
Phone: (719)540-8504

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build a small form factor silicon chip antenna for radio frequency identification (RFID) applications in smart tags. A new high-performance, low cost, small size silicon chip antenna, fabricated by wafer batch processing, will be combined with a standard, passive (no battery) RFID chip to form a low cost, high-performance RFID tag of small dimensions. The antenna and the RFID chip are stacked directly on top of each other. Phase I used a simplified process and scaled up structures. In Phase II the process will be optimized, devices with the intended dimensions will be used, and the antenna chip and the RFID chip will be stacked.

Passive RFID systems are used in applications such as object tagging, asset management, hazardous materials tracking, and tracking of important documents. Existing RFID technology is limited by the need for large transponder antennas (~ 1 inch by 2 inch minimum) and costly multi-component assembly. The silicon wafer batch processed antenna chip technology will produce millimeter-scale smart tags (programmable replacement for bar codes), enabling products for large commercial markets.

Title: SBIR Phase II: Integrated Reactor Scale and Topography Feature Scale Simulator for Plasma Enhanced Semiconductor Processes

Award Number: 0091528
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2001
Expires: September 30, 2003
Total Amount: $499,965

Investigator: James Cole, jvc@cfdrc.com
Company: CFD Research Corporation
215 Wynn Drive, 5th Floor
Huntsville, AL 35805
Phone: (256)726-4800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide a commercial software tool that integrates reactor scale, (pre) sheath transport, and feature scale models for comprehensive analysis of thermal chemical vapor deposition and low-pressure plasma processes in integrated circuit fabrication. Phase II will focus on development of (pre) sheath models, a feature scale simulation tool, a charging model, and the supporting infrastructure in proprietary software, called CFD-ACE+, to integrate these models. (Pre) sheath models from Phase I will be enhanced to address additional common plasma reactor operating conditions. A feature scale simulator, based on the multi-physics models of the existing proprietary software and embedded in the reactor model, will be developed. The model for surface charging will be integrated with the (pre) sheath and sheath models for ion transport and the feature scale models. The software infrastructure will be extended to simplify the model definition steps common to all feature scale simulators.

This tool will provide engineers in the semiconductor industry with a means to predict the effect of both reactor designs and process conditions on the size, shape, and quality of the device components they are producing. It will extend the CFD-ACE+ commercial reactor scale modeling software to interface properly with feature scale simulators.

Title: SBIR Phase II: Planar Magnetic Levitation Technology for Precision Microelectronics Manufacturing Equipment

Award Number: 0078419
Program Manager: Winslow L. Sargeant

Start Date: February 1, 2001
Expires: January 31, 2003
Total Amount: $397,820
Investigator: Edward C. Lovelace, lovelace@satc.com
Company: SatCon Technology Corp
161 First Street
Cambridge, MA 02142-1221
Phone: (617)349-0861

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a planar magnetic levitator/positioner for precision microelectronics manufacturing equipment. Based on feasibility proven in Phase I, Phase II will design, construct, and test a minimum-actuator maglev stage that can be readily integrated in a process tool. A single-moving maglev platen will be driven in all six degrees of freedom with three levitation motors. The platen will generate large two-dimensional motions for transportation with small four-axis motions for alignment and small adjustments. It will lead to a clean-room compatible, lightweight, compact, inexpensive structure that can meet demanding dynamic performance requirements in next-generation precision microelectronics manufacturing.

Magnetic levitation has many potential applications in microelectronics manufacturing equipment that require precise planar position control, such as wafer steppers, wafer handlers, wire bonders, surface profilometers, scanned probe microscopes, and precision inspection machines. This technology is expected to figure prominently in the highly competitive microelectronics manufacturing capital equipment industry.

Title: SBIR Phase II: Micro-Coax Manufacturability Study

Award Number: 0620136
Program Manager: Juan Figueroa

Start Date: August 10, 2006
Expires: July 31, 2008
Total Amount: $500,000
Investigator: Sean Cahill, seanc@bridgewave.com
Company: BridgeWave
3350 Thomas Rd
Santa Clara, CA 95054
Phone: (408)567-6900

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project deals with the ever-increasing burden placed on the microelectronics industry as computational speeds increase. While the number-density-speed of transistors doubles every 18-24 months (a phenomenon known as Moore's Law), the ability to retrieve and store data from external sources is not increasing nearly as quickly. The performance improvement rate of key computing tasks such as simulation, signal processing and database searches is becoming limited by off-chip bandwidth. Approaches such as "flip-chip bumping" are not a panacea, because despite their small size, these structures leak signals to one another; a significant performance detriment. The company has developed a novel MicroCoax interconnect technology to address these problems, utilizing existing semiconductor manufacturing infrastructure. The research objectives are to gain insights into MicroCoax fundamentals and understand application specific issues within market segments that are most impacted by current technological limitations. Research will focus on continuing exploration of MicroCoax material set, process flow, integration, and reliability, along with specific application to three distinct market spaces namely, MMICs, High-speed Digital/Optoelectronics, and high-frequency test.

Electronics technology impacts nearly every person on earth in some way. Even folks living in remote places are subject to natural disasters, which may be predicted by atmospheric and geological simulation and warning systems, allowing timely evacuation. Goods distribution and logistics are increasingly dependent on computationally intensive database search and tracking. Medical diagnosis and treatment rely increasingly on signal processing for imaging and therapeutics. High-bandwidth wireless systems allow for recovery of communication infrastructure following floods and hurricanes. All of the aforementioned technologies have high-speed electronic systems at their core, and MicroCoax can affect them all. High-bandwidth systems are quite expensive today, in large part because of interconnects based on machined waveguides and significant labor content associated with such approaches. If successful the proposed technology, MicroCoax, can eliminate much of the cost, making such systems more commercially viable and ubiquitous. While a disruptive technology such as MicroCoax will be invisible to the average user, electronics designers and will be able to expand their application horizons due to elimination of prohibitive cost constraints. Electronics, semiconductor, communications and related industries will stall without continued innovation in packaging and interconnect strategies. The economic implications are significant, as worldwide electronics sales number somewhere around US$1.3 trillion at this time.

Title: SBIR Phase II: Single Step Chemical Mechanical Planarization of Copper/Ultra Low k Interconnects

Award Number: 0620428
Program Manager: Juan Figueroa

Start Date: July 26, 2006
Expires: July 31, 2008
Total Amount: $496,673

Investigator: Deepika Singh, singh@sinmat.com
Company: SINMAT
2153 SE Hawthorne Rd Ste 129
Gainesville, FL 32641
Phone: (352)334-7237

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop and commercialize a single step chemical mechanical polishing (CMP) process for fabrication of next generation of copper based interconnects that join millions of transistors on a chip. The current state of the art copper CMP process is complicated and requires multiple steps to meet the defect quality and planarity requirements. Furthermore, existing processes create high stresses during polishing, which may not be compatible with the fragile low dielectric constant materials are now being introduced by the semiconductor industry. To address these challenges the research team proposes to develop the "soft polishing layer" concept for gentle removal of copper that does not damage the fragile dielectric layer. The use compatible chemistries and nanoparticles in the slurry allows successful development of a flexible, defect-free, single step process to fabricate copper based interconnects that will result in substantial cost savings to the semiconductor chip manufacturers. During Phase II, the company will partner with the leading edge CMP companies and chip manufacturers to address industrial scale integration issues related to development and commercialization of the single step slurry.

With the impending introduction of new fragile ultra low k materials, CMP processes are expected to become more complicated and expensive, to achieve the necessary levels of performance. The successful implementation of the single step CMP process is expected to meet or exceed the technical performance levels of the 45 nm manufacturing node while decreasing the CMP manufacturing costs by up to 80% which translates to over $ 4 billion savings for the chip industry (10 X savings for the chip industry for every "X" dollar of slurry revenue). The reduction in costs is largely due to the simplification of the manufacturing process, higher throughput, increased yield, less use of capital equipment and manpower, and reduction in consumable costs. The successful completion of this project will help maintain and grow the country's leadership in nanotechnology, a key area for future health and vitality of the nation. This project will help increase the number and quality of manufacturing jobs in the country.

Title: SBIR Phase II: Optical-Maskless-Lithography Equipment

Award Number: 0620456
Program Manager: Juan Figueroa

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $499,943
Investigator: Rajesh Menon, rmenon@nano.mit.edu
Company: LumArray
15 Ward St
Somerville, MA 02143
Phone: (617)253 6865

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is a major step in the development of an optical-maskless lithography technology that is capable of high resolution, high throughput, flexibility, low cost, and extendibility. Current lithography technologies suffer from the problems of high tool costs, high mask costs, and inflexibility in the case of optical-projection lithography, and high tool costs, very low throughputs, and high complexity in the case of scanning electron- beam lithography. The company's Zone-Plate-Array-Lithography (ZPAL) technology will mitigate these issues, while providing unprecedented flexibility in nanopatterning. This project covers two major thrusts: one the manufacture of zone-plate arrays containing over 1000 zone plates, each with a numerical-aperture (NA) greater than 0.85, second the development of a high-accuracy alignment sub-system that can achieve overlay accuracy of 20nm with potential extendibility below 5nm. A successful completion of the first thrust of this project will result in large arrays of high-NA zone plates installed in the prototype lithography system, enabling high resolution and high throughput. A successful implementation of the alignment sub-system in the prototype tool will meet specifications of accuracy unmatched by alternate technologies.

It is widely recognized that nanostructures of complex geometries are indispensable to create functionality and enable a nanotechnology revolution. At present, the tools that are available for the creation of such nanostructures are highly limited in flexibility, resolution, cost and throughput. The tools based on ZPAL have the potential to create a new paradigm in the development and manufacture of nanostructures by sharply reducing the development-cycle time and manufacturing costs. Being maskless, this technology provides flexibility by enabling the designers of nanostructures to quickly realize their designs in hardware for prototyping and even low-volume manufacturing. The company's tools have the potential to enable industries in a wide spectrum of industries such as micro-electro-mechanical devices (MEMs), nano-electro-mechanical devices (NEMs), nano-electronics, nano-magnetics, integrated optics, photonics, biochips, microfluidics, to name a few. Initial target customers are manufacturers of application-specific-integrated circuits (ASICs), compound semiconductors and photomasks. In the ASIC industry alone, the tools have the potential to enable savings of over $3B per year. Furthermore, this technology can provide the cost-effective, flexible solution required to revive and grow this important segment of the semiconductor industry.

Title: SBIR Phase II: High-Speed, Low-Cost Maskless Lithography

Award Number: 0620566
Program Manager: Juan Figueroa

Start Date: September 6, 2006
Expires: August 31, 2008
Total Amount: $429,287

Investigator: Richard Yeh, yeh@alcestech.com
Company: ALCES
4750 Cortland Dr.
Jackson, WY 83001
Phone: (307)732-1994

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will research and develop a maskless lithography tool based on the results of the feasibility study. The company has a unique and proprietary approach to achieve higher throughput and lower cost than currently available maskless lithography tools. The approach will employ Line Light Modulator (LLM) to pattern wafers with a linear array of 2048 beams. The patent-pending LLM is a novel and efficient light engine that converts a single light source into a large linear array of beamlets. Using a large array of beamlets increases the power handling capability of the system which increases the exposure throughput. The result is a one to two order of magnitude improvement in throughput compared to existing maskless lithography tools. Our tool also takes advantage of the new 405nm diode laser. The 405nm diode laser offers a combination of power, cost, and speed not available in other UV laser sources. In the feasibility study, we have demonstrated the ability to pattern photoresist with <1um resolution using the LLM. In Phase II, we will develop and fully characterize a prototype tool that will achieve a 1um resolution, 50nm position accuracy, and a throughput of 65mm2/sec (two minutes per 4" wafer).

As high volume semiconductor production has mostly moved overseas, the US semiconductor industry relies more on prototyping and initial manufacturing of innovative, cutting-edge technology. Lowering the cost to pattern wafers at these volumes helps keep US companies competitive by enabling rapid and cost-effective innovations. Cost is especially important for the small- to medium-sized companies that neither have the capital for high cost mask sets, nor require the most advanced resolutions of modern conventional lithography tools. The proposed tool addresses this need for fast and cost-effective semiconductor lithography with good throughput, resolution, and seamless integration with current lithography processes. The proposed project will provide researchers with an affordable tool to quickly fabricate new and existing designs. These low cost lithography tools will also be useful in fabrication and MEMS laboratory courses. A maskless lithography tool will make it practical for students to design and fabricate devices instead of simply using masks made for the course.

Title: SBIR Phase II: Large-Scale Manufacturing Process for Uniform Semiconductor Nanowires

Award Number: 0620589
Program Manager: James Rudd

Start Date: September 13, 2006
Expires: August 31, 2008
Total Amount: $297,784
Investigator: Francesco Lemmi, flemmi@nanosysinc.com
Company: Nanosys
2625 Hanover
Palo Alto, CA 94304
Phone: (650)331-2188

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative manufacturing technology for inorganic semiconductor nanowires for use in high-performance thin-film electronics products. In Phase I, the company successfully demonstrated the feasibility of this innovative manufacturing method to yield large volumes of high quality, uniform nanowire nanostructures of the quality and quality required to enable the application of these materials in high performance thin-film electronics. Specifically, the company: (1) setup a prototype nanowire manufacturing reactor capable of large-volume production; (2) identified critical process parameters affecting materials quality and methods to optimize them; and (3) established control over the process parameters enabling the precise fabrication of nanowires. Phase II research will build on the knowledge gained in Phase I, and focus on further development and optimization of this system into a fully automated, manufacturing system capable of pilot scale production of nanowires for commercialization in high performance electronics applications including displays and phased array antennas.

Commercially, the project represents an innovative approach to a manufacturing process technology for large-scale production of high quality inorganic semiconductor nanowires, and will enable wide-spread production of low-cost high-performance electronics fabricated by roll-to-roll manufacturing. Applications of these materials exist in novel electronic devices and systems including specific uses in displays, RFIDs, phased array antennas and sensors.

Title: SBIR Phase II: Molecular Transfer Lithography with Real-Time Alignment

Award Number:	0646183
Program Manager:	William Haines
Start Date:	February 15, 2007
Expires:	January 31, 2009
Total Amount:	$500,000

Investigator: Charles Schaper, cschaper@transferdevices.com
Company: Transfer Devices, Inc.
500 Laurelwood Road, Suite 11
Santa Clara, CA 95054
Phone: (408) 980-9684

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a comprehensive automated nanolithography and alignment system for integrated electronics and photonics manufacturing. Transfer Devices, Inc. is the pioneer, and has significant intellectual property, in transfer lithography. The product driver for this application is the MxL (molecular transfer lithography) template. It is a consumable, one-time-per-use item that forms patterns by bonding patterned resist layers onto a substrate surface, with subsequent water dissolution of the template. MxL is a non-imprint, non-photolithography process that solves the defect propagation problem of contract printing, and is applied for large area, conformal printing at low costs and high throughput. The proposal seeks to optimize the replication of MxL templates, and coordination with an advanced adaptive alignment system, to achieve unprecedented overlay and high resolution patterning for high throughput next generation lithography of integrated circuits and photonic devices. The reason for the success of the proposed solution is a technologically superior solution of that of alternative approaches by combining low-cost, environmentally friendly processing with defect free conformal printing over large areas at high throughput rates. MxL (molecular transfer lithography) is a patent protected unique process using a water dissolvable sacrificial polymer template. This advanced process is coordinated with an adaptive alignment scheme to produce state-of-the-art registration with sub-50 nm features at sub-20 nm placement capability.

Commercially, the proposed process and technological solution will significantly advanced the capability to manufacture nano-technological devices for a wide range of applications including integrated circuits, solar wafers, displays, data storage, MEMS, as well as emerging areas in photonics, high brightness LED's, optoelectronics, life sciences, and nanotechnology. The project will be implemented commercially into the lithography marketplace, which by 2009 has a total market size of roughly $20B including equipment technology, masks, and consumables.

Title: SBIR Phase II: Novel Hybrid Rapid Thermal Processing (HRTP) Systems for Annealing of Advanced Silicon Devices

Award Number: 0725021
Program Manager: William Haines

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $500,000
Investigator: Syamal Lahiri, slahiri1@sinmat.com
Company: SINMAT
2153 SE Hawthorne Rd Ste 129
Gainesville, FL 32641
Phone: (352)334-7237

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on development of a novel high-temperature system for processing of advanced silicon devices. Currently used rapid thermal processing (RTP) systems result in substantial dopant profile broadening because of their relatively large time constants. The development of a novel Hybrid Rapid Thermal Process (HRTP) system which combines the advantages of RTP and laser annealing will be accomplished through this project. The advantages of HRTP anneals was demonstrated in the Phase I of the project. In the Phase II project extensive thermal simulation studies will be performed to understand, optimize and scale up the process.

Rapid Thermal Processing (RTP) systems are a critical part of semiconductor manufacturing operations and are used to form gate oxides, silicides and annealed ion implanted dopants for formation of ultra-shallow junctions. The market-size for these applications exceeds $500 M/year. With the rapid miniaturization of the devices, there is a strong need to develop higher ramp rate and higher temperature annealing systems to achieve the formation of ultra-shallow junctions. The proposed HRTP system is expected to fill this niche. The HRTP system can also be usedin thermal annealing of wide band gap semiconductors such as GaN and SiC as they require extremely high temperature, which cannot be achieved by traditional systems.

Title: SBIR Phase II: Enhanced Plasma deposition Process for MgO-Based Magnetic Tunnel Junctions with 500% Magnetoresistance

Award Number: 0724913
Program Manager: Cheryl F. Albus

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $499,883

Investigator: Benaiah Schrag, schrag@micromagnetics.com
Company: Micro Magnetics
421 Current Road
Fall River, MA 02720
Phone: (508)672-4489

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop the process to fabricate magnesium-oxide (MgO) based magnetic tunnel junction (MTJ) sensor devices, which are simultaneously ultra-sensitive at high frequencies, small in size, with high output, and extremely low power consumption. The dual advantages of high sensitivity and low power consumption will separate these sensor devices from traditional Hall-effect and magnetoresistive sensor products, which are power hungry and typically not suitable for many high-performance and battery-powered sensing applications. This innovative approach combines the high resistivity tunneling and enhanced signal strength derived from magnesium oxide tunnel barrier technology.

The broader impact anticipated if this project is realized is a new class of MgO-based sensors with high sensitivity and low power consumption, and the development of a reliable fabrication process suitable for mass production. This project will advance the state of understanding of the emerging spintronic technology of magnetic tunnel junctions, a class of devices which forms the central component of a number of important commercial products in the high-tech semiconductor and data storage industries. Finally, the collaboration of physicists, electrical engineers, materials scientists, and students will result in a broader multidisciplinary training and education for all the participants in the field of spintronics.

Title: SBIR Phase II: Fabrication of Conformal Antennas for Airborne SatCom Using Kinetic Metallization

Award Number: 0724502
Program Manager: Muralidharan S. Nair

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Ralph Tapphorn, rtapphorn@inovati.com
Company: Innovative Technology Inc
Cabrillo Business Park
Goleta, CA 93117
Phone: (805)571-8384

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project will develop direct write copper conductors onto doubly curved dielectric substrates using the Kinetic Metallization (KM) process. There is a need for new processes and methodologies to enable low profile RF systems on current and planned airborne platforms. Low profiles antennas are achieved through integration with structural elements. The concept is referred to as aperstructures, and in this Phase II research the scientific and engineering foundation necessary for robust aperstructures will be laid. Principally, research to establish process-property relationships will be conducted, as well as an investigation of novel material systems. The envisioned result of this research is conformal antennas integrated into the load bearing structures of the application platform. Conformal antennas represent a significant stride forward in the ability to communicate in high bandwidth applications. They also offer lower profiles, lighter weight and greater mission flexibility.

Originally airborne platforms were identified as high benefit early adopters. Targeted markets in the Navy and Air Force have already been identified with customers awaiting the Phase II results to transition the KM process to the manufacture of antennas. Ship systems, land systems, and non-military opportunities such as automobiles and skyscrapers will also gain from the development of this research.

Title: SBIR Phase II: R-CEL for DUV Lithography

Award Number: 0724417
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Zhiyun Chen, zchen@pixelligent.com
Company: Pixelligent
387 Technology Drive Suite 3122
College Park, MD 20742
Phone: (301)405-9284

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to develop a product for a reversible contrast enhancement layer (R-CEL) using semiconductor nanocrystalline materials. The R-CEL technology, if successfully developed, will enable finer resolution optical lithography postponing the need for more expensive techniques such as electron beam or x-ray lithography. R-CEL technology will help to extend the diffraction limit facing optical lithography by enabling double exposure techniques to be used for pattern definition.

The use of R-CEL with double exposure will increase the capability of optical lithography thus enabling the extension of Moore's Law without the need to switch to more expensive alternatives. It will also help restore the technological competitiveness of domestic vendors in the lithography industry. The SBIR project will also advance the understanding of semiconductor nanocrystal characteristics including detailed absorption and recombination processes and the effect of nanocrystal surface conditions on dispersion with polymers. This information will be valuable in other semiconductor nanocrystal UV applications including optical storage, UV light sources and detectors.

Title: SBIR Phase II: Development of Efficient Short-Wavelength Radiation Sources For Next-Generation Lithography

Award Number: 0724183
Program Manager: Rathindra DasGupta

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Joseph MacFarlane, jjm@prism-cs.com
Company: Hyperion
455 Science Drive
Madison, WI 53711
Phone: (608)280-9179

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will pursue the development of novel plasma technologies for creating highly efficient, short-wavelength radiation sources for use in next-generation semiconductor chip manufacturing. The development of radiation sources that efficiently emit light at wavelengths near 13.5 nm is crucial to the expected emergence of EUV lithography as the primary technique used in manufacturing integrated circuits and DRAM near the end of this decade. Laser-produced plasma experiments will be conducted to validate and refine the novel high-efficiency, low-debris EUV light source designs developed in our previous work. Comparisons between experimental data and simulations performed using state-of-the-art simulation tools will facilitate the development of light sources with high 13.5 nm conversion efficiencies. This project will lead to lower cost, more efficient, and more robust EUV lithography light sources for use in the manufacturing of next-generation semiconductor chips.

Short-wavelength radiation sources are applicable to a wide variety of research areas, and have significant value in commercial applications, basic research, and defense research and technology. Such sources are valued not only for use in EUV lithography, but also in medical research, instrumentation, and technology. While this project will focus on the development of plasma-based technologies for creating highly efficient light sources for EUV lithography, it is likely that techniques and capabilities developed under this project will further the development of plasma light sources applicable to other major areas of research and technology.

Title: STTR Phase II: Fully Embedded Optical Interconnects based on Optical Bus Architecture for Large Size Printed Circuit Boards

Award Number: 0724096
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Alan Wang, alan.wang@omegaoptics.com
Company: Omega Optics
10435 Burnet Rd Ste 108
Austin, TX 78758
(512)996-8833

Abstract:

This Small Business Technology Transfer (STTR) Phase II research project is to develop a commercial board level optical interconnect using bus architecture. Conventional copper links on printed circuit boards fail to provide sufficient bandwidth for data transfer above 10 Gbit/sec. Optical interconnections are widely viewed as an alternative to higher throughput. However, existing photonics-related approaches suffer from issues of packaging, reliability and manufacturing cost. In this project, Omega Optics and the University of Texas at Austin seek to develop a fully embedded board level optical interconnect for enhanced bandwidth, while reducing the difficulties of optoelectronic packaging and device reliability. Phase I results demonstrated 150 GHz bandwidth with 51 cm interconnection distance.

Instead of utilizing surface mounted optical components this approach separates the fabrication of the optical layer with the electrical parts and laminates it inside printed circuit boards, between which the interconnection is setup through in-layer vias. This fully embedded technology seals all the optical components and provides a seamless interface with electrical layers, therefore it eliminates the concerns of external optoelectronic devices for end users. The revolutionary breakthrough over copper links sought through this research would benefit the entire computer industry and enable the continued progression of bandwidth and interconnect distance.

Title: SBIR Phase II: Microfluidics Device for Real-time Process Control of Copper Plating Baths

Award Number: 0646935
Program Manager: Muralidharan S. Nair

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $500,000

Investigator: Holly Garich, hollygarich@faradaytechnology.com
Company: Faraday Technology Inc
315 Huls
Clayton, OH 45315
Phone: (937)836-7749

Abstract:

This Small Business Innovation Research (SBIR) Phase II research program will advance the monitoring of copper plating baths, responding to the stated need to design, develop and prototype innovative sensors and systems for testing and characterization in both industrial and laboratory settings, for specific use as a process control device. This technology couples the theories of microfluidics and alternating current voltammetry for a powerful monitoring tool. The anticipated result of this research project is a marketable, commercially viable sensor with the capability to accurately and precisely measure concentrations of all components of the copper plating bath. In addition, application of the proposed method is anticipated to significantly reduce the waste generated by semiconductor and printed circuit board industries.

This work addresses the needs of the printed circuit board and semiconductor industries, which are important aspects of the US commercial economy and will play an increasing role in the US as well as world society. In addition to providing tight process control and therefore a better quality product, the proposed sensor is anticipated to be more environmentally friendly than current technologies due to the decrease in sample size and analysis time requirements, resulting in lower chemical and power consumption, an objective of the 2005 International Technology Roadmap for Semiconductors.

Title: SBIR Phase II: Gentle Atomic Level Chemical Mechanical Smoothening (CMS) of Gallium Nitride Substrates

Award Number: 0646586
Program Manager: William Haines

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $499,900
Investigator: Syamal Lahiri, slahiri1@sinmat.com
Company: SINMAT
2153 SE Hawthorne Rd Ste 129
Gainesville, FL 32641
Phone: (352)334-7237

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and scale-up an industrially robust and low cost chemical mechanical smoothening (CMS) process to produce atomically polished gallium nitride (GaN) on silicon substrates for high power and high frequency applications. As GaN is mechanically hard and chemically inert, traditional surface polishing processes have resulted in significant surface damage which negatively affects the electrical performance. In contrast, the CMS process forms a soft layer on GaN surface which can be removed by nanoparticles. In the Phase II of this project, the company plans to further optimize and scale-up the CMS process. In conjunction with the compound semiconductor chip manufacturers and academic partners, the company's plan is to further validate the polishing technology by fabricating and testing the performance of high electron mobility transistors. The research team members are internationally recognized experts and are in an excellent position to execute the research plan and attain the project goals.

The commercialization of the proposed polishing technology is expected to significantly impact GaN based semiconductor technology used for high frequency, high power microwave devices in wireless mobile communication and radar defense systems. This process will accelerate commercialization of GaN on silicon technology by increasing yield and reducing manufacturing costs.

Title: SBIR Phase II: A Quality Monitor for Enabling Water Recycling in Semiconductor Processing - The Particle Scout

Award Number: 0646557
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Bingrong He, bingrong@uncopiers.com
Company: Uncopiers, Inc.
6923 Redbud Drive
Manhattan, KS 66503
Phone: (785)293-4917

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project concerns Ultrapure Water (UPW), the life blood of the semiconductor industry. The proposed instrument seeks to satisfy the ITRS requirements on two counts: 1. full flow inspection, and 2. detection of sub-100nm liquid-borne particles. 1. A typical semiconductor fab uses about 3 million gallons of UPW every day, and the ITRS, in its attempt to conserve the precious resource, water, mandates that 90% of UPW be recycled/reused by 2010. The recycled UPW loop will need full flow monitoring, which the proposed Particle Scout will do. 2. The purity of UPW directly affects the chip yield, because the final operation on wafers is UPW rinse and any contaminants present in the UPW contaminate the wafers it rinses. As the industry moves to sub-100 nm nodes the ITRS particle detection requirements fall to sub-50 nm.

Particle Scout" for monitoring in real-time the particulate purity of recycled UPW for use in Semiconductor processing successfully overcomes a critical technological barrier facing the IC manufacturing industry today. Beyond IC manufacturing industry it will find applications in all enterprises where UPW is used: Power generation, Nuclear Reactors, Pharmaceutical industry, Biotechnology, Space exploration, and processing of Advanced high purity chemicals.

Title: SBIR Phase II: Extrusion Manufacturing Process for Ultrahigh Bandwidth, Low Attenuation Graded-Index Polymer Optical Fibers

Award Number: 0646397
Program Manager: Juan E. Figueroa

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000

Investigator: Whitney White, white@chromisfiber.com
Company: Chromis Fiberoptics
6 Powder Horn Dr.
Warren, NJ 7059
Phone: (732)764-0907

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will advance the technology for reliably manufacturing low attenuation, ultrahigh bandwidth, graded-index, perfluorinated polymer optical fibers (GI-POF) by a low cost continuous extrusion process. Currently there is an unmet need for an easy-to-use, rugged medium that allows the migration of data communications to speeds of 10 Gigabits per second, and beyond, in rapidly growing applications such as data centers, supercomputing and consumer electronics. This project will result in a production quality process for manufacturing plastic fibers having bandwidth equal to the best multimode glass fibers, but with a simple "plug-and-clamp" installation process, and tolerance of bend radii fivefold tighter than that allowed by glass fibers. The project will address three areas to develop the technology into commercially viable products: 1) Advanced extrusion process development to greatly improve fiber bandwidth distribution and attenuation, while doubling production speed; 2) Investigation to prove-in new polymers that can increase the fiber operating temperature up to 85 deg C; 3) Investigation and development of a unique, readily manufactured multi-core fiber design that can offer customers almost unlimited bandwidth, as well as greatly improved attenuation in tight bends.

If successful the production technologies developed in this project will result in the possible recapturing of American leadership in POF manufacturing while stimulating American-based production of the manufacturing capital equipment used in this industry. Similarly, American companies using POF to develop next-generation short-distance communication systems will also benefit, as they will enjoy better access to information and custom products based on GI-POF. The results of this project will help improve the "ecosystem" for many areas of datacom manufacturing in the US. Also, by enabling a product that makes installation of high-bandwidth cabling much simpler and less expensive, the Phase II project will be of considerable benefit to schools, hospitals, and other institutions which have many needs for high-bandwidth communication, but often do not have large budgets to support such systems. The scientific benefits of the Phase II project are likely to be the simplified and lower-cost construction of massively parallel computing facilities, and increased commercial interest in chemical synthesis techniques for amorphous fluoropolymers and their precursor chemicals.

Title: SBIR Phase II: Trapping Particle Detector for On-Line Monitoring

Award Number: 0646388
Program Manager: William Haines

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000
Investigator: Chris Doughty, cdoughty@verionix.com
Company: Verionix
251 Granville Lane
North Andover, MA 01845
Phone: (617)905-0015

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop improved particle detectors for monitoring of semiconductor manufacturing tools. This detection technology will increase count rates for greater than 0.2 micron diameter particles by 100 to 1000 times improving correlations between the particle detector and wafer by greater than 10 times. For smaller particles this detector will enable detection, ultimately to the nanoparticle regime (less than 25 nanometers). The intellectual merit of this proposal is that it will advance the state of knowledge in the field of engineering and physics of microplasmas. It will broaden knowledge of plasma scaling and of the behavior of particles in plasmas. The project will involve the following tasks: Optical detector hardware development ; Trap development for capturing particles; Data analysis, Control system and Software interface development and ; Field testing of prototypes. This project will provide currently unavailable detection technology for monitoring particles.

Commercially, this project will improve the performance of semiconductor process tool manufacturer's products by enabling cost-effective, real-time monitoring. The broad economic benefit of this program will be to enhance the competitiveness of domestic semiconductor manufacturers where particle issues account for approximately 11% of manufacturing tool down time and are a major cause of scrap and yield losses. For the future nanotechnology industry as a whole this detector will enhance workplace and public safety by enabling monitoring of nanoparticle levels and production processes.

Wireless Networks

Title: SBIR Phase II: Fabrication of Photonic Band Gap Structures Embedded in Low Temperature Co-fired Ceramic for Millimeter Wave Applications

Award Number: 0110399
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2001
Expires: September 30, 2004
Total Amount: $499,867
Investigator: Vladimir Manasson, vmanasson@waveband.com
Company: WaveBand Corporation
375 Van Ness Avenue, Suite 1105
Torrance, CA 90501
Phone: (310)212-7808

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new materials engineered for microwave electronics. As microwave applications expand, including portable wireless devices, and as digital integrated circuit speeds and clock rates increase to the millimeter wave (MMW) range, the need arises for low-loss elements of microwave/MMW interconnects (EMIs) with properties uniform over a broad range of frequencies and environmental conditions. A new technique is now sought to embed EMIs based on Photonic Band Gap Structures (PBSs) in ceramic substrates at an early stage of fabrication. PBSs will reduce radiative losses in devices fabricated using the Low Temperature Co-fired Ceramic On Metal technique by preventing radiation leakage and by minimizing undesired scattering. The result will be improved performance, without increasing manufacturing costs. Phase I designed, fabricated, and tested PBS-based EMIs, wherein, cross waveguides with low cross talk were successfully tested. Phase II will automate the design and production of devices that include PBS EMIs. The technology will be demonstrated through the design and fabrication of a MMW antenna based on PBS.

A PBS will lead to quite new applications: frequency-band controlled filters, perfect channel-drop filters, point-defect resonant cavities, line-defect ninety-degree waveguide bends, waveguide intersections with low crosstalk, and others. The new technique will be employed in high-volume production items for applications such as automotive radars, avionics, as well as in a variety of broadband wireless communication devices.

Title: SBIR Phase II: Multi-Frequency Low-Multipath Small Antennas for High Accuracy GPS

Award Number: 0450524
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $500,000
Investigator: Francesca Scire-Scappuzzo, fscire@psicorp.com
Company: Physical Sciences Incorporated (PSI)
20 New England Bus Ctr Dr
Andover MA, 01810
Phone: (508)689-0003

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project will consist of the design, development, and manufacturing of a novel low-multipath GPS antenna for high accuracy applications. This antenna prototype utilizes two key technologies: (1) a new design of GPS antennas using high-technology materials and manufacturing methodologies, that enables low-multipath, gain control, multi-frequency, tunability, and size reduction; and (2) a novel geometry of the metal ground plane to further rejects multipath interference. At the end of Phase II the anticipated results include, multipath error mitigation uniformly at L-Band, gain improvement at low elevation angles up to 10 dB with respect to choke ring antennas, multi-frequency operation at GPS and GALILEO frequencies, and at least 33% smaller size than other commercial low multipath antennas.

Because multipath interference reduction significantly improves GPS accuracy, the proposed multi-frequency GPS antenna will benefit the international scientific community that relies on high precision GPS for new advances in Earth and atmospheric sciences. In particular, the novel substrate antenna will allow accurate real-time GPS measurements, otherwise impossible, in support of the NSF funded EarthScope program, that is intended for the study of the structure and evolution of the North America continent using a network of GPS receivers

Title: SBIR Phase II: Athermal Multiplexers Based on Reflective Arrayed Waveguide Grating Devices

Award Number: 0450072
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $500,000

Investigator: Luis Gravede-Peralta, luisgrave@hotmail.com
Company: Multipass Corporation
11 South Lake Shore Drive
Lubbock TX, 79366
Phone: (806)742-8060

Abstract:

This Small Business Innovation Research Phase II project will optimize Performance and demonstrate reliability of temperature insensitive silica-based arrayed waveguide grating (AWG) multiplexers developed under SBIR Phase I award. In Phase I we have successfully demonstrated that the temperature sensitivity of silica-based AWGs can be eliminated by a combination of a reflective device with a unique external mirror that rotates with temperature at a constant rate. The rotation of the external mirror compensates for the temperature induced index change of silica waveguides and the resulting peak wavelength shift of individual channels, making the device athermal. This has been accomplished without penalties in the device performance. The goal of Phase II is to develop compact 40-channel, 100 GHz, totally passive athermal AWGs with Gaussian or flattop passband profiles that is manufacturable in large volume. Special attention will be given to the reliability certification of athermal AWGs as specified by Telcordia standards. During Phase II we will distribute reliable prototypes to our partners and potential customers for field tests. The research and development program carried out under this Phase II project will result in robust manufacturing process of reliable athermal AWGs ready for commercialization.

This project is focused on producing a highly reliable, temperature insensitive, AWGs based on silica-on-silicon technology. AWGs are planar optical devices that are considered key components in dense wavelength division multiplexed (DWDM) optical Networks. The novel approach to the manufacture of silica based AWGs, relying on high-technology silicon IC foundries, results in high quality devices that are produced at low cost, in high volume, and without a large front-end investment. The innovative design results in complete suppression of the temperature sensitivity of silica based AWGs. This approach eliminates the need for electric power and external temperature control of AWGs, resulting in a more robust, and considerably less expensive device package.

Title: SBIR Phase II: Adaptive Phased Arrays for Broadband Wireless Access

Award Number: 0422037
Program Manager: Muralidharan S. Nair

Start Date: November 1, 2004
Expires: October 31, 2006
Total Amount: $496,968

Investigator: Joseph Carey, joe.carey@fidelity-comtech.com
Company: Fidelity Comtech Inc
2400 Trade Center Ave
Longmont CO, 80503
Phone: (303)786-8048

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will culminate in the demonstration of the smallest, most economical phased array system yet developed for addressing the problem of how to traverse the "last mile" between a broadband network and the home. During the course of the project, the state of the art in phased array antenna technology will be advanced and networking algorithms will be developed to take advantage of this innovative technology.

The broader impact of this research project is to fulfill the challenge to economically deliver wireless Internet access to rural communities. This steerable technology provides a greater than 50 percent increase in coverage and a cost savings of up to 55 percent. These cost and coverage improvements would help meet the needs and bring the benefits of broadband Internet into areas of the country that remain underserved.

Title: SBIR Phase II: Innovative Software Definable Radio and Network Architecture for Low-Cost Commercial Application

Award Number: 9983341
Program Manager: Juan E. Figueroa

Start Date: April 1, 2000
Expires: November 30, 2002
Total Amount: $749,587

Investigator: Richard Bergfeld, rbergfeld@aol.com
Company: Ameranth Wireless, Inc.
12230 El Camino Real
San Diego, CA 92130
Phone: (717)897-0103

Abstract:

This Small Business Innovation Research Phase II project follows a successful Phase I technology demonstration and will establish the feasibility of a multimode (IEEE 802.11 and Bluetooth) data communications system using a single-chip radio modem and a single-chip baseband processor, both software configurable. The program objectives are, (1) Quantify key system design parameters, (2) Determine the best suited radio and baseband processor architectures, (3) Identify critical system features and interfaces needed to assure system applicability to existing and anticipated commercial applications.systems, (4) Specify a radio and baseband system to be simulated with the Ameranth 21st Century Restaurant(TM) commercial design software, (5) Design a prototype radio, (6) Construct a prototype transceiver module using selected Ameranth terminals, (7)Demonstrate the operation of the system using the Ameranth terminals/system application(s), and (8) Prepare for initial production and commercialization. The technology is a Bluetooth chipset implementation using silicon-on-insulator wafer structure and BiCMOS transistor structure.

The market for wireless computing devices is enormous. Ameranth products have applicationacross a wide range of industries, including the hospitality, retail, transportation, law enforcement, health care, finance, telecommunications and defense industries. Ameranth has more than 2,300 customers that have expressed interest in these products.

Title: SBIR Phase II: Parallel Hardware Implementation of the Split and Merge Discrete Wavelet Transform for Wireless Communication

Award Number: 0239330
Program Manager: Winslow L. Sargeant

Start Date: March 15, 2003
Expires: February 28, 2005
Total Amount: $500,000

Investigator: Alexander W. Moopenn, amoopenn@mosaixtech.com
Company: Mosaix, LLC
176 Melrose Avenue
Monrovia, CA 91016
Phone: (626)305-5550

Abstract:

This Small Business Innovative Research (SBIR) Phase II project proposes to develop the Intellectual Property (IP) core of novel image compression / signal decomposition algorithm based on the discrete wavelet transform (DWT). This is a fully parallel, scalable, multi-resolution, and low power implementation of the JPEG2000 DWT engine and is particularly well suited for use in both consumer applications at one end of the spectrum (as in reduced bit-rate web browsing over wireless communications channels as found in the next generation of web enabled cell phones) as well as in high-end commercial applications at the other end of the spectrum (as in non-linear video editing accelerators for the movie industry). This particular implementation is a highly efficient implementation of the DWT transform and makes use of a novel Overlap-State wavelet decomposition algorithm that minimizes memory, I/O and computational requirements. Over the next decade, spiraling consumer demand for fast mobile communication of voice and IP over increasingly integrated terrestrial and satellite based systems plagued by a limited electro-magnetic spectrum allocation necessitates the pursuit and development of better compression algorithms that a visually pleasing at low bit rates. As a consequence of extensive research, transform coding techniques now dominate every single image and video-coding scheme proposed to-date. Consequently, efficient software and hardware based transform coding system designs and implementations have become a high priority objective.

In fact, it is widely accepted that JPEG2000 will become the universally accepted format for digital images and high quality video - whether on the web, cable, over wireless systems, in digital cameras, printers, faxes or remote sensors. With its wavelet based image-coding technology, it offers features previously impossible in JPEG. Compared with the old baseline JPEG, the new JPEG2000 spec poses formidable technology challenges for the myriad of developers and OEM's planning on using it. The new standard uses coding algorithms based on the discrete wavelet transform (DWT) which is fundamentally different from the discrete cosine transform (DCT) JPEG spec. In JPEG2000, the importance of computational and especially memory bottlenecks has clearly increased several fold over the old specification. In fact, various implementations of computationally efficientCE wavelet transforms have been reported in recent years.

Title: SBIR Phase II: Wireless Firefighters Lifeline

Award Number: 0216076
Program Manager: Winslow L. Sargeant

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,975

Investigator: James D. Halsey, halsey@islinc.com
Company: Info Sys Lab Inc
8130 Boone Blvd Suite 500
Vienna, VA 22182-2640
Phone: (703)448-1116

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will demonstrate a capability for locating imperiled firefighters in buildings using wireless technology based on long wavelength signals that penetrate buildings with lower perturbation than observed at higher frequencies. The system is being developed for firefighters (estimated 5 year market of over $150 million) but is useful for any application requiring geolocation in buildings where GPS cannot work. Such applications include tracking personnel and equipment in crisis situations, military combat, inventory management and police and military training. This concept has significant advantages over competing technologies; ultra-wideband solutions pose frequency-licensing problems, and man-portable inertial units are bulky, costly and have significant time-dependent errors.

The Wireless Firefighter Lifeline (WFL) system is completely mobile and supports multiple firefighters. It complies with Part 15 rules and will not require FCC licenses. Phase II will demonstrate the underlying technology over a wide range of conditions and will produce a prototype system that will serve as the baseline for future system development. It provides extensive commercial and societal benefit, offers performance superior to that of other potential technologies, and is well positioned to attract further funding.

Title: SBIR Phase II: Adaptive/Cognitive Software Radio Architecture for Gbps+ Wireless Networking

Award Number: 0620588
Program Manager: Errol Arkilic

Start Date: August 4, 2006
Expires: July 31, 2008
Total Amount: $500,000
Investigator: David Fogelsong, david@silvuscom.com
Company: Silvus Communication Sys
1185 W Olympic Blvd
Los Angeles, CA 90064
Phone: (310)738-1787

Abstract:

This Small Business Innovation Research Phase II project will develop interference-mitigating technology for wireless networks. The traditional 802.11 WLAN systems that have been used for data communications are becoming ubiquitous. The next generation of these systems will be relied upon for video distribution, metropolitan networking, as well as a host of other applications that are as yet undefined. They must achieve aggregate network throughput rates in excess of one Gbps while operating in the unlicensed ISM bands. This, however, must be done in the face of ever increasing interference in the bands that in turn pose a serious threat to continued market growth. The current effort will address the interference problem by successfully combining novel spectrum sensing and cognitive approaches (observe, learn, react) with a host of powerful PHY, MAC, and combined PHY-MAC protocols. This effort will look to heavily leverage a new tool in the arsenal, namely that of multiple antennae enabled nodes that are included in the major Wi-Fi and WiMax standards.

The FCC revolutionized the wireless industry by opening up the unlicensed ISM bands. These bands reduce the barrier to entry for companies to introduce wireless services to niche markets without the expense and delays associated with obtaining a proprietary licensed band. The price paid for utilization of the ISM bands is interference. Traditionally these bands have been sparsely occupied, however, with ever increasing adoption of WLANs, and the emergence of WiMax and metropolitan networking in this band, interference is going to increase in significance. If successful, the current effort will allow high utilization of the ISM bands for high throughput high fidelity applications, and will help ensure low price wireless access to the society at large.

Title: SBIR Phase II: Location Aware Computing Using Near Field Electromagnetic Ranging

Award Number: 0646339
Program Manager: Muralidharan S. Nair

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $499,508

Investigator: Hans Schantz, h.schantz@q-track.com
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515 Sparkman Drive
Huntsville, AL 35816
Phone: (256)489-0075

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project seeks to transform the Real-Time Location Systems (RTLS) industry by bringing to fruition a simple, inexpensive, yet highly accurate approach to location awareness: Near-Field Electromagnetic Ranging (NFER) technology. RTLS is an important and rapidly growing segment within the Radio Frequency Identification (RFID) industry. In today's world of just-in-time commerce, Supply Chain Management (SCM) requires inexpensive real-time location data to improve efficiency and maintain competitiveness. Established technologies like the Global Positioning System (GPS), UltraWideBand (UWB), and traditional time-of-flight ranging have proven unable to perform satisfactorily within complicated, real-world, indoor propagation environments.

The anticipated result of this research effort will be a pilot installation of a NFER tracking system in a warehouse. It is predicted that: "RTLS and wireless LAN technologies, combined with innovative applications, will fundamentally change the way businesses manage and track high-value assets." Accelerated development of a technology that can meet this market need will bolster the American economy and increase American competitiveness.

Computer Algorithms and Image Processing

Title: SBIR Phase II: Neuromorphic Color Sensor for Object and Place Recognition

Award Number: 0091594
Program Manager: Sara B. Nerlove

Start Date: May 1, 2001
Expires: October 31, 2004
Total Amount: $500,000

Investigator: Anthony M. Lewis, tlewis@iguana-robotics.com
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P.O. Box 625
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Abstract:

This Small Business Innovation Research (SBIR) Phase II Project proposes the construction of a miniature object recognition and color segmentation system on a chip. This chip will be tuned to recognize various predefined targets in natural environments. The chip will use an object recognition model, color histogramming, originally derived from research in cognitive neuroscience. Taking advantage of recent advances in Neuromorphic Engineering, the company will implement the basic sensing and computational elements directly in silicon using mixed analog/digital processing. In contrast, implementing the same model or algorithm with conventional microprocessor technology would require that the basic computations be simulated as an intermediate step. The removal of this intermediate step will result in an intelligent sensor with dramatically lower cost, smaller volume, and reduced power usage-achievements not possible using competing microprocessor-based technology.

The applications for this technology include intelligent toys and prosthetic devices. A toy might be made to recognize and the Reference be able to respond to the presence of another toy or specially designed environment. More advanced and elaborated versions of the chip might be used as an aid to the blind by assisting them in finding standardized (i.e. specially colored) objects. For example, a blind person might be assisted in localizing a coffee mug, distinguishing between two similar items of clothing differing only in color, or finding a standardized 'EXIT' sign in a building. The broader impact of this technology is that it will help bridge the gap between the natural, unstructured environment and computing technology.

Title: SBIR Phase II: Grid Computing for Energy Exploration and Development

Award Number: 0522194
Program Manager: Errol B. Arkilic

Start Date: August 15, 2005
Expires: July 31, 2007
Total Amount: $500,000
Investigator: Dimitri Bevc, dimitri@3dgeo.com
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4633 Old Ironsides Dr # 401
Santa Clara CA, 95054
Phone: (408)450-7840

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a grid-enabled environment where large multidimensional seismic data sets can be rapidly accessed, visualized, and interpreted by geographically dispersed users with heterogeneous local resources. The proposed work will transform the Phase I prototype into production-ready commercial quality software, and demonstrate it on 3-D seismic data. The key technical innovations of the Phase II project are (1) a multi-resolution data visualizer, (2) a data-staging tool, and (3) a multi-channel collaboration tool to support collaborative visualization and data analysis on the grid. The proposed technology will allow multiple users to share and interact with multidimensional grid-dispersed data sets, while viewing independent multiple renderings with resolutions and bandwidths commensurate to their local display and network capabilities. The proposed technology will be enabled by implementing several grid services, and a virtual file system, that make grid deployed data sets appear local to the user. This implementation comprises the bulk of the technical tasks, and leverages the middleware. The immediate outcome of the Phase II project will be a version of Internet Seismic Processing production software (INSP) with specialized features for remote visualization, data staging, and collaborative analysis of seismic images on the grid.

The ultimate objective of the Phase II project is a commercial grid-enabled software product providing scientific data, services, computing power, and visualization on demand, not only to the oil and gas industry but to a much wider range of application areas, such as geographic information systems, education, medical imaging, and battlefield management. The product will push the limits of what can be done, and fully contribute to a new business paradigm, made possible by the advent of the grid, allowing businesses to concentrate on their core competencies and rely on other entities for grid-enabled context technologies, without deterring from their primary objectives. The outcome of Phase II will be a commercial implementation and utilization of the grid, and the toolkit, which up until now, has been used mostly in academic and research applications. This technology will first be commercialized in a strategically important economic sector; namely, for the exploration of new energy resources. Specific to U.S. energy needs, this unique application of high end information technology to an area of economic and national importance will ultimately open up new exploration venues in extremely complicated geological conditions, leading to new discoveries, and decreasing US dependence on imported oil

Title: SBIR Phase II: IBARS - An Image Barcode Acquisition and Recognition System for Mobile Commerce

Award Number: 0522144
Program Manager: Errol B. Arkilic

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $499,550
Investigator: Huiping Li, Huiping.Li@appliedmediaanalysis.com
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Phone: (410)493-9043

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops the concept of using hand-held, mobile devices to link the physical world to information networks using advanced pattern and symbol recognition technology that will be deployed on the mobile device. The proposed mobile symbol recognition technology will enable many opportunities for mobile e-commerce by recognizing bar codes, text on documents and user-customizable icons that are used to carry and convey information. To address these opportunities, technical challenges associated with limited processing power and memory resources, lower-quality optics in cameras, varying available network bandwidth, and the diversified development platforms they represent must be overcome. The advances proposed include the ability to unwarp images to account for distortions due to perspective imaging and lenses, removing imaging artifacts such as non-uniform lighting and highlights, deblurring images caused by fixed focus and motion, and improving the image contrast all within the resource constraints of the mobile devices. Recognition algorithms in the system must be able to automatically identify and decode various barcodes symbologies, handle multiple languages and fonts for Optical Character Recognition (OCR), and be trainable for user customizable icons. Special consideration must be given to cross platform development so algorithms can be efficiently and robustly embedded in different development platforms.

The ability to perform image processing and pattern recognition algorithms on diversified handheld devices will provide advances in fields such as computer vision, mobile computing, and software engineering. This concept is powerful in that it requires no new infrastructure, since it uses popular mobile devices, and existing symbols such as barcode tags, text, and user-customizable icons. The downloadable symbol recognition component will enable many applications. Other than service providers and OEMs, merchants, advertisers, information providers and other service providers are likely partners and customers for our technology. Finally, the technology can be used to help disadvantaged groups (handicapped or visually impaired, for example) get access to product information (prescription drug instructions, for example) or transact commerce activity conveniently, using a device they may already have, or that is easily acquired. These include applications in medical care delivery, military applications, sign recognition for the visually challenged, and others

Title: SBIR Phase II: A Foundation for Emergency Egress Simulation

Award Number: 0521897
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,374
Investigator: Daniel Swenson, swenson@thunderheadeng.com
Company: Thunderhead Engineering Consultants, Inc
1006 Poyntz Ave
Manhattan KS, 66502
Phone: (785)770-8511

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new capability to model emergency egress from buildings. The primary focus of the research is evacuation due to fires, but the software will be designed such that exposure and response to biological and chemical agents can also be simulated. The project will couple egress analysis to time-varying fire conditions (e.g. smoke density, heat, and CO) calculated using a Computational Fluid Dynamics fire simulator. This will enable simulation of emergency situations in which, for example, some exit paths become blocked. In addition to incorporating current human response models, the software will allow researchers to specify more complex individual behavior based on the results of recent studies of observed human behavior during emergencies. Thus, the project will not only result in a commercial product of immediate use to the fire safety industry, but will also provide a framework in which to incorporate future knowledge into a problem of fundamental importance to an urban society.

This research will lead to a product that will facilitate broad use of fire emergency egress analysis and will introduce a new technology (coupling egress analysis with CFD fire modeling) into the present fire safety design and regulation process. In 2003 fire claimed 3,925 American lives and caused direct losses of $12.3 billion, with a total economic cost of $165 billion. Any technology that reduces even a fraction of this cost will be significant. The integration of egress analysis with fire simulation provides new capability to more accurately simulate emergency building evacuation. The engineering time required for the analyses will be significantly reduced by a common user interface and geometry database that will enable the broader application of this technology throughout the fire safety industry. Societal impacts include increased public safety, advancement in fire research, and reduced building costs. Coupling egress analysis and fire simulation will lead to new discoveries and recommendations based on post accident analysis. The software will enable researchers to add their own models of human behavior to the analysis

Title: SBIR Phase II: Variable Azimuth Wave-Equation Imaging (VAWEM)

Award Number: 0450588
Program Manager: Juan E. Figueroa

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $512,000
Investigator: Dimitri Bevc, dimitri@3dgeo.com
Company: 3DGeo Development Inc
4633 Old Ironsides Dr # 401
Santa Clara CA, 95054
Phone: (408)450-7840

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will implement and demonstrate the feasibility of a new technology that enables enhance seismic resolution and imaging of deep water complex geologic structures by using variable azimuth wave-equation migration (VAWEM). VAWEM will provide much greater resolution and accuracy than what can be accomplished today for towed marine streamer data, and at significantly less computational cost. The software will be optimized for deployment on Linux clusters, and testing will be conducted to determine the optimal geophysical parameters for obtaining the best possible images. The project involves significant computer engineering to obtain the maximum efficiency required to image terabyte size data sets and significant geophysical work to demonstrate the validity of the approach. This advanced imaging methodology will improve success rate and cost effectiveness for new field discoveries and increase recovery efficiency for the development of existing fields. This technology is a fundamental revolutionary advance, and is a necessary building block in any seismic processing system that images 3-D prestack data using wave-equation methods for imaging deep water, under-salt complex geological structures which are the focus of modern oil and gas exploration.

Societal and economic benefits from the proposed VAWEM technology will accrue directly to the nation by lowering energy costs and reducing dependence on foreign energy sources. Energy is at the core of the U.S. and world economies; therefore, the political, societal, and economic benefits of the proposed technology go well beyond the substantial direct economic benefit that this technology will bring to the proposing company and its customers. Commercial potential of the proposed technology is directly applicable to the fastest growing and strategically most important area of U.S. exploration, namely the deepwater subsalt oil and gas province of the Gulf of Mexico federal waters. It is estimated that most of the Gulf's untapped resources (45 Billion barrels of oil and 207 trillion cubic feet of natural gas) are trapped in deepwater subsalt reservoirs, and in ultra deep (over 15,000 ft) gas deposits. Since exploratory wells in these areas typically cost more than $30 million, tapping these reserves will require advanced imaging technology such as VAWEM to reduce risk and make exploration feasible. Reduction USA's dependence on Persian Gulf sources and the strategic benefits of maintaining strong U.S.A. leadership in oil technology transcend purely financial considerations

Title: SBIR Phase II: Algorithms and Hardware for Real-Time H.264 Encoder

Award Number: 0450514
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000

Investigator: Sassan Pejhan, sassanp@vbrick.com
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12 Beaumont Rd
Wallingford CT, 6492
Phone: (203)303-0225

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop novel algorithms and hardware accelerators, as well as a prototype, for a real-time, high-resolution, H.264-based network video appliance. H.264 is the latest video compression standard, jointly developed by the ITU-T and ISO/IEC (MPEG). It is also designed for transmission over packet-based networks and to achieve significantly superior compression efficiency compared to previous standards and proprietary solutions. This compression efficiency, however, is achieved at the cost of severely increasing the complexity of the encoder. Real-time, high-resolution H.264 encoders are not feasible with current personal computers or DSP-based approaches. The new algorithms and designs for hardware acceleration will be targeted at video compression techniques that were introduced by the H.264 standard for the first time. They are anticipated to improve encoder performance by at least one order of magnitude compared to current implementations

If successful a real-time, network appliance with the compression efficiency of H.264 will have broad applications, particularly in the areas of distance learning, remote training, security and surveillance. The innovations resulting from this should enable implementers to significantly improve the real-time performance of H.264. Limited bandwidth and the resulting poor quality video have so far been an impediment to realizing the full benefits of digital video. A real-time, high-resolution network appliance with the compression efficiency of H.264 will bring digital video in the mainstream by delivering high quality video to the endpoints of the network. This will drive both business and consumer uses. It will provide the visual communication crucial to making distance learning and remote training a superior experience and compelling from an economic viewpoint - and therefore mitigate geography as a barrier to participation in scientific and engineering activities. Students can partake in classes offered at remote campuses while rural K-12 schools can partner with museums in major cities to provide their students with a richer education.

Title: SBIR Phase II: A Decision Support System for the Railroad Blocking Problem

Award Number: 0450504
Program Manager: Juan E. Figueroa

Start Date: December 1, 2004
Expires: November 30, 2006
Total Amount: $532,000

Investigator: Ravindra Ahuja, ravi@InnovativeScheduling.com
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Gainesville FL, 32608
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Abstract:

This Small Business Innovation Research Program (SBIR) Phase II project entails developing a decision support system for the railroad-blocking problem, one of freight railroad transportation's most significant optimization problems. The mathematical complexity of railroad transportation problems has precluded the development of optimization algorithms for solving them preventing railroads from benefiting from the advances taking place in the field of optimization; they still rely on manual decision-making processes for most of their planning and scheduling needs. During Phase I, the company developed prototype software for the railroad blocking problem and tested it on the data provided by three major US railroads: CSX Transportation, BNSF Railway, and Norfolk Southern Corporation. In this Phase II project the company will develop a prototype for a commercial decision support system for the railroad-blocking problem by combining state-of-the-art operations research techniques with latest information technology tools. This project will enhance core optimization engines and algorithms using cutting-edge ideas in network optimization, heuristic optimization, data structures, and software engineering. Database connectivity will also be provided. This Phase II project will extend algorithms for the railroad-blocking problem to similar problems arising in postal/package delivery service design and developing prototype software.

Currently, railroads takes months of team effort to determine a blocking plan and undertake this exercise once in several years with intermittent periods of minor adjustments to account for seasonal variations in the traffic pattern. The proposed decision support system would allow a railroad to determine a blocking plan in a matter of a few hours and produce solutions far superior than those obtained manually. The proposed solution will enable a large freight railroad to optimize its blocking plans frequently and reduce cost by at least $10 million annually and hundreds of millions of dollars for railroads companies in the USA and Canada over a few years. The research will establish the efficacy of network optimization and heuristic methodology in solving railroad planning and scheduling problems. The success of this product will lead to a greater acceptance of optimization models and optimization-based software in the railroad industry.

Title: SBIR Phase II: New Algorithms for Pan-Tilt-Zoom (PTZ) Camera Based Object Tracking

Award Number: 0450171
Program Manager: Juan E. Figueroa

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $500,000

Investigator: Laura Drake, ladrake@ieee.org
Company: JunTech, Inc.
2314 E. Stratford Ct.
Shorewood WI, 53211
Phone: (414)332-8349

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new class of moving object tracking algorithms and software prototype for Pan-Tilt-Zoom (PTZ) cameras in video surveillance systems. In most of today's video surveillance systems, human operators using PTZ cameras perform real-time object tracking manually. This is often stressful and inefficient (an operator can only control one PTZ camera at a time) and causes inconsistent results. The proposed project will develop a new class of algorithms to direct PTZ cameras to track multiple moving objects of interest automatically. Using an optimal filter with new object state and observation models does this. The project outcome will be smart software modules that can be integrated into standard video surveillance systems to improve their capabilities.

Video surveillance systems are important tools in the fight against crime and terrorism. Most of the systems on the market today are relatively standard DVR's (digital video recorders) with few smart features. The proposed innovation (automatic object tracking) is a smart feature that can significantly improve a standard system's capabilities by allowing it to get better and more useful images. Since this feature is demanded by many end-users, it is highly attractive to equipment vendors and integrators. Furthermore, by introducing new models for object tracking , the proposed innovation also advances the state-of-the-art in image processing and computer vision research.

Title: SBIR Phase II: Computerized Tool for Baggage Screening

Award Number: 0422071
Program Manager: Juan E. Figueroa

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $498,882

Investigator: Edward Sommer, ejsommer@nrt-inc.com
Company: National Recovery Technologies, Inc. (NRT)
566 Mainstream Drive
Nashville, TN 37228
Phone: (615)734-6400

Abstract:

This Small Business Innovation Research Program Phase II research project will develop a technology for improving security checkpoint effectiveness and increasing throughput while reducing labor costs for airports and other sensitive installations by integrating information technology systems incorporating new x-ray image inspection technology, new electronics communications technology, materials handling automation, and database-centric computerization. Current processing rates through a typical security checkpoint are relatively slow and laborious and costs are high. Today's checkpoints take little advantage of computerization thereby limiting their effectiveness. It is planned that the prototype system will be integrated into a TSA approved test site and tested and evaluated by an independent third party Modernization of checkpoint security will improve protection of many other segments of society. In today's world it is vital that our nation's citizenry, transportation systems, institutions, sensitive installations, and economy have the best protection possible. Security has become much more restrictive and time consuming.

If successful this project will develop a product that will be able to increase the security at check bags handling facilities while reducing the time to conduct the checks. The streamlining and improving of security at federal buildings, government installations, maritime ports, shippers, mailrooms, and other sensitive locations can increase confidence in our day-to-day lives and help improve the nation's economic security.

Title: SBIR Phase II: Next Generation Binary Decision Diagrams (BDD)-Based Logic Optimization System

Award Number: 0421993
Program Manager: Errol B. Arkilic

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $500,000
Investigator: Qian Ren, qren@logic-mill.com
Company: LogicMill Technology
41 The Hollow
Amherst, MA 01002
Phone: (413)587-2030
Abstract

This Small Business Innovation Research Phase II project targets the synthesis of very large-scale integrated circuits (ICs) and systems on chip (SoC) in very short CPU time. The expected short CPU time comes from relying on binary decision diagram (BDDs) that replaced the traditional algebraic representations used pervasively in present-day tools. This Phase II SBIR project is devoted to developing further the capabilities of swift and integrating it with a number of commercial tools. The development plan includes new capabilities, such as improving area by adding new logic transformations and improving the speed of processing by implementing novel decomposition algorithms.

This project will significantly advance the theory of modern logic optimization and promote its understanding in industry and academia. It would also promote the inclusion of faster logic synthesis tools in existing Electronic Design Automation (EDA) systems. It would benefit the national EDA industry, and help the US to maintain its competitive advantage against its foreign competitors in this strategically important market.

Title: SBIR Phase II: Adaptive Personalization and Context Management for Location-Based Mobile Devices (AdaptTribe)

Award Number: 0349778
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $467,609

Investigator: Daniel Greening, greening@bigtribe.com
Company: BigTribe Corporation
330 Townsend St Ste 209
San Francisco, CA 94107
Phone: (415)995-7150

Abstract:

This Small Business Innovation Research Phase II research project develops personalized user-interfaces for location-based services. This adaptive proximity-based personalization algorithm recommends nearby venues based on predicted user interest and distance. It will further develop a highly distributed algorithm that allows handsets to perform part of the calculation, dramatically reducing computation costs that central servers would otherwise bear. This context-based user-interface allows users to chain operations, concentrating activities by proximity, and avoiding retyping. This project will expand the user- interface advancements to include personalizing categories, and a user-interface approach that mixes categories with individual venues. In addition it will explore algorithms that mix different types of venues on the same screen. Identity federation will help retailers and portals more readily deal with intermediary services. Self-service retail interfaces can allow traditional "brick-and-mortar" retailers to cost-effectively provide "click-and-mortar" services to consumers. A SOAP-based web-service will allow portals to filter data and configure look-and-feel more precisely. However, the proposedtag mechanism will likely be good enough for most portals, as the output format can be configured easily through CSS, and filtering can be performed through the company's self-service portal interface

The end result of this project is a product that can be incorporated in enterprise logistics applications that help field personnel find, reserve, use and store resources while being able to improve the speed that consumers navigate user-interfaces, even when location is irrelevant. The in-handset personalization may ensure better privacy and security, even in non-location based applications. The product will use proximity to maximize value: building business-consumer relationships, enhancing social harmony and strengthening communities, as a result.

Title: SBIR Phase II: Artificial Intelligence Software for Student Assessment in Chemistry Education

Award Number: 0349630
Program Manager: Sara B. Nerlove

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $500,000
Investigator: Benny Johnson, johnson@quantumsimulations.com
Company: Quantum Simulations Incorporated
5275 Sardis Road
Murrysville, PA 15668
Phone: (724)733-8603

Abstract:

This Small Business Innovation Research Phase II project builds Phase I work on development of meaningful interactive tutoring and assessment capabilities for chemistry education software. Despite clearly articulated teacher and student demand for improvement, this area has been repeatedly identified as that where existing offerings are weakest. Quantum Simulations proposes a new and different approach, adapting and incorporating new concepts from artificial intelligence (AI). More than just assigning a grade, meaningful opportunities will be created for students to learn directly from the assessment itself. The proposed technology will benefit all students; however, it is specifically targeted to help those who have the greatest need--such as students of average or marginal performance and students from historically underserved groups-- by lowering barriers to accessing high-quality science instructional software. Quantum Simulations has partnered with members of the Department of Education's STAR Schools program to further these goals.

Quantum Simulations' customers include textbook publishers, software providers, hardware vendors and distance learning companies. A prominent textbook publisher, Holt, Rinehart and Winston, has entered into a long-term contract and has partnered with Quantum Simulations to commercialize this Phase II technology, resulting in rapid dissemination to an established end user base.

Title: SBIR Phase II: Technology for Integrated Computation and Communication

Award Number: 0349414
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $500,000
Investigator: Chitoor Srinivasan, srinivas@cs.rutgers.edu
Company: EDSS., Inc.
Port Saint Lucie, FL 34952
Phone: (772)335-3677

Abstract:

This Small Business Innovation Research Program Phase II research project proposes to develop a prototype product for an innovative parallel program development and execution technology, which can run parallel programs asynchronously in multiprocessors and supercomputers up to 100 times faster than what is currently possible, without using Message Passing Interfaces (MPI). For more than thirty years it had been assumed that the only way to efficiently compile and execute parallel programs was through MPI. Even though it had been recognized that parallel programs would run faster if executed asynchronously on the basis of data availability, technology needed to do that efficiently was not available, until Technology for Integrated Computation and Communication (TICC) came along. This tuning technology eliminates the need for dynamic checking of temporal coordination, and makes it possible to execute control signal exchange protocols in parallel with computations. More than 40 million messages may be exchanged per second. This eliminates communication bottleneck and allows asynchronous execution of parallel programs based on data availability without using MPI. TICC defines the semantics of causal statements and provides a very efficient implementation for them. TICC brings the following additional facilities: (1) Component based parallel program development environment, (2) Dynamic debugging of parallel programs (3) Dynamic monitoring and changing of messages and message traffic, (4) Dynamic repair and failure recovery, (5) Dynamic reconfiguration, and (5) Dynamic evolution parallel software systems. These have the consequent benefit of reducing parallel program development and maintenance costs, making them more easily and widely available.

This, together with decreasing costs of multiprocessors, has the potential to usher in a new era of desktop supercomputing by 2007, with profound impact on science, technology, industry, education, theories of computation and communication, and society in general.

Title: SBIR Phase II: Time-Lapse P- and S-Wave Monitoring of Fluid Flow

Award Number: 0321747
Program Manager: Errol B. Arkilic

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: David Lumley, david.lumley@4thwaveimaging.com
Company: Fourth Wave Imaging Corporation
16A Journey, Suite 200
Aliso Viejo, CA 92656
Phone: (949)916-9787

Abstract:

This Small Business Innovative Research (SBIR) Phase II project concerns the use of time-lapse seismic P-wave and S-wave data simultaneously to obtain seismic monitoring images of fluid-flow saturation and pore pressure in subsurface reservoirs. Time-lapse seismic using P-waves alone may not always produce reliable discrimination between fluid-flow saturation changes and pore pressure changes since this information is contained in the large-reflection- angle portion of the P-wave seismic data, which can easily be contaminated by noise and can be subject to data acquisition aperture limitations. Using S-waves in addition to P-waves in the time-lapse analysis can provide more accurate inversion results, thereby improving the reliability and robustness of fluid-flow saturation and pressure estimates. The critical commercialization research and development issues in this project are: (1) mode-equalization image processing and pre-conditioning of the P-wave and S-wave data sets to make them suitable for simultaneous quantitative inversion and analysis; (2) computation of optimal seismic attributes and robust pressure-saturation inversion of these attributes; (3) testing and bulletproofing these techniques on a real field data set to overcome the inevitable practical data issues; and (4) developing the tools in an interactive GUI-based software package to provide a workflow that facilitates integrated numerical computation and human interpretation.

Commercial applications of proposed research will include accurate mapping of bypassed oil, monitoring of costly injected fluids in hydrocarbon reservoirs and global-warming CO2 sequestration projects. It will have applications in the monitoring of ground water reserves, contaminant plumes and environmental clean-up activities. Medical imaging is another potential market target use of elastic waves as they could yield superior results over acoustic waves alone. Commercial and societal benefits include extending the life of existing oil and gas fields, thus reducing the need for exploration in environmentally sensitive areas and improving the nation's energy security.

Title: SBIR Phase II: Development and Commercialization of a Real-Time Visualization Tool for the Energy Industry

Award Number: 0320525
Program Manager: Errol B. Arkilic

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: Mark Laufenberg, lauf@powerworld.com
Company: PowerWorld Corporation
1816 South Oak Street
Champaign, IL 61820
Phone: (217)384-6330

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new software tool for viewing real-time electrical data for the energy industry. The purpose of this project is to allow an advanced visualization environment to be used with real-time power system data as input. Existing product will be decoupled from off-line power flow cases and generalize the visualization links so that any real-time database can be linked to the visualization objects. The end result will be a software product that will allow any user with secure access to view real-time power system data from any Windows PC with a TCP/IP connection to the Internet.

The market for this product will be all electrical utilities, independent system operators, and regional transmission organizations in the world since they all must have an energy management system (EMS) installed in their control center. EMS systems have the ability to display real-time power system data obtained from meters installed throughout the electrical grid and sent in real-time to the control center. However this data has been essentially trapped in the control center with no way for company employees in other locations to visualize in real time what is happening on the system. Typically a report on real-time system information necessitates a telephone call to an EMS operator. When implemented this system should generate savings for the power companies which in turn will be passed on to the consumer.

Title: SBIR Phase II: Robust, Intelligent and Practical Face Recognition Based on Optical Joint Transform Correlation and Neural Networks

Award Number: 9983308
Program Manager: Juan E. Figueroa

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $399,967

Investigator: Andrew Kostrzewski, akostrzewski@poc.com
Company: Physical Optics Corporation
20600 Gramercy Place, Bldg 100
Torrance, CA 90501
Phone: (310)320-3088

Abstract:

This Small Business Innovation Research Phase II project will enable Physical Optics Corporation (POC) to build a highly robust and adaptive face recognition system called the Opto-electronic Intelligent Face Recognition System (OIFRS). This system will uniquely combine an artificial neural network and an optical joint transform correlator (JTC) to increase invariance to distortion, shift, scale, and facial expression. In Phase I, we conducted a concept feasibility study and demonstration, developing an optical face recognition system. In Phase II, POC will implement a parallel optical JTC to increase processing speed, accommodate a large number of training patterns, and enhance scalability. POC will design, develop, and implement an innovative, adaptive, nonlinear, self-aligned pseudo-phase-conjugate joint Fourier-Fresnel transform correlator, which will make recognition highly invariant to longitudinal translation and tilt of the input face, and to head position.

The proposed innovative OIFRS technology will lead not only to a new robust face recognition system but also to a variety of other security systems with high dual use application potential. OIFRS versatility will benefit not only the national security concerns of DOE, DoD, and other agencies that require highly secure access control, but also commercial access control, and credit card verification.

Title: SBIR Phase II: Knowledge Modeling and Computational Intelligence

Award Number: 9983287
Program Manager: Juan E. Figueroa

Start Date: April 15, 2000
Expires: September 30, 2003
Total Amount: $815,888
Investigator: Richard Saeks, rsaeks@accurate-automation.com
Company: Accurate Automation Corporation
7001 Shallowford Road
Chattanooga, TN 37421
Phone: (423)894-4646

Abstract:

This Small Business Innovation Research Phase II project proposes to design, implement and flight test an adaptive critic based flight control system using both the nonlinear and linear quadratic adaptive critic algorithms developed in Phase I; implement a hardware-in-loop test system for the adaptive critic flight control system; and flight test the adaptive critic flight conotrol system in Accurate Automation's LoFLYTE neurocontrol testbed aircraft.

Title: SBIR Phase II: Statistical Absorption Tomography for Turbulent Flows

Award Number: 0077512
Program Manager: Jean C. Bonney

Start Date: August 15, 2000
Expires : July 31, 2002
Total Amount: $395,322

Investigator: Yudaya Sivathanu, sivathan@enurga.com
Company: En'Urga Inc
1291-A Cumberland Ave
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Phone: (317)463-7288

Abstract:

This Small Business Innovation Research Phase II project involves the development of a commercial optical patternator, based on Statistical Absorption Tomography. The mathematical deconvolution procedure that forms the basis for optical patternation of turbulent flows was developed and evaluated during the Phase I research. Local absorptances, resolved to less than 1/10th of the integral length scale were obtained in a turbulent spray, using the deconvolution algorithm, in conjunction with an optical patternator, suited for constant temperature, axisymmetric flows. During the Phase II, three research issues that affect the commercialization of the optical patternator will be addressed. The three issues that will be addressed during the Phase II research are: (1) obtaining local transmittances in turbulent flows with temperature gradients, (2) obtaining spatially resolved mass flux in turbulent sprays, and (3) obtaining patternation factors for turbulent flows issuing from non-axisymmetric nozzles.

Two broad areas of commercial applications for the optical patternator are for obtaining pattern factors in commercial nozzles and for monitoring smoke stack emissions. The immediate market for the patternator is as an on-line quality control instrument for spray nozzle manufacturers. The estimated annual market size is approximately 150 million dollars

Title: SBIR Phase II: New Oxide Coatings for Protection of Alloys in a High-Temperature Oxidizing Environment

Award Number: 0078234
Program Manager: Sara B. Nerlove

Start Date: July 1, 2000
Expires: June 30, 2003
Total Amount $500,000

Investigator: Dimitri Bevc, dimitri@3dgeo.com
Company: 3DGeo Development, Incorporated
4633 Old Ironsides Dr.
Santa Clara, CA 95054
Phone: (408)450-7840

Abstract:

This Small Business Innovation Research Phase II project from 3DGeo Development Incorporated will develop a software package which utilizes primary and converted-wave energy to accurately and efficiently image gas and oil reservoirs, and to determine rock properties for reservoir evaluation and management. In the recently completed Phase I project, 3DGeo demonstrated the feasibility of imaging with converted waves by analyzing the nature and occurrence of converted waves in synthetic seismic data. Full wavefield modeling and ray tracing in realistic models was used to simulate both towed-cable and ocean-bottom-cable marine data. Both acquisition geometries show important converted-wave events that will be used in Phase II to accurately image reservoirs and estimate rock properties. In addition to the mode converted energy, this project will incorporate two other significant propagation phenomena that commonly occur in geological settings which give rise to converted waves, namely: (1) multiply reflected events [multiples], and (2) transmitted and reflected energy propagating along multiple paths in the subsurface [multi-valued traveltimes]. These two phenomena, coupled with the mode conversions, which are the main focus of this research effort, comprise the greatest challenge to seismic prospecting for oil and gas.

This Phase II project develops a comprehensive and synergistic subsalt imaging solution that exploits the full potential of the seismic wavefield for reservoir imaging and rock property estimation in complex areas. Commercial potential of the proposed technology is directly applicable to subsalt oil and gas exploration in complex areas such as the Gulf of Mexico. US companies will spend $50 billion drilling deep subsalt prospects over the next 5 years, and this project could have a direct and significant impact by developing an accurate and economical reservoir monitoring and imaging technology.

Title: SBIR Phase II: Optical Diffusion Tomography in Frequency Domain by the Elliptic Systems Method

Award Number: 9983523
Program Manager: Jean C. Bonney

Start Date: August 15, 2000
Expires: July 31, 2002
Total Amount: $750,000

Investigator: Jonathon Benson, jlbenson@vnet.net
Company: Medical Optical Imaging Inc
8701 Mallard Creek Road
Charlotte, NC 28262
Phone: (704)548-1090

Abstract:

This Small Business Innovation Research Phase II project builds upon the concepts developed in the Phase I grant to develop a clinical prototype of an optical mammography device that could be used for breast cancer screening or diagnosis. The major technical obstacles to the development of an optical mammography device have been the need for imaging algorithms that are fast and accurate in the presence of scattered light, and for developing measurement techniques that can collect enough photons in a safe and timely way to develop an accurate image. Phase I demonstrated the technical feasibility of a new approach to the algorithms and hardware.

The software objectives of this project involve testing an approach to compute inclusion absorption coefficients, modifying the software to directly locate inclusions without transformation and developing a 3-D and GUI interface. Hardware objectives include developing a clinical prototype that would be safe and appropriate for imaging human subjects and calibrating and testing the hardware/software device on experimental data.

Title: SBIR Phase II: Advanced DSP Toolkit For Java

Award Number:	0078563
Program Manager:	Juan E. Figueroa
Start Date:	September 1, 2000
Expires:	October 31, 2002
Total Amount:	$376,481

Investigator: Andrew Watkins, andrew@mpi-softtech.com
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110 12th Street North
Birmingham, AL 35203
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will contribute mathematical services in signal and image processing for distributed Java computing. A major component of internetworked information is digital images and audio signals. Current vector, signal, and image processing standards are evaluated to achieve advanced signal processing for Java. Phase I emphasized the design, algorithms, and Java relevance. VSIP (vector signal and image processing) constitutes a viable option for commercialization in the distributed Java environment. This Phase II effort seeks to bridge the gap between the theoretical and the commercial for VSIP in Java, while identifying operational modes and service requirements for this non-traditional programming environment.

If successful, a huge community of Java programmers in academia, industry, and government could be enabled, as well as all the service recipients whose applications exploit such as library. Standardization for platform independence is a critical issue for Internet applications. An advanced commercially DSP toolkit would provide for a greater level of portability for signal-processing-intensive Internet applications. This would provide for better support for processing audio/visual information in valuable application settings. Embedded Java applications will make use of the toolkit to provide advanced signal analysis capabilities with mobility, portability, and high quality.

Title: SBIR Phase II: 3D Volumetric Image Display

Award Number: 0078583
Program Manager: Juan E. Figueroa

Start Date: September 1, 2000
Expires: August 31, 2003
Total Amount: $423,999

Investigator: Che-Chih Tsao, actrescorp@aol.com
Company: ACT Research Corporation
16 Walnut Street, Apt. 43
Arlington, MA 02476
Phone: (781)646-3587

Abstract:

This Small Business Innovation Research Phase II project is to develop a new computer peripheral: a Volumetric Image Display system that displays 3D images in a real space. Many viewers can walk around the display and see the 3D images from omni-directions without special glasses. The overall business objectives corresponding to this project are to develop and implement the technologies required for building the VID product, to demonstrate the market viability, and to complete the financial preparation for Phase III. In order to speed up commercialization, a Basic Model product will be completed in year 1. It will feature a flexible configuration and good specifications to address the initial need in various fields. Marketing will then begin in year 2 to test market and seek business alliances, using the Basic Model as a demonstration platform as well as an evaluation product. A low-volume manufacturing procedure will be established to support initial sales. In year 2, techniques that further improve product color and gray scale will be developed and demonstrated.

We already have a Phase III funding commitment. Based on the demonstrated market viability and technical readiness, a new business plan will be prepared to raise additional funding commitments to complete the finance preparation for Phase III. The marketing goals also include obtaining at least one development contract from a major corporation, as part of the Phase III finance. Market analysis indicates great commercial potential in four major segments: medical, computer aided design and engineering, visual data analysis, and computer gaming.

Title: SBIR Phase II: Advanced Question Answering

Award Number: 0215672
Program Manager: Juan E. Figueroa

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $500,000
Investigator: Mihai Surdeanu, mihai@languagecomputer.com
Company: Language Computer Corporation
6222 Misty Trail
Dallas, TX 75248
Phone: (972)490-5420

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is developing an advanced questions answering (QA) system with the use of innovative natural language processing (NLP). The specific areas addressed by this project are: (1) a true open-domain, high precision QA system optimized for commercial deployment; (2) distributed processing that provides an unprecedented QU system response time; and (3) system management and reporting tools for real-time customer feedback.

The final product will provide accurate and short answers to questions asked in plain English. The need for this capability is widespread in companies, government agencies, and among individuals. The users may be casual questioners who ask simple factual questions, consumers who look for specific product features and prices, research analysis that collect market, finance, or business information, or professional information analysts such as law enforcement officials searching for very specific information requiring considerable expertise.

Title: SBIR Phase II: Minimal Sensor Signal Processing for Turbine Engine Health Monitoring

Award Number: 0216021
Program Manager: Juan E. Figueroa

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $500,000

Investigator: Carole A. Teolis, carole@technosci.com
Company: Techno-Sciences, Inc.
10001 Derekwood Lane
Lanham, MD 20706
Phone: (301)577-6000

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop full waveform models and minimal sensor algorithms for the General Dynamics - Advanced Technology Systems (GDATS) eddy current sensor (ECS). These algorithms will enable the practical real-time high performance health monitoring for turbine engines. Current processing techniques could require four or more sensors; however, these approaches do not make use of all the information made available by the ESC. Using the full ECS signature, it is possible, in theory, to estimate integral vibration frequency, phase and amplitude using only a single sensor. The reduction of the number of sensors required in each engine stage could potentially save millions of dollars over the life of the engine.

There are no systems commercially available today for continuous health monitoring of gas turbine engines. Once in use, this system will allow pilots to react immediately to critical engine health problems thus avoiding potentially catastrophic engine failures and loss of lives. The minimal sensor algorithms for continuous health monitoring have a large market spanning the aviation industry, as well as the rapidly expanding power industry.

Title: STTR Phase II: Automation of the Crosscut Operation in a Wood Processing Mill

Award Number: 0321635
Program Manager: Juan E. Figueroa

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $500,000

Investigator: Alexander Mullin, smullin@barr-mullin.com
Company: Barr-Mullin Inc.
2506 Yonkers Rd.
Raleigh, NC 27604-2241
Phone: (919)832-2848

Abstract:

This Small Business Technology Transfer (STTR) Phase II project is to design and develop a fully automated system for crosscutting planks of lumber into parts with specific length and surface characteristic requirements. This system consists of a scanning device with four heads to scan the four surfaces of each incoming plank, a mathematical programming model and a software system to determine an optimal cutting pattern for each plank, and all necessary mechanisms to interface with (and to coordinate the operation of) various components of the manufacturing line. These components include the transport devices such as conveyor belts, the positioning devices, the saw mechanism, and the subsequent cut-piece sorter. Installation of an automated system would result in both higher speed and higher yields. The project will also extend the scope of this mathematical model, in combination with the models for the gang-rip saw operation, to create a combined system for ripping and crosscutting.

The software system developed under this research grant will have an impact on the efficiency of the crosscut operation, by increasing both its speed and its yield. This in turn could lead to substantial reductions in the manufacturing cost as well as to significant savings in the overall consumption of wood, which is a scarce national resource. This project supports the educational development of one graduate student at NC State University.

Title: SBIR Phase II: Robotic Systems for Network Interrogation of Smart Civil Structures

Award Number: 0110217
Program Manager: Juan E. Figueroa

Start Date: September 1, 2001
Expires: August 31, 2004
Total Amount: $499,906

Investigator: Steven W. Arms, swarms@microstrain.com
Company: MicroStrain Inc
310 Hurricane Lane
Williston, VT 05495
Phone: (802)862-6629

Abstract:

This Small Business Innovation Research (SBIR) Phase II, project is aimed at the continued development and field testing of an autonomous robotic structural inspection system capable of remote powering and data collection from a network of embedded sensing nodes with remote data access via the internet. The system will utilize existing microminiature, multichannel, wireless, programmable Addressable Sensing Modules (ASM's) to sample data from a variety of sensors. These inductively powered nodes do not require batteries or interconnecting wires, which greatly enhances reliability and reduces installation cost. Networks of sensing nodes can be embedded, interrogated, and remotely accessed in applications where visual inspection by people is not practical due to: physical space constraints, remote geographic locations, high inspection costs, and high risks involved for those performing the inspections.

The sensors can indicate the need for repair, replacement, or reinforcement, which will reduce the risk of catastrophic failure and will be useful after natural disasters, such as earthquakes, hurricanes, tornadoes, and floods.

Title: SBIR Phase II: Imaging Subsurface Fluid Flow with Time-Lapse Seismic Data

Award Number: 0091452
Program Manager: Sara B. Nerlove

Start Date: March 1, 2001
Expires: February 28, 2003
Total Amount: $493,450

Investigator: David E. Lumley, david.lumley@4thwaveimaging.com
Company: Fourth Wave Imaging
16A Journey, Suite 200
Aliso Viejo, CA 92656
Phone: (949)916-9787

Abstract:

This Small Business Innovation Research (SBIR) Phase II project concerns the development and implementation of seismic imaging and inversion methods and parallel computer algorithms to estimate subsurface fluid-flow properties from time-lapse seismic data. In recent years, there has been exponential growth in time-lapse seismology project activity. These projects have yielded seismic difference anomalies that result from monitoring time-variant changes in the earth's subsurface related to fluid flow. However, such anomalies are often qualitative and ambiguous--what causes the anomalies, and what do they mean? The proposed Phase II research will develop the capability of making quantitative estimates of the 3D distribution of subsurface fluid pressure and fluid saturation changes that cause the seismic anomalies, using wave-equation seismic imaging and inversion techniques, coupled with rock physics analysis. The research consists of three parts: optimized parallel software and computational design, amplitude preserved seismic imaging and impedance inversion, and robust rock physics inversion to estimate pressure and saturation. The software and services generated by this Phase II research will be invaluable to help guide new wells and optimize reservoir management decisions in the 70+ oilfields world-wide that are being actively monitored with time-lapse seismic data.

Near-term commercial applications of the proposed research include petroleum industry mapping and monitoring of commercial oil reserves, monitoring of costly injected fluids (water, steam, CO_2, miscible gas), and imaging pressure compartmentalization and the leaking or sealing properties of faults and fractures. Non-petroleum applications may include monitoring groundwater reserves, near-surface monitoring of contaminant plumes and environmental clean-up projects. Potential far-market applications may include sub-sea acoustic imaging, synthetic aperture radar satellite imaging, and medical imaging.

Title: SBIR Phase II: Internet Based Remote Seismic Depth Imaging

Award Number: 0091447
Program Manager: Sara B. Nerlove

Start Date: February 1, 2001
Expires: January 31, 2004
Total Amount: $500,000

Investigator: Dimitri Bevc, dimitri@3dgeo.com
Company: 3DGeo Development, Inc
465 Fairchild Drive, Suite 226
Mountain View, CA 94043-2251
Phone: (415)969-3886

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a seismic processing system that enables the delivery of leading-edge seismic services over the Internet and Intranets. Internet-based seismic processing (INSP) enables exploration companies to directly control their critical seismic imaging projects, without the need of purchasing and maintaining expensive hardware and software. INSP is a complete processing system that includes a client-based Java GUI, and server-based processing and database modules. The computationally intensive modules run on shared-memory parallel computers and Linux clusters. Phase I implemented the essential functionalities for a useful product, demonstrated concept feasibility, and laid the groundwork for the Phase II project. Phase II will add functionality to the product, and implement all security and data management aspects necessary for Internet deployment.

INSP ushers in a paradigm shift for the upstream oil and gas industry. Commercial potential is significant because INSP makes digital information and compute-intensive technology accessible to a large client base that wishes to outsource its non-core competencies to an application service provider, while maintaining control of projects. INSP greatly increases interaction between the client and contractor, thereby increasing the quality of the final seismic image, and reducing exploration and development cost.

Title: SBIR Phase II: Design of a True Three Dimensional (3-D) Information Display System

Award Number: 0110266
Program Manager: Juan E. Figueroa

Start Date: December 1, 2001
Expires: November 30, 2003
Total Amount: $491,525

Investigator: Soma Chakrabarti, schakrabarti@biocomp-systems.com
Company: BioComp
2429 Via Linda Drive
Lawrence, KS 66047
Phone: (785)841-6835

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes the development of a low-cost desktop true three dimensional (3-D) information display system suitable for commercialization during Phase III. The proposed video monitor will provide highly realistic static and dynamic 3-D images by presenting information over a volumetric space, rather than a conventional planar space. As a result, the displayed information neither suffers from the loss of actual depth information as in a conventional monitor, nor requires the use of specially designed eyeglasses needed for stereovision systems. Fullcolor true 3-D views will be generated by projecting plane-by-plane image slices onto a projection screen that moves backward and forward in synchronization with the information generated on a CRT screen. By accessing these planes-of-view 30 times per second, flicker-free true 3-D views are generated over a volumetric space that are viewable from multiple angles. The anticipated low cost of this practical system should make it affordable for personal use since it will be designed primarily with commercially available system components, aided by novel digital imaging techniques and software approaches.

Thus, the proposed system is expected to find many diverse applications ranging from scientific and industrial visualization to entertainment. Some of the initial applications include biomedical image processing, scientific visualization, protein structure determination, general-purpose 3-D computer graphics, radar imaging, battlefield management, and aircraft design.

Title: SBIR Phase II: An Intelligent Three-Dimensional (3D) Mosaic Tool for Multiple 3D Images Integration

Award Number: 0091359
Program Manager: Juan E. Figueroa

Start Date: April 1, 2001
Expires: March 31, 2004
Total Amount: $500,000

Investigator: Ping Zhuang, geng@genextech.com
Company: Genex Technologies, Incorp
10605 Concord Street, Suite 500
Kensington, MD 20895-2504
Phone: (301)962-6565

Abstract:

This Small Business Innovative Research (SBIR) program investigates a novel software tool for integrating multiple 3D images. Three-dimensional (3D) modeling of physical objects and environment is an essential part of the challenges for many multimedia tasks. However, most physical objects self occlude, and no single view 3D image suffices to describe the entire surface of a 3D object. Multiple 3D images of the same object or scene from various viewpoints have to be taken and integrated in order to obtain a complete 3D model of the 3D object or scene. This process is called the "3D mosaic". The primary objective of this SBIR effort is to develop a fully automatic and intelligent software tool that is able to mosaic (i.e., align and merge) multiple 3D images of the same object taken from different viewpoints, without a priori knowledge of camera positions. The main innovations of this proposed effort are threefold: (1) an intelligent alignment method that is able to register multiple un-calibrated 3D images without needing any priori knowledge of camera location and orientation; (2) a seamless merge method to "stitch" together the aligned 3D images using the fuzzy logic principle; and (3) an intelligent 3D image compression algorithm that preserves 3D image geometric features while achieving high compression ratio.

The 3D Mosaic technique to be developed under this SBIR program has enormous commercial applications including industrial design and prototyping, reverse engineering, manufacturing part inspection, part replacement and repair, animation, entertainment, 3D modeling for WWW documents, archiving, virtual reality environment, education, virtual museum, commercial on-line catalogues, etc. It will become an important part of future 3D TV technology.

Title: SBIR Phase II: A Programming Environment to Enable Engineers to Program Distributed Measurement and Control Networks

Award Number: 0216240
Program Manager: Juan E. Figueroa

Start Date: October 1, 2002
Expires: September 30, 2004
Total Amount: $499,170
Investigator: Thomas D. Sharp, tsharp@sdltd.com
Company: Sheet Dynamics, Ltd.
1776 Mentor Avenue, Suite 170
Cincinnati, OH 45212-3571
Phone: (513)631-0579

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a high level graphical programming environment for distributed measurement and control networks used in industry. Using this environment, an industrial control engineer will be able to describe the desired behavior of his/her system at a high level of abstraction (e.g. 'control motor speed', 'monitor bearing', 'monitor pump') and then "click a button" for the executable distributed application to be generated. In addition, the engineer will be able to monitor the behavior of the executing system at the graphical level to help identify problems. This system will automatically partition the graphical description into components targeted at specific processors on the network based upon the resources required by the algorithm. This functionality will greatly benefit the industrial control engineer, who will be able to focus on algorithm and application development rather than details of hardware and networking realizations.

As the commercial potential of distributed approaches are becoming more prevalent in industrial applications, the potential of this software system will grow at a fast rate. For example, 15 network controllers instead of one now manage a Proctor & Gamble diaper manufacturing line. Currently the market for distributed measurement and control is fragmented, with over 60 proprietary process network standards in use. The advent of the IEEE 1451 smart transducer standard creates a huge market opportunity by providing a portable application model that enables development tools, such as those being developed in this project, to be used with the multitude of existing commercial process busses.

Title: SBIR Phase II: An Aspect-Oriented Solution for Unit Test Generation

Award Number: 0238697
Program Manager: Juan E. Figueroa

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $498,243
Investigator: Paul Anderson, Paul@grammatech.com
Company: GrammaTech
317 North Aurora Street
Ithaca, NY 14850-2073
Phone: (607)273-7340

Abstract:

This Small Business Innovation Research Phase II project aims to make it much easier to create unit-level regression tests for Java programs. Their benefits are clear, but existing techniques for creating them are flawed because they are difficult to apply to existing code, and tool support requires modification of the target code. The innovation is to instrument a gold-standard version of the module of interest so that when a client application executes, all events that cross the boundary to the module are intercepted and logged to a file. Later, after the unit has been modified or extended, and without any further need for the client application, the events can be reconstructed and fed to the unit. The results are checked for consistency with the log, and discrepancies flagged as faults. This makes it much easier for a user to create a test suite for a module. The approach is made feasible by using Aspect-Oriented Programming, and object mocking. The research challenges are: how to devise techniques for tolerating permitted changes in the target module, and how to reduce the chances of a single failure triggering a profusion of cascading failures. The use of advanced static analysis techniques, including dependence analysis, is the key to solving these problems.

If successful, this system will help software development organizations reduce the cost of development and maintenance of their software assets while at the same time increasing its quality. It will help increase assurance of safety-critical software, such as in medical equipment, or flight-control systems, thus reducing the risk of damage to property and loss of life.

Title: SBIR Phase II: Video Mining for Customer Behavior in Retail Enterprises

Award Number: 0548734
Program Manager: Errol Arkilic

Start Date: May 26, 2006
Expires: May 31, 2008
Total Amount: $500,000
Investigator: Satish Mummareddy, smummareddy@videomining.com
Company: VideoMining Corporation
403 South Allen St Suite 101
State College, PA 16801
Phone: (814)867-8977

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at developing video mining techniques for automatically generating statistics about in-store shopping behavior to help retail enterprises. These statistics can provide valuable insights for supporting critical decisions in store layout design, merchandising, marketing, and customer service. Further, since it is automated, video mining can become a tool for monitoring the impact of all customer-facing elements in a store. The Phase II research will continue in cooperation with the proposing company's partners and customers, while addressing the remaining challenges for video mining. The proposed tasks include robust person detection, tracking people across multiple cameras, modeling and recognizing complex shopping behavior involving shopping groups and sales associates. The approach will be to use a variety of computer vision and statistical learning techniques under the constraints of a typical retail environment.

Retail enterprises today operate in a hyper-competitive environment characterized by blurring categories, eroding market shares and fickle, but more demanding customers. These challenges have prompted retailers to adopt customer-centered strategies focused on uncovering and matching the needs of customers to gain (retain) market share. These strategies rely heavily on obtaining deeper insights into shopper behavior. Current methods (human observation and manual video indexing) for analyzing shopper behavior are limited in their scope while being expensive and time-consuming. On the contrary, the shopper insights gained from the proposed video mining platform will enable more informed decision-making leading to improvements in retail productivity and business process optimization. The proposing company has plans to immediately incorporate the outcome of the SBIR research into its retail product line.

Title: SBIR Phase II: THz Imaging Focal Plane Array

Award Number: 0548853
Program Manager: Errol Arkilic

Start Date: March 6, 2006
Expires: February 29, 2008
Total Amount: $464,344
Investigator: Oliver Edwards, oliver@zyberwear.com
Company: Zyberwear
2114 Victor Rd
Ocoee, FL 34761
Phone: (407)295 5955

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to develop a high-resolution focal plane array for terahertz imagery. THz radiation is a largely unexplored region of the spectrum, but holds great promise for its ability to pass through clothing, packaging and baggage walls (security applications) and for its ability to excite resonant molecular motions according to the composition and conformation of complex molecules such as explosives, illegal drugs and pharmaceuticals (imaging spectroscopy). Present uncooled detector technology is marginal in its ability to sense THz radiation and in video frame rate.

The anticipated results of this work are to demonstrate: (1) a 20 to 40 times improvement in noise-limited radiation detection at operation up to 250 Hz frame rate; (2) a new technique for very low cost manufacture of all-wavelength focal plane arrays; and (3) a high-performance THz focal plane array.

Title: SBIR Phase II: Fast Remote X-ray Screening

Award Number: 0620369
Program Manager: Errol Arkilic

Start Date: September 7, 2006
Expires: August 31, 2008
Total Amount: $500,000
Investigator: Edward Sommer, ejsommer@nrt-inc.com
Company: National Recovery Tech Inc
566 Mainstream Dr. Suite 300
Nashville, TN 37228
Phone: (615)734-6400

Abstract:

This SBIR Phase II project will provide development of a new homeland security technology for improving security for crowded venues by integrating a new networked security screening technology and new electronics communications with materials handling automation and computerized process control. New approaches and technologies are needed to provide effective security screening for places having high passenger and high pedestrian traffic. A primary need is to be able to screen persons and their carried items at significantly higher processing rates from those achieved using conventional security checkpoints while maintaining a smooth flow of people through the system. The Phase I project demonstrated technical feasibility. Phase II will complete development of the new high flow security screening system and design, construct, and test a near commercial scale prototype system. It is planned that the prototype system will be tested and evaluated by a TSA-approved, independent third party. Upon successful testing the system will be ready for deployment.

The U.S. transportation industry needs fast effective improvements in its security systems. Improved security technologies for use in transit systems can be applied to many other segments of society as well. In today's world it is vital that our nation's citizenry, transportation systems, institutions, and economy have the best protection possible from those who seek to weaken and destroy our society. The proposed technology will provide smooth flow of people and items through a fast and effective security inspection station with greater than an order of magnitude increase in processing rates compared to current technologies. The new technology will provide a significantly higher level of protection to persons in busy and crowded areas against attacks by terrorists using weapons or explosives than is currently available. Similarly, security at federal buildings, government installations, maritime ports, shippers, mailrooms, and other sensitive locations can be improved by the proposed technology that will allow for a faster and less impeded flow of persons and packages through the security inspection process.

Title: SBIR Phase II: T-Splines for Surface Intersection

Award Number: 0620461
Program Manager: Errol Arkilic

Start Date: August 4, 2006
Expires: July 31, 2008
Total Amount: $499,111

Investigator: David Cardon, tspline@byu.edu
Company: T-Spline Company
331 North 1100 East
Orem, UT 84097
Phone: (801)592-0263

Abstract:

This SBIR Phase II project addresses what is considered to be a significant unsolved problem in the Computer-Aided Design (CAD) industry; the fact that many CAD models contain numerous small, unwanted holes or gaps. These gaps occur most often along the seams where two surfaces in a CAD model meet, such as where a wing meets the fuselage of an airplane, and result from fundamental mathematical limitations. Software for analyzing a CAD model for physical properties such as aerodynamics, deflection, or stress cannot work unless those holes are repaired; a time consuming process that causes a significant bottleneck in the CAD workflow. Under Phase I funding, a solution to this gap problem was devised that uses a new surface formulation called T-Splines. Tasks to be performed in Phase II include extending the algorithms to work in arbitrary cases, designing and implementing algorithms for converting trimmed-NURBS models into gap-free T-Splines, adding fillets to the surface intersection, and incorporating the core software into two existing CAD packages using the idea of a "plugin."

The gap problem has vexed the CAD industry for over 25 years. The solution to the gap problem conceived in previous efforts involves a new technology called T-Splines, which some researchers in the CAD community believe represents a significant advance in the field of surface modeling theory. This project will help the T-Splines technology to mature and will hasten its adoption into the CAD industry.

Title: SBIR Phase II: CLEAR-View - A Cost Effective Thermal Imaging Sensor

Award Number: 0724500
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,991

Investigator: Kamil Agi, kagi@ka-wireless.com
Company: K&A Wireless, LLC
2617 Juan Tabo Blbd NE Ste A
Albuquerque, NM 87112
Phone: (505)338-2380

Abstract:

This Small Business Innovative Research (SBIR) Phase II project aims to develop and produce a novel suite of algorithms to enhance the performance of thermal imagers, offering real-time solutions in the automotive, surveillance and other segments of the thermal imaging market. The proposed algorithm is integrated with noise-infested, uncooled microbolometer infrared cameras, elevating their performance and offering manufacturing-cost reductions while adding new features and capabilities. At the heart of the approach is a Scene-Based NonUniformity Correction (SBNUC) algorithm, which works to correct the fixed-pattern noise resulting from nonuniform detector-to-detector responses in the focal-pane array. The novel SBNUC approach relies on exploiting the presence of minute amounts of scene/camera motion in a video sequence, naturally present in almost all applications, to algebraically extract the nonuniformity-noise parameters in a dynamic fashion, without the need for a mechanical shutter, as done conventionally. This approach improves the camera's reliability.

If successfully commercialized, the largest market is in the automotive sector, where the lower cost and improved performance of the device can potentially lead to tens of millions of dollars from new installs of collision-avoidance systems in cars and trucks. The enhanced features and lower costs offered by this technology also offer the potential of expanding the use of thermal imaging in other applications. In the firefighting market segment, equipping every firefighter with a thermal imager will reduce the number of fatalities due to smoke inhalation, heat, and response efficiency. In security applications, more information will be delivered at a higher level of quality.

Database Management

Title: SBIR Phase II: Organized Search Results with Document Clustering

Award Number: 0131966
Program Manager: Juan E. Figueroa

Start Date: February 1, 2002
Expires: January 31, 2004
Total Amount: $499,905

Investigator: Raul Valdes-Perez, valdes@cs.cmu.edu
Company: Vivisimo, Inc.
2435 Beechwood Blvd.
Pittsburgh, PA, PA 15217-2722
Phone: (412)422-2496

Abstract:

This Small Business Innovation Research Phase II project will produce advances in document clustering technology. The company's proprietary software transforms a long list of raw search results into organized hierarchical folders that are browsed in Windows Explorer style. This software brings into easy view relevant information that otherwise would remain buried in the search results. It also enables effortless knowledge discovery: at a glance, a user learns the main subtopics corresponding to the query. The company has the first document clustering technology good enough for mass use, in terms of speed, quality of the clustering, and ease of interaction.

The resultant software product will augment the capabilities of web, enterprise, and database search engines. The market will include search engine vendors, system integrators and large organizations in business, academe, and government.

Title: SBIR Phase II: The Visual Database: Portable, Extensive Markup Language (XML)-Based Middleware For Media Representation, Interaction and Exchange

Award Number: 0450513
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $470,500

Investigator: William Schroeder, will.schroeder@kitware.com
Company: Kitware Inc
28 Corporate Dr # 204
Clifton Park NY, 12065
Phone: (518)371-3971

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will create a portable representational and interaction metaphor for digital media embedded in a 3D context. Popular document technologies remain text oriented-that is, content is organized into pages and viewed in reading order. The company is creating a novel information exchange paradigm that is generally applicable to information that is best understood in an interactive 3D environment. Applications of this technology include embedded routes on maps, electronic medical records, biological atlases, digital tours of 3D environments such as buildings, and mechanical assembly/disassembly diagrams. Analogous to a PDF file, but designed for a 3D interaction environment, the proposed solution defines an open, portable schema that can be efficiently represented using the portable Extensible Markup Language XML. In Phase II the company will specialize the editor for geospatial application, atlas creation, and assembly planning; addressing such technical challenges as large data and user interaction.

If successful the technology will enhance the ability of researchers, teachers, businesses, and consumers to record, describe and exchange complex 3D content. This innovation has the potential to improve the productivity of individuals and firms that create and communicate with such information; and to enhance the effectiveness of researchers and teachers to convey abstract concepts to others. This project defines a novel metaphor for working with information that goes beyond traditional organizational metaphors such as books and web pages. The proposed product supports complex 3D information; and takes advantage of recent developments in 3D graphics and visualization technology. The representational schema is simple enough to be supported by small portable devices such as PDA's, and sophisticated enough to support complex human/computer interaction in a 3D visualization environment.

Title: STTR Phase II: Location-Based PDA Bird Field Guide

Award Number: 0422158
Program Manager: Juan E. Figueroa

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,386
Investigator: Giles Timms, giles@pulluin.com
Company: South Dakota Health Technology Innovations, Inc.
109 Austin St.
Vermillion, SD 57069
Phone: (605)624-9792

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and test an electronic field guide for North America that will facilitate bird identification in the field combining images, audio, geographic information, and descriptive data. The system will include 1000 birds of North America, uniquely presented audio content, expanded GIS features, support for Windows CE devices, and the wireless transfer of data. The highlights of this software are the mobility offered by the PDA, database searches to aid species identification, access to multimedia and GIS data in the field. The proposed software will provide significant benefits to the education and research communities by allowing multiple PDA users to upload their observations to CLOs (Cornell Lab of Ornithology) eBird server (www.ebird.org) via desktop software or wireless Internet connection.

The availability of PDA-based software for use by students will facilitate student learning and enable students to play a key role in data collection for national and international research projects. The availability of this software to birders and amateur naturalist will promote citizen participation in science and conservation. The data collection and GPS features of the system will help researchers to accurately record scientifically useful data. The portable data collection and data transfer features will facilitate the gathering of data and timely reporting of that data to researchers

Title: SBIR Phase II: Automatic Information Awareness

Award Number:	0349724
Program Manager:	Sara B. Nerlove
Start Date:	January 15, 2004
Expires:	December 31, 2005
Total Amount:	$499,560

Investigator: Yves Schabes, schabes@teragram.com
Company: Teragram Corporation
236 Huntington Ave
Boston, MA 02115
Phone: (617)369-0100

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to study and implement a large-scale information awareness system which will fuse, present and provide an alert as to the existence of newly available information from large bodies of documents based on each user's profile. The amount of information available electronically has been growing at such a rate that it is not only impossible for people to identify the nature of the information content as it is made available, but it is even more out of the question for people to absorb the actual information content. Thus, awareness of and synthesis of the content of information has now become the real challenge. This project will enable users to specify their interests and to detect new information trends matching each individual user's interests, based on the relevance and importance of newly available information. By extracting information from unstructured texts, categorizing it, and fusing it, each user will be presented with a unique view of the content.

Teragram profiler technology allows users to specify information needs for the future. It will provide an alert mechanism based on user specified interests contained in user profiles, measurement and formulation of information speed, volume, decay; and fusion of information found in multiple documents. Such techniques will enable the next generations of information retrieval systems in which information will be tailored to the users' interests thus enabling easy access to relevant information found in large repositories.

Title: SBIR Phase II: Discovery Analyst: A Data Mining System for Image Databases

Award Number: 0349736
Program Manager: Juan E. Figueroa

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $500,000
Investigator: Stuart Blundell, sblundell@vls-inc.com
Company: Visual Learning Systems, Inc.
1280 S. 3rd Street West
Missoula, MT 59801
Phone: (406)829-1384

Abstract:

This Small Business Innovation Research Program Phase II project will develop a highly innovative data mining software tool that is capable of mining imagery and spatial information stored in a database management system (DBMS). Billions of dollars have been spent in converting the world's vast supply of paper maps into digital, geographically referenced, data for geographic information systems (GIS) applications because location matters in almost every instance of decision-making for both government agencies and private sector businesses. The proliferation of relational, spatial, and now visual data from high-resolution satellites, all stored in a common DBMS architecture, offers organizations the opportunity for knowledge discovery in databases; however, the technical challenges of maintaining, navigating, and mining these data are formidable. Current workflow approaches are disjointed and exclusive of image data. The product resulting from this project will allow all of the data to be queried and mined in a holistic workflow approach yielding potential useful discoveries through its primary innovations not presently available in data mining software; 1) Seamless integration of data mining and feature extraction workflows, 2) Mining content of high-resolution earth imagery stored in spatial databases, 3) Cleanup of GIS databases, and 4) Advanced query generation and data mining technology. Market research confirms that companies are investing in data mining software and high- resolution commercial satellite imagery.

The proposed product will have commercial applications in both traditional GIS application areas (forestry, defense, civil government, agriculture) and emerging vertical markets for GIS applications (banking and financial, telecommunications, security, manufacturing, retail and healthcare. There is a powerful demand for the knowledge acquisition vital to all location-based government decision-making processes. This significantly impacts the quality of management in our national security, resource handling, and the quality of our environment.

Title: SBIR Phase II: HIVbase, Data Integration Software to Support the Study of Chronic Viruses

Award Number: 0349669
Program Manager: Errol B. Arkilic

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $499,812
Investigator: Susanna Lamers, susanna@genejohnson.net
Company: Gene Johnson, Inc.
4 Milton St.
St. Augustine, FL 32084
Phone: (985)493-3487

Abstract:

This Small Business Innovation Research Phase II project will provide HIV researchers with progressive approaches to manage and analyze genetic data. There is a crisis developing in biology, in that completely unstructured information does not enhance understanding. Today's HIV investigators possess massive amounts of research information in user-hostile formats, error- filled spreadsheets, outdated databases, and directories containing thousands of individual files. These researchers need advanced protocols for extracting value from their disorganized information. Phase I feasibility study proved that the proposed solution provides a quality link between collection and the analysis of data that has never before been available to HIV researchers. This link helps HIV researchers do their job and ultimately promotes understanding for the most deadly and costly epidemic of our time. This project aims to solving researchers problems through the development of software that combines the power of unique data storage and integration with novel applications for data mining, analysis, and data retrieval. The goal is to provide researchers with a combination of modern querying, database, and analysis approaches.

The initial target market for the proposed product is made of HIV researchers and their associated facilities. This market is large, growing in multiple directions, and in need of this product. HIV infects an estimated 40 million people and is being funded at record levels from both government and private organizations. The major significance of the proposed product is in its ability to assist accelerate the efforts of the many scientists, epidemiologists and pharmacologists to make important discoveries relating to this on-going and tragic epidemic

Title: SBIR Phase II: Web-Based International Trade Knowledge Discovery System (TradingCube)

Award Number: 0349464
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $499,895
Investigator: Carlos Sanchez, csanchez@tradingcube.com
Company: TradingCube Inc.
819 Florida Avenue
Pittsburgh, PA 15228
Phone: (412)624-2690

Abstract:

This Small Business Innovation Research Program Phase II project will focus on applied research for the development and implementation of a commercial Web-Based International Trade Knowledge Discovery System. It will address the significant need for organizations supporting international trade and for small and medium-sized business to have improved access to information and dynamic analyses of world markets in a single source. This product will provide subscribers with dynamic analyses of world markets for baskets of goods allowing them to extract actionable information to make strategic and tactical decisions while enabling the functionality of a novel combination of tools including knowledge discovery, data management technologies, web technologies, international trade economics and strategic analysis. This project will focus on: (1) Implementing a prototype based on the results of the Phase I feasibility study within a web portal framework, (2) Developing a library of international trade analyses, interactive maps and graphics, (3) Developing a meta-business directory and implement an international trade search engine, and (4) Developing personalization features and snapshot reports.

The proposed product will contribute to applications of knowledge discovery in the international trade domain, data warehousing, information hierarchies, and clustering-indexing techniques to support analytical queries. In addition it advances research in the application of Scalable Vector Graphics (SVG). SVG is a language for describing two-dimensional dynamic and interactive graphics in XML. The product addresses one of the fundamental areas on which trade promotion can have a significant impact --access to actionable information that will help businesses maximize export potential. In the process it will contribute to economic growth, education and participation of small businesses and underrepresented groups in international trade. The development process and product will involve researchers and students from several disciplines. The potential market includes any commercial, private or public organization with the need to find and evaluate international trade opportunities.

Title: SBIR Phase II: Bootstrap Tilting Inference and Large Data Sets

Award Number: 0078706
Program Manager: Juan E. Figueroa

Start Date: December 1, 2000
Expires: November 30, 2003
Total Amount: $487,103

Investigator: Tim Hesterberg, TimH@insightful.com
Company: Insightful Corporation
1700 Westlake Avenue N Ste 500
Seattle, WA 98109
Phone: (206)283-8802

Abstract:

This Small Business Innovation Research Phase II project is for development of fast bootstrap confidence intervals and hypothesis tests, and ways to make bootstrapping feasible for large data sets. Classical inference (intervals and tests) methods are known to be inaccurate when theoretical assumptions are violated, the usual case in practice. For example, skewness causes the usual t-test to be in error. The new methods are an order of magnitude (power of sqrt(n), where n is the sample size) more accurate in general than classical inferences. Bootstrap methods are a promising alternative to classical inferences, and can handle complex statistics including modern robust statistics, but are slow and have been little used in practice.

The methods proposed are typically 17--37 times faster than other bootstrap methods. The methods are fast enough to be seamlessly incorporated into standard software, alongside or instead of classical inferences. This provides statistical practitioners a realistic alternative to easy but inaccurate classical inferences and non-robust methods. The competitive advantage to the firm that does this first is a major opportunity. Furthermore, the large sample methods would be attractive in the thriving data mining market.

Title: SBIR Phase II: Automating Workflow In Agriculture - Integrated Pest Monitoring System for On-Time and Online Decision Making

Award Number: 0132164
Program Manager: Juan E. Figueroa

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $499,700

Investigator: Agenor Mafra-Neto, president@iscatech.com
Company: ISCA Tech
1660 Chicago Ave., Suite M-2
Riverside, CA 92507-2052
Phone: (909)686-5008

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will proceed with the development of a fully automated and integrated pest management (IPM) system. The goal of IPM is to minimize reliance on pesticides by emphasizing the moment-to-moment knowledge of the field situation to dynamically make decisions and deliver timely, targeted actions. Current IPM programs use data collection technologies from early 1900s, thus lacking speed and integration necessary to generate reports required by decision-makers who need to act quickly. With the Phase II development of a robust centralized Internet hub housing expert systems for automated data analysis, reporting (with GIS) and quick distribution of information, the benefits to agriculture will be unsurpassed.

The company targets its suite of field data management and decision-making tools the pest management market.

Title: SBIR Phase II: A New Digital Video Surveillance System

Award Number: 0131228
Program Manager: Juan E. Figueroa

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $500,000
Investigator: Jun Zhang, junzhang@csd.uwm.edu
Company: JunTech, Inc.
2027 E. Newton Ave.
Shorewood, WI 53211
Phone: (414)332-8349

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a digital video surveillance system prototype. Over the past few years, video surveillance systems have been moving from analog to digital. The success of a digital video surveillance system depends on three key enabling technologies: compression, search and retrieval and network transmission. Existing commercial systems generally use standard video compression techniques, which often result in higher memory and bandwidth requirements and jerky object motion. In current video search and retrieval, the existing systems offer only search-by-time and no search-by-content. In network transmission, today's systems use relatively simple techniques that tend to make remote monitoring slow and sluggish. The company is using a highly efficient compression algorithm that exploits the special characteristics of surveillance video and is based on a segmentation technique. This technique, when applied to video search and retrieval, leads to search-by-content, which is more efficient and effective in practical applications. Finally the proposed system will employ fast network transport protocols and scalability techniques to make remote monitoring faster, uninterrupted by network traffic surges, and to allow display on a range of user devices.

This digital video surveillance system can be used to maintain the security of banks, airports, government buildings, corporate sites, homes, and small businesses. It can also be used to monitor the performance and operating conditions of machines and equipment.

Title: SBIR Phase II: A Machine Learning Approach to Approximate Record Matching

Award Number: 0216213
Program Manager: Juan E. Figueroa

Start Date: July 15, 2002
Expires: June 30, 2004
Total Amount: $499,764

Investigator: Andrew Borthwick, Andrew.Borthwick@choicemaker.com
Company: ChoiceMaker Technologies
41 East 11th St., 11th Floor
New York, NY 10003
Phone: (212)905-6031

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enhance the company's approximate record-matching software, the Maximum Entropy De-Duper, MEDD(TM) by: 1) Enhancing MEDD's performance using advanced standardization tools to convert data, such as names and addresses, into standard formats; 2) Expanding MEDD's market by matching business names not only person names; 3) Internationalizing MEDD to support Canadian French or Mexican Spanish; 4) Benchmarking MEDD against the competition and developing a methodology to objectively compare matching systems; 5) Reducing MEDD's reliance on training data to ease deployment; producing the best possible "untrained" models that will adapt and improve through client use; 6) Applying the latest advances in machine learning technology to the record-matching problem to increase competitive advantage; and 7) Speeding MEDD word blocking with a fast, innovative memory-resident data-store.

MEDD's market includes all business and government entities that store mission-critical information in large databases. The project will yield societal benefits for public health, anti-terrorist efforts, epidemiological research, the U.S. Census, and the data quality of records relating to racial and ethnic minorities.

Title: SBIR Phase II: Universal Nanoparticle Taggants

Award Number: 0548756
Program Manager: Errol Arkilic

Start Date: February 16, 2006
Expires: February 29, 2008
Total Amount: $511,495
Investigator: Robert Haushalter, bob@parallel-synthesis.com
Company: Parallel Synthesis Technologies, Inc
3054 Lawerence Expy
Santa Clara, CA 95051
Phone: (408)749-8308

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will provide a system that is capable of easily labeling documents, with millions of unique optical signatures that provide a means of distinguishing these documents from other similar objects. Since there are no suitable commercial alternatives, both a scanning spectrometer and hyperspectral imaging system will be constructed and evaluated. The compatibility of developed materials with current screening technology, and the large number of distinct resolvable optical codes available, provides a level of authentication that will be difficult to replicate or decrypt.

Since there is a strong and continuing need to authenticate and verify documents, objects or people, the benefits of this technology will be broad-based and will influence authentication, sorting and identification of many items such as documents, pharmaceuticals or biological samples. The commercially available multiplexing level (number of distinguishable optical signatures) for optical encoding technology is currently limited to 100, so there is immediate need for a technology to provide a means of optically distinguishing very large numbers of similar objects.

Data Storage

Title: SBIR Phase II: Holographic Disk Data Storage on a New Photochromic Glass

Award Number: 0091591
Program Manager: Juan E. Figueroa

Start Date: March 1, 2001
Expires: February 29, 2004
Total Amount: $499,999

Investigator: Ralph DeMasi, newspan@nsotech.com
Company: New Span Opto-Tech Inc
9380 SW 72nd Street, B-180
Miami, FL 33173-3243
Phone: (305)275-6998

Abstract:

This Small Business Innovation Research (SBIR) Phase II project studies holographic data storage in a new ion-exchanged photochromic glass disk. It is well known that holographic data storage can significantly increase data storage capacity and reduce access time. However, the technology maturity of holographic data storage is believed to be impeded by: the lack of good holographic material that can be erased and recorded optically with almost unlimited rewriting cycles, with large index modulation for large capacity multiplexed data recording, and with long lifetime and immunity to destructive readout for archival applications. As demonstrated in Phase I the new ion-exchanged photochromic glass can satisfy all above requirements. In addition, it does not require developing or fixing after hologram recording making it an attractive candidate to replace other holographic materials in holographic storage applications. The Phase II research will first explore techniques to increase the recording volume thickness. The holographic performance parameters will again be determined after the thickness improvement. A compact holographic storage system will then be designed and constructed to show the effectiveness of disk type storage application. High capacity storage will be demonstrated. Commercial development will be explored with some major storage companies.

Using the new ion-exchanged glass can significantly improve the holographic data storage technology for commercial and military applications such as computer data storage, on-line storage, library archival applications, image storage and processing for medical applications and military target identification, and fast access to large intelligent databases.

Title: SBIR Phase II: Novel Coded High Density Optical Disk Data Storage

Award Number: 0450531
Program Manager: Juan E. Figueroa

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $485,058

Investigator: Jianwen Yang, jjyang@nsotech.com
Company: New Span Optotechnology Inc
9380 SW 72nd St Ste B180
Miami FL, 33173
Phone: (305)275-6998

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project aims to develop a high-density optical disk storage prototype based on a new coding concept that will result in the prototype development of a compact packaged high-density optical disk storage system that is back compatible with current optical disk. Using such coding concept can significantly increase the disk data storage density and data access rate based on a modification of existing optical disk recording/readout hardware architecture. The new high density disk drive allows back compatibility with the current DVD disk and has advantage of easier market acceptance for product roll out than other developing storage technologies such as holographic and near field storages. The near term objective is to achieve 50 GB/disk capacity and more than 100 GB/disk is the next foreseeable product goal.

If successful, the outcome of this project will enhance the availability of high-density low cost storage for many social applications, increasing US based data storage technologies, and increasing US jobs. It will have extensive commercial and military applications such as computer data storage, on-line storage, library archival applications, image storage, and processing for medical applications, and military target identification and fast access to large intelligent databases. Educational impacts include advancing library archive storage for educational uses and benefiting university research in astronomy, meteorology and others that require huge data storage.

Title: SBIR Phase II: Group Coding for Reliable High Performance Network-Centric Storage

Award Number: 0239034
Program Manager: Juan E. Figueroa

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000

Investigator: Qutaibah M. Malluhi, qmm@datareliability.com
Company: Data Reliability Inc.
3895 Metro Drive
Jackson, MS 39209
Phone: (601)944-0048

Abstract:

This SBIR Phase II project takes advantage of a powerful new coding technique called Group Coding (GC) pioneered in Phase I by Data Reliability Inc. (DRI), and an innovative storage system architecture called NetSTOR, to build a prototype for a highly available, reliable, high performance, application-friendly, and scalable network-based storage engine. The engine is multi-platform software that cost-effectively aggregates distributed islands of independent storage resources into a single virtual shared pool of storage. GC typically offers 6 to 27 times enhancement for encoding and 3.5 to 6.5 times enhancement for decoding. The NetSTOR approach is superior to commonly used data replication because it offers optimal redundancy leading to better resource (storage and bandwidth) utilization. NetSTOR is capable of aggregating the capabilities of multiple parallel storage nodes to get improved response times in both WAN and LAN environments. NetSTOR dramatically enhances the overall system throughput and exhibits perfect linear throughput scalability.

The NetSTOR engine serves as an enabling core storage technology. Applications can build on and benefit from the unique feature of this core. Many applications will exploit the competitive advantages of NetSTOR including storage virtualization, electronic software distribution, multimedia network-based services, modeling and simulation applications, data grids, document storage and delivery, distributed information retrieval, medical imaging, video on demand and terrain visualization. The GC technique pioneered by this project provides a new way of looking at and understanding existing array codes. This understanding will lead to the discovery of new codes and could result in significant scientific advances in coding theory. The impact of Phase II is not limited to the technological and commercial merits. For this project, DRI is partnering with Jackson State University (JSU); the Reference, the project will offer JSU students a tremendous educational experience. Since Jackson State University is an HBCU (Historically Black College and University), the project will set a precedent for continuous collaboration and will increase the participation of underrepresented and minority groups in science and technology.

Title: SBIR Phase II: Variable-Focal-Length Liquid Crystal Objective Lens

Award Number: 0091550
Program Manager: Juan E. Figueroa

Start Date: February 15, 2001
Expires: January 31, 2003
Total Amount: $499,389
Investigator: Jackie Lin, jackie.lin@reveo.com
Company: Reveo Inc
3 Westchester Plaza
Elmsford, NY 10523-1609
Phone: (914)345-9556

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is designed to develop and commercialize our electrically controllable, dynamic-focusing liquid crystal microlens/microlens array device for 3D optical media readout and writing. The device will be the world's first compact, electrically controllable, dynamic focusing liquid crystal (LC) microlens reading/writing device for 3D data storage, and has the potential to revolutionize optical data storage and retrieval. The device will dramatically increase both the reading and writing speed of conventional CD/DVD systems and multi-layer DVDs and will be the enabling component in the next generation of truly 3D data storage technologies. In Phase I, the feasibility of the technology was demonstrated and tested various dynamic liquid crystal lens structures to gain an understanding of the issues of design, fabrication, and optical properties of LC microlenses. Building on this success, Phase II is dedicated to the optimization of the LC microlens structures and the development of a fast-switching dynamic focusing LC microlens with large variable focal length range and numerical aperture. Finally, a microlens array to develop parallel reading/writing devices will be designed and built. A prototype 3D reading device will be demonstrated. In Phase III, Reveo will commercialize the new technology.

Optical storage offers higher capacities, removable platters, and more durable media than magnetic disk storage, but it is limited by slow access speeds and higher costs of drives and media. The first product to be developed from the microlens technology will be an electrically controllable, dynamic-focusing liquid crystal microlens device for integration into the data reading system of current DVD players and other optical storage drivers. The device will maximize retrieval efficiency of current optical storage media so customers can immediately enjoy the benefits of 3D data storage technology.

Title: SBIR Phase II: Zero-Remanence Tamper-Responsive Cryptokey Memory

Award Number: 0724306
Program Manager: William Haines

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,809

Investigator: James Deak, jdeak@nve.com
Company: NVE Corporation
11409 Valley View Rd
Eden Prairie, MN 55344
Phone: (952)996-1636

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project is to develop a more secure encryption key for non-volatile memory. Secure ICs often utilize encryption to protect non-volatile memory contents. A clever engineer can recover the key after decapsulating and probing the semiconductor die. NVE intends to produce an innovative non-volatile spintronic cryptographic key memory that will self-erase without data remanence in the event of tampering and without applied power. The main research objectives of this work involve development of a fully integrated 256-bit embedded tamper resistant magnetic random access memory.

The technology proposed in this Phase II SBIR program is intended to provide a defense against theft of intellectual property and to protect sensitive data stored in an integrated circuit. Identity theft has become a very large issue for society in general and particularly in the more computerized societies. This is more than a problem of economics, as US military systems have also been reversed engineered by both friendly and unfriendly nations to gain access to US weapons capability. The technology proposed under the Phase II program addresses the need to provide a tighter level of security for data stored on integrated circuit (IC) and IC assemblies. Commercially, this provides an extra layer of protection on IC-based assemblies such as smart cards, cash machines etc. In addition, the proposed program would render a system inoperable in the event of physical tamper. This may be a very useful tool in stemming the tide of fraudulent usage, compromises, and reverse engineering of IC-based instruments as well as certain types of identify theft.

Engineering Analysis & Modeling

Title: SBIR Phase II: Digital Machine Shop - An Immersive Two-Handed Precision 3D Modeling Environment

Award Number: 0110214
Program Manager: Juan E. Figueroa

Start Date: October 1, 2001
Expires: September 30, 2003
Total Amount: $500,000

Investigator: Paul K. Mlyniec, paul@dartforms.com
Company: Digital ArtForms
15466 Los Gatos Blvd., #214
Los Gatos, CA 95032-2551
Phone: (408)356-6169

Abstract:

This Small Business Innovation Research (SBIR) Phase II project, The Digital Machine Shop, is a practical immersive precision modeling system. With the aid of Digital Jigs, Digital Blades, and other innovative techniques, the user sculpts and assembles precision objects in a natural fashion with his or her own two hands. Real users from many backgrounds have validated the approach, showing these new paradigms to be easy to learn and easy to use. They have achieved comfort and productivity in a fraction of the time required by conventional modeling products because natural dexterity and real-world strategies apply. The apparent absence of Repetitive Stress Injury (RSI) in the Digital Machine Shop's two-handed interface promises to be a bonus of immeasurable value. The ease of use of the Digital Machine Shop will serve to tap the talent, creativity, and expertise of a large segment of society that has been discouraged by the complexity and tedium of conventional interfaces. Those comfortable with digital methods will benefit from enhanced productivity and creativity.

The Digital Machine Shop embodies enabling technologies whose impact far exceeds the scope of this project. It is through the example of practical innovation that the industry will adopt new and improved methods. The potential commercial applications include: architectural design, visual simulation modeling, game modeling, industrial design, automotive design, education, fine arts, and medicine.

Title: SBIR Phase II: Applications of Morse Theory in Reverse Engineering

Award Number: 0521838
Program Manager: Errol B. Arkilic

Start Date: July 15, 2005
Expires: June 30, 2007
Total Amount: $500,000

Investigator: Michael Facello, facello@geomagic.com
Company: Raindrop Geomagic Inc
617 Davis Dr.
Durham NC, 27713
Phone: (919)474-0133

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will investigate applications of Combinatorial Morse Theory in Reverse Engineering, a field that focuses on converting physical objects into a digital representation suitable for CAD, CAM, and CAE. The biggest challenge in this field is to automate the conversion process while producing a model that meets all the requirements of downstream applications. These requirements include both an accurate representation of features and a high degree of smoothness. Combinatorial Morse Theory relies on a single mathematical approach: the definition of a continuous function on a polygonal model and the decomposition of the surface based on the gradient flow of that function. One advantage of this over earlier approaches to the conversion problem is its flexibility obtained by adapting to and combining different analysis criteria. Morse theory is the key to computing patch layouts that naturally adapt to and follow the shape of the surface, a property that is difficult to achieve but necessary to automatically construct high-quality NURBS surfaces of scanned or triangulated CAD models.

The proposed algorithms will allow users to easily create accurate representations of scanned physical parts, thereby providing an efficient closed-loop between physical and digital at any phase of a product life cycle. This project will make strong research contributions in computer science and mechanical engineering by dealing with the practical applications of Morse Theory, automatic feature detection and patch layout. It will also make strong advances in the amount of information that can be extracted from a polygonal model. Commercial applications include design and analysis of complex shapes such as turbine blades, transmission housings, and engine blocks, creating digital inventory of legacy parts, historical preservation, mass customization and biometric shape reconstruction. These applications will allow manufacturing companies to be more competitive globally because it enables product differentiations and existing processes to be carried out efficiently, cost-effectively, and automatically. The societal impact of this technology includes the improvement of work environments due to reduction of dust, noise, and work-related injuries associated with traditional processes, prevention of loss of lives and equipment by enabling sampling based inspections as well as improvement of the quality life through customized medical devices, and apparel that conform perfectly to the wearer

Title: SBIR Phase II: An Integrated Software Tool for Modeling and Model-Based Control of Semiconductor Manufacturing Equipment

Award Number: 0450482
Program Manager: Juan E. Figueroa

Start Date: June 1, 2005
Expires: May 31, 2007
Total Amount: $500,000

Investigator: Jon Ebert, jle@scsolutions.com
Company: SC Solutions Inc
1261 Oakmead Pkwy
Sunnyvale CA, 94085
Phone: (408)617-4550

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a commercial prototype of a novel software tool for integrated model-based control design for Rapid Thermal Processing (RTP) systems. Semiconductor process engineers and RTP equipment design engineers will use the tool. Currently, the design and development of advanced process controllers is a relatively slow and complicated process. There is no high-level tool that allows the process engineer to design, tune and deploy advanced controllers and develop low-order, fast physical models to be used for control. Based on customer feedback and its own experience the company has found a strong need for an integrated modeling and control tool that can be customized for a specific process. Phase I results proved the feasibility of such a tool by closed-loop simulations of a generic RTP chamber using a proof-of-concept version of the proposed tool. This Phase II will further develop and implement relevant model-order reduction algorithms, implement the algorithm for speeding up the Monte Carlo ray tracing calculations, develop the user interface, and integrate the tool components. The company will work closely with its industrial partner in testing the prototype tool in the design of next-generation RTP equipment.

If successful the proposed software package will result in a tool that will substantially reduce the development time of RTP equipment and processes. The tool also provides components for development of advanced techniques in virtual sensing and fault detection. RTP is the company's initial focus, but will leverage the modular nature of the product to extend its capabilities to other semiconductor equipment (e.g., CMP, CVD, etch, etc.) and even equipment used in other industries. Moreover, devices for MEMS and new nanoscale electronics technologies (e.g. spintronic and molecular computing) are expected to be commercialized using CMOS-like manufacturing processes. Hence, by creating a new way of designing and developing equipment and processes efficiently, this tool will have an impact far beyond RTP. The software will serve as a teaching and training tool that can be used in universities and government laboratories of NIST, DoD, DoE, etc

Title: SBIR Phase II: Rapid Application Development Architecture for Product, Process, and Cost Configuration Across Manufacturing Verticals

Award Number: 0450308
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $499,999

Investigator: Nainesh Rathod, nainesh.rathod@imaginestics.com
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Phone: (765)464-1700

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop prototype architecture of an engineering advisory system and validate its application. Although the cost of product design could be only about 5% of the total product cost, decisions made during the design stage can contribute as much as 70-80% to the final product cost. Inappropriate design decisions made without sufficient manufacturing knowledge, or information, increases iterations in the product development lifecycle, causing significant costs to both the original equipment manufactures (OEMs) and the lower tier manufacturers. A survey by Purdue University indicated that 90% of the engineers/designers had very little process knowledge, thus indicating that there is a serious design-manufacturing knowledge gap. The aims and responsibilities of the Phase II project are to bridge the design-manufacturing knowledge gap through the development of an engineering advisory system to be used in early design. The system would be analogous to a spell-checking tool, advising engineers/designers on manufacturability and cost. The system will perform Dynamic Design for Manufacturability (DFM) analysis, evaluate part geometry in order to provide advice on the manufacturing aspects of the part, especially tooling and process related parameters in part design, help in estimating relative manufacturing costs for a part by mapping the geometric and non-geometric parameters of the part to a cost-based manufacturing process model, integrate 3D Shape Search Engine (licensed from Purdue University) with Part/Tooling/Cost Advisor & Knowledge Reuse Agent, seamlessly integrate with commercial Computer-Aided-Design (CAD) system using sophisticated geometric reasoning algorithms and a hybrid B-rep-voxel approach, and extract manufacturing feature-based geometric information.

If successful this product will enable engineers/designers make informed decisions early in product design about processes and part/tooling for manufacturability while serving as an on-demand manufacturing "what-if" educational tool for engineers/designers. It will reduce non-value added design features so optimal and economical processes can be considered, thus lowering tooling costs while minimizing the risk in the quotation process for both OEMs and tooling firms. The outcome of this research also have an educational impact in engineering schools by introducing students to manufacturing processes and design for manufacturability concepts. The company will provide the engineering advisory system to universities to use in their engineering curriculum. The outcome of the proposed research can improve product design, lower cost and positively impact the local economy by linking local suppliers in early design directly through an engineering advisory system.

Title: SBIR Phase II: Creating Functionally Decomposed Surface Models from Measured Data

Award Number: 0450230
Program Manager: Ian M. Bennett

Start Date: February 15, 2005
Expires: January 31, 2007
Total Amount: $489,179

Investigator: Tamas Varady, varady@geomagic.com
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Abstract:

This Small Business Innovation Research Phase II project deals with the problems of reconstructing complex free-form shapes from measured data. Raindrop Magic's primary interest is to produce well-structured, high-quality CAD models. Several techniques exist to reach this goal; unfortunately, automatic surfacing systems provide only rough approximations and do not capture the original design intent, while manual segmentation methods are not very stable and require tedious work. Using functional decomposition, objects are built up as a collection of large, independent primary surfaces being connected by smaller, dependent feature surfaces, such as fillets or swept surfaces. In Phase I, semi-automatic methods were elaborated to create good segmenting curve nets. Exploiting the specific properties of different feature types, the research team proposed algorithms to compute optimal surface representations for each. In Phase II, the team envisions transforming and extending their theoretical results into robust and efficient computational algorithms. Five subsystems are proposed: Surface-Indicators, Constrained-Fitting, Curve-Tracing, Fairing, and Feature-Fitting. New core technologies are developed for creating different geometric entities, which are eventually integrated to obtain high-quality surface models. This technology should significantly shorten lead-time in related industrial design and manufacturing processes and produce aesthetic objects, having a positive impact on the whole society.

The proffered technology has broader impacts in two key market sectors: reverse engineering and advanced surfacing. At the research front, the proposed project deepens the understanding of computer-aided geometric modeling working with scan data, a field that has not received much attention from the large CAD companies, but is an active area of research. It combines the knowledge of both discrete and continuous mathematics and takes advantage of the strength of both approaches. On the technology front, it introduces a new paradigm that will significantly improve the current commercial systems of reverse engineering with better engineering features and advanced surfacing through simpler operations. The main applications will be product design, including automotive, aerospace, consumer products, and medical devices. The improved product will help the US manufacturing industry to be more competitive in the world market, providing a way to introduce design on demand and engineering on demand services. The proposed project will help US companies to increase customer-focused production and reduce the time between product iterations.

Title: SBIR Phase II: Parallel Processing of Time-Lapse Seismic Data Via the Internet

Award Number: 0216413
Program Manager: Sara B. Nerlove

Start Date October 1, 2002
Expires September 30, 2005
Total Amount $602,687

Investigator(s): Stephen Cole, steve.cole@4thwaveimaging.com
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Phone: (949)916-9787

Abstract:

This Small Business Innovation Research (SBIR) Phase II project concerns the processing and analysis of time-lapse seismic data on parallel computers, using the Internet to control the processing flow and visualize the results. In recent years, there has been exponential growth in time-lapse seismic project activity. Time-lapse seismic analysis facilitates the management of oil and gas reservoirs by imaging fluid movement in the reservoir over time. The results are used to guide reservoir management decisions-such as where to place a new well or where to inject water, gas, or steam to stimulate hydrocarbon movement-and help maximize the life of both new and existing fields while minimizing recovery costs. The computer algorithms needed to process time-lapse seismic data are complex and require advanced computational hardware-typically multiprocessor Unix workstations or clusters of personal computers-that many potential customers do not have. The proposed innovation will allow customers to process their data on a centralized PC cluster, using the Internet to control the processing and to visualize the results remotely. The proposed innovation will improve the links between the components of the time-lapse seismic workflow, leading to greater understanding and more widespread commercial acceptance of the technology. Potential applications of the research proposed by Fourth Wave Imaging include petroleum industry mapping of by passed oil, monitoring of costly injected fluids, and imaging flow compartmentalization and the hydraulic properties of faults and fractures. Non-petroleum applications include monitoring groundwater reserves, subsurface monitoring of contaminant plumes and environmental clean-up projects. The web-based parallel software system developed for this project could be applied to other computer-intensive fields such as earthquake seismology and medical and satellite imaging. Tools from this web-based software platform such as those for modeling rock physics and seismic data may also be useful for educational purposes.

Title: STTR Phase II: Integrated Software and Systems for Large-Scale Nonlinear Optimization

Award Number: 0422132
Program Manager: Juan E. Figueroa

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,929

Investigator: Richard Waltz, waltz@ziena.com
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Phone: (847)869-3269

Abstract:

This Small Business Innovation Research Program Phase II research project will address the design and creation of integrated nonlinear optimization software that combines complementary approaches to nonlinear optimization to achieve robust performance over a wide range of application requirements. The work will concentrate on the area of smooth nonlinearly constrained optimization, which arises directly in numerous applications and as a sub-problem in mixed-integer nonlinear programming and global optimization. The work will employ both mathematical convergence analyses and extensive testing on problems of practical interest. Results of the research will take nonlinear optimization software to a new level, based on an adaptive and versatile collection of algorithms in contrast to the single-algorithm approaches employed by current optimization packages. Nonlinear optimization models arise in diverse areas of science such as medical imaging, oceanography, crystallography, and climate modeling, and in almost all areas of engineering, chip feature placement for semiconductor manufacturers to energy management for electric and gas utilities.

Nonlinear optimization is also rapidly becoming a key tool in decision analysis in such areas as finance and revenue management. By enabling optimization packages to be more fexible and more reliable, this research will lead to stronger support for current nonlinear optimization applications while making new, more ambitious applications possible.

Title: SBIR Phase II: Integrated Fire Modeling Software

Award Number: 0349759
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $498,900
Investigator: Brian Hardeman, hardeman@thunderheadeng.com
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Phone: (785)770-8511

Abstract:

This Small Business Innovation Research project will develop an integrated fire modeling software package for use in building design and accident analysis. This will increase public safety by providing widespread access to state-of-the-art fire simulation. Modeling fires using a rigorous scientific approach makes it possible to predict the course of an evolving fire and its impact on the building occupants, contents, and structure. The software will help designers implement new fire safety codes and standards that allow the use of Performance-Based design as an alternative to Rule-Based design. Performance-based design and post-accident analysis offer the potential to reduce injury, loss of life, property damage, and the overall cost of constructing and maintaining buildings through advanced technology. This project will accelerate the introduction of new fire simulation technology into the fire safety industry. In the United States, the total cost of fires is over $100 billion annually, with a loss of more than 4,000 lives. Driven by the availability of the Fire Dynamics Simulator (FDS) from NIST and new performance-based fire safety standards, the fire safety industry is responding to these costs by adopting greater use of fire simulation. As a result, there is an emerging market for fire simulation software that is powerful, yet easy to use.

The potential market includes fire safety engineers (design), companies involved in accident review and litigation, Authorities Having Jurisdiction (regulation), and fire service personnel (suppression and investigation).

Title: SBIR Phase II: Relational Bayesian Modeling for Electronic Commerce

Award Number: 0349497
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $450,056
Investigator: Bruce D'Ambrosio, dambrosi@cleverset.com
Company: CleverSet, Inc.
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Phone: (541)738-1010

Abstract:

This Small Business Innovation Research Phase II project will focus on scale-up and validation of the company's relational model discovery technology, with specific application focus on web-visitor behavior modeling. In Phase I research the company developed a modeling paradigm based a synthetic variable language for relational Bayesian modeling. Its synthetic variable language is the first comprehensive effort to develop a principled way to represent, discover, and perform probabilistic inference with mixed intra-table, cross-table, and multi-table relational features. This capability provides the basis for construction of comprehensive, integrated models of relational data. Models constructed capture the rich detail of web visitor behavior and can be used to make inferences about web visitor intent (e.g., whether or not a purchase in planned) in real- time. These results are not obtainable by any other modeling technology. The technical objectives for the Phase II project are to: (1) develop a complete language to establish solutions to outstanding issues in our synthetic variable capability, (2) engineer the infrastructure needed for commercial deployment, (3) construct deployable models of web visitor behavior to identify opportunities for intervention, and (4) conduct field-trials of model-based interventions to establish the business value of our approach. A paradox of modern society is that we possess so little knowledge relative to the amount of data we collect and store. E-commerce provides a paradigmatic example of this paradox. E-Commerce platforms collect unprecedented amounts of information about customer interactions, yet today's E-commerce applications do not provide the service expected by customers or the performance demanded by online retailers. Online retailers are demanding increasingly sophisticated marketing and merchandising technologies.

The proposed product will empower online merchants and service providers by enabling efficient and integrated understanding of online consumer behavior and will bring in a new class of customer centric (instead of page-centric) web-based interactions that will contribute to the evolution of the World Wide Web as a communication medium. The company's technology also applies to offline scientific analysis as a method for hypothesis generation in complex relational data as in the E-commerce domain. This technology enables scientists to make better use of the data at their disposal.

Title: SBIR Phase II: A Toolbox for Optimal Design

Award Number: 0321420
Program Manager: Errol B. Arkilic

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $500,000

Investigator: Victor Pereyra, victor@ca.wai.com
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New York City, NY 10014
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project combines large-scale simulation of wave propagation phenomena with optimization. Simulation in itself is seldom a final objective. Rather, simulation is usually a step in an iterative process to solve the real problem, that could be the determination of material properties from indirect measurements, imaging, parameter estimation or optimal design, to name a few. All these problems share the need to couple a large simulation package with an optimization one. This project will formalize this concept and proceed to create a set of tools to facilitate this coupling in the area of transient wave propagation phenomena, with special applications to piezoelectric transducer design, oil exploration and production, and optimal and protective structural design. These applications are chosen to exemplify the usage of the toolbox and emphasize its generality. It will couple a wave propagation finite element system and a system for 3D forward and inverse geological modeling, with a number of optimization programs.

The target market for the proposed solution is small to medium sized companies in need of a set of affordable design tools that will cover a number of different classes of application areas which have been previously available only to large firms. The results of this project will have a broad impact on a large number of small and medium size industries that rely on Computer Aided Design and Engineering to develop their products, accelerating and making more efficient the process between product conception, production and market introduction, key in a highly competitive world.

Title: SBIR Phase II: Scalable, Parallel Automatic Mesh Generation

Award Number: 0321529
Program Manager: Errol B. Arkilic

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $496,549

Investigator: Mark Beall, mbeall@simmetrix.com
Company: Simmetrix, Inc.
10 Halfmoon Executive Park Drive
Clifton Park, NY 12065
Phone: (518)348-1639

Abstract:

This Small Business Innovation Research Phase II project proposes to develop technologies to automatically generate large meshes appropriate for finite element and similar analyses directly from CAD model representations. This will be done using scalable, parallel algorithms that will enable the generation of meshes on distributed parallel computers including workstation clusters. The result of this project will be software that is capable of generating meshes with hundreds of millions of elements in an efficient manner. The generated meshes will already be partitioned to be compatible with the needs of parallel analysis codes. The commercial applications of this research are in those industries that need to perform large-scale simulations of complex problems over general domains.

The procedures to be developed will allow simulation based design technologies to be applied to applications that demand massive simulations. By enabling these large-scale simulations for industrial problems, this technology will enable the more widespread and effective use of numerical simulation in the design of manufactured products in all industries (automotive and aerospace being two major industries with an immediate need for this technology). The software developed in this project will be available for licensing to all CAD/CAE software developers to enhance the capabilities of their products.

Title: SBIR Phase II: Meshless Petrov-Galerkin Geo-Environ Technology For Wide Scale Field Uses

Award Number: 0321651
Program Manager: Juan E. Figueroa

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $379,038

Investigator: Sumant Gupta, cfest@cfest.com
Company: Consultants for Environmental System Technologies
2 Corporate Park, Suite 202
Irvine, CA 92606
Phone: (949)724-1696

Abstract:

This Small Business Innovative Research (SBIR) Phase II proposes to develop a Meshless Petrov-Galerkin Geo-Environ Technology For Wide Scale Field Uses. Groundwater supplies are increasingly threatened by organic, inorganic, and radioactive contaminants that are introduced to the environment by improper disposal or accidental releases. Estimates of remediation costs at U.S. government sites alone totals into the billions of dollars. Computational mechanics and aerospace advances in meshless Petrov-Galerkin provide easy means for stable accurate simulations of large groundwater reservoirs without grid generation. The proposed software package Meshless Groundwater Model-Petrov Galerkin (MGM-PG) will be designed for advanced hydrologists as well as for groundwater basin managers, purveyors, and field hydrologists. Current software advancements will be interfaced for easy conceptual model development for various applications. MGM-PG potential market includes: (i) groundwater reservoir quantity and quality management; (ii) cleanup of contaminated sites; (iii) storage of wet year surplus surface water underground and its uses for extended draught periods (ASR projects); (iv) safe disposal of treated effluents by rapid infiltration and extraction projects (RIX projects); (v) conjunctive uses of surface and subsurface water; (vi) landfill sites; and (vii) cleanup of large contaminated Federal Facilities.

This technology has applicability to thousands of EPA National Priority List for expedited clean up of contaminated sites and also for groundwater management projects that are implemented at a cost of billions of dollars by federal agencies, State, counties, petroleum facilities, and chemical industries. Worldwide only 4-5 geo-environ codes have been developed for wide variety of societal needs. MGM-PG will be a new technological advancement and will promote training of new graduate students in meshless advances rather than old methods.

Title: SBIR Phase II: Modeling and Model-Based Control for Chemical Mechanical Planarization

Award Number: 9983309
Program Manager: Winslow L. Sargeant

Start Date: July 1, 2000
Expires: June 30, 2003
Total Amount: $750,000

Investigator: Abbas Emami-Naeini, emami@scsolutions.com
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Phone: (408)617-4550

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop physical modeling and model-based sensing and control techniques for chemical mechanical planarization (CMP) systems. CMP is rapidly emerging as a global planarization technology for microelectronics fabrication. Phase I found feasible modeling and real-time control techniques using actual experimental data from a commercial CMP system. Three-dimensional (3D) results of contact mechanical models correlate closely with experimental results for removal rate distribution across a wafer. Reduced input-output models relating the within wafer nonuniformity (WIWNU) to the pressure ratio and pad conditioning, obtained from detailed 3D models, were used as a basis for real-time and run-to-run control. Phase II will extend these models and control methods and develop a model-based embedded controller for within-wafer and within-die uniformity control. Phase II will culminate in tests of advanced process modeling and control software and an embedded controller for CMP systems.

Commercial applications in the semiconductor industry are expected to result in improved and repeatable performance, increased throughput, and improved yields. An embedded controller product promises significant improvements in uniformity and throughput by allowing real-time control of uniformity for various CMP applications. Process modeling software and control software have potential for significant improvements in the 'trial and error' approach currently employed in CMP.

Title: SBIR Phase II: Large Eddy Simulations (LES) of Gas-Particle Flows

Award Number: 9983395
Program Manager: Juan E. Figueroa

Start Date: June 1, 2000
Expires: May 31, 2003
Total Amount: $499,904

Investigator: Shivshankar Sundaram, jls@cfdrc.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop, validate and demonstrate Large Eddy Simulations (LES) for the prediction of gas-particle flow phenomena. The Phase I study has clearly demonstrated the feasibility of using a commercial CFD code to perform Gas-Particle Large Eddy Simulations in flows with simple geometry. Good predictions of particulate dispersion, deposition and agglomeration in isotropic and channel turbulent flows have been obtained. The Phase II study will refine the models and techniques developed in Phase I and extend them to simulate more complex flows, in practical geometries. The Phase II work will be focused on the following main areas: unstructured and mixed element (adaptive cartesian) grids (driven by the need for fast and accurate simulations; adaptation and implementation of advanced sub-grid scale models and particle transport in these alternative grid topologies; implementation of enhanced particle sub-grid scale models for (a) fluid sub-grid scale (SGS) velocity (b) deposition and (c) agglomeration; extensive and systematic validation in channel, free shear and mixing layer flows; technology demonstration using a practical contaminant transport simulation. A team of experienced investigators and strongly interested end-users of this capability (Aerodyne Research, PLG, Dura Pharmaceuticals) has been assembled. The end-product of the Phase II effort will be an Integrated Large Eddy Simulation System for gas-particle flows (featuring advanced gridding, solver and visualization software). Gas-particle processes cannot usually be well-understood without a detailed consideration of the complex and usually highly nonlinear interaction between the flow and the motion of the particles. The developed Integrated Large Eddy Simulation System will foster a better fundamental understanding of dilute particulate turbulent flows in complex geometries. It will enable improved engineering design in a variety of fields such as air pollution control and chemical/bio-terrorism programs to chemical/pharmaceutical/semiconductor processing.

The product developed at the end of Phase II will put a sophisticated physics simulator heretofor only avaialbe with academicians and that too in simple flow situations, in the hands of a trained industrial engineer enabling him to better understand and improve the processes of concern.

Title: SBIR Phase II: An Advanced Computational Simulation Tool for Metalorganic Vapor Phase Epitaxy of Compound III-V Layers in Industrial Reactors

Award Number: 9983415
Program Manager: Juan E. Figueroa

Start Date: June 1, 2000
Expires: May 31, 2003
Total Amount: $522,495

Investigator: Samuel Lowry, sal@cfdrc.com
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215 Wynn Drive, 5th Floor
Huntsville, AL 35805
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Abstract:

This Small Business Innovation Research Phase II project will produce a commercial simulation tool to design and optimize Metalorganic Vapor Phase Epitaxy (MOVPE) systems for the fabrication of III-V materials. The Phase I study has demonstrated the proof-of-concept of using advanced models to optimize MOVPE equipment and processes. Specifically the effects of radiative heat transfer, gas flow field, gas phase/surface chemistry and electromagnetic induction heating on the deposition rate/uniformity were quantified using the models. Following preliminary validation, the models were tested for both two and three-dimensional commercial reactor geometries. The proposed Phase II project will focus on the necessary model refinements and development identified during the Phase I study. Specifically, improvements are sought in the areas of modeling chemistry of ternary and quaternary III-V materials, establishing the relationship between strain and growth rate, and development of mechanisms, which can model deposition accurately both in the kinetic as well as the mass-transport regime. Comprehensive databases for optical, thermodynamic/transport properties, and reaction mechanisms will be implemented to ensure the commercial success of the proposed simulation tool. Model developments will be followed by extensive validation studies on commercial MOCVD reactors, to be conducted in collaboration with Aixtron AG, one of the leading MOVPE equipment manufacturers. Validations will also be performed on reactor geometries and cases available from the open literature as well as research groups currently working in collaboration with CFDRC. Phase III work will focus on commercialization aspects such as improvements in software frontends, improved data handling and development of virtual reactor prototypes for commercial use.

The availability of the proposed simulation tool will facilitate the design, optimization and scale-up (to large wafer sizes) of reactors/processes for MOVPE. This will result in lower equipment and fabrication costs and improved uniformity/quality of the grown materials. Thus, the simulation tool will be an enabling technology in eliminating a major road block in the commercialization of III-V MOVPE technology. This will also have a positive impact on the growth of the optoelectronic device and telecommunication industries.

Title: SBIR Phase II: Design-Based Developments for Pump Cavitation Control

Award Number: 0078582
Program Manager: Cheryl F. Albus

Start Date: January 1, 2001
Expires: December 31, 2002
Total Amount: $399,883
Investigator: Daniel Baun, dob@conceptnrec.com
Company: Concepts ETI Inc
217 Billings Farms Road
White River Junction, VT 05001
Phone: (802)296-2321

Abstract:

This Small Business Innovation Research Phase II project is to provide the means to reliably calculate turbopump stiffness and damping matrices based on dynamic force measurements collected using a magnetic bearing rig. During Phase I exploratory development of a high suction specific speed (NSS) = 65,000 rocket engine turbopump pump stage was carried out and laid the foundation for this project. A complementary Phase I project for NASA focused on an NSS = 85,000 stage. Earlier Air Force funding concentrated on demonstrating magnetic bearings as a useful lab instrument. More recent breakthroughs include a novel fix for auto-oscillation and establishing the structure of an innovative dynamic force matrix measurement methodology. The primary challenge in this work is to isolate those forces on the rotor (with and without cavitation) due to the interaction of the impeller with the stator using innovative test and signal processing techniques. By testing a series of impellers, a database of rotordynamic coefficients will be established based on component dynamic force data. An additional objective is to evaluate the capability of CFD for replicating those physical force measurements. The goal is to create scientifically based design methods for lighter high-performance turbopumps.

Smaller, lighter, and higher speed rocket engine turbopumps are required to meet lower space launch cost requirements. Successful accomplishment of this fundamentally based approach for measuring component specific rotor dynamic forces and a method for using experimental results on a broader basis in the design process can lead to a breakthrough technology. It will enable turbopump designers to overcome current thresholds due to hydraulic induced rotor dynamic instabilities. In addition to reducing equipment size and cost, reliability will improve. The technology is also applicable to industrial turbomachinery including industrial pumps, aircraft engine fuel pumps, and compressors.

Title: SBIR Phase II: Simulation of Rapid Thermal Processing in a Distributed Computing Environment

Award Number: 0078608
Program Manager: Juan E. Figueroa

Start Date: December 1, 2000
Expires: November 30, 2002
Total Amount: $399,576

Investigator: Jiwen Liu, liu@esi-al.com
Company: Engineering Sciences Inc
1900 Golf Road, Suite D
Huntsville, AL 35802
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will continue to develop and demonstrate a computational tool for detailed simulation of Rapid thermal processing (RTP) in a distributed computing environment by taking advantages of the findings in Phase I. RTP has become a key technology in the fabrication of advanced semiconductor devices. As wafers get larger and chip dimensions smaller, the understanding of the highly coupled physics such as radiative heat transfer, transient fluid flow and heat transfer as well as chemical reactions through numerical modeling using high-performance computing is the key to the design, optimization, and control of RTP reactors. In Phase II, A 3D surface radiation model based on the modified discrete transfer method (MDTM) will be developed to treat radiative transfer in the lamphouse and process chamber as a whole process. The detailed pattern effects will be taken into account by rigorously solving time-domain Maxwell's equations through a finite volume approach. The rarefied gas dynamics in low pressure RTP will be modeled by adding Burnett terms into the Navier-Stokes equations. The governing equations that contain various multi-disciplinary physical models will be solved by a 3D unstructured finite volume method. To address computationally intensive 3D simulation needs, an efficient parallel strategy will be implemented in the solution procedure. Data communication among parallel processors will be conducted by the Message Passing Interface (MPI) library. To accelerate the overall solution convergence and improve the parallel performance, the algebraic multi-grid (AMG) method will be used to solve the discretized equations in each processor.

It is expected that the proposed simulation tool can be used to systematically investigate the underlying physics occurring in RTP systems, and to help in the design, optimization, and control of RTP reactors. The proposed simulation tool will significantly benefit the semiconductor manufacturing equipment industries that require a detailed understanding of multimode and highly coupled transport phenomena. The potential applications include the design, optimization, and control of RTP reactors and many other manufacturing and materials processing systems.

Title: SBIR Phase II: Mesh Generation for High-Order Finite Element Methods

Award Number: 0132742
Program Manager: Juan E. Figueroa

Start Date: February 1, 2002
Expires: January 31, 2004
Total Amount: $497,925

Investigator: Robert M. O'Bara, obara@simmetrix.com
Company: Simmetrix, Inc.
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Phone: (518)348-1639

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop technologies to generate meshes over general three-dimensional domains that are appropriate for high-order finite element analysis. A current stumbling block to the wide adoption of high-order finite element techniques is the lack of automatic means to generate appropriate curved meshes. This project will develop a new and innovative procedure for the effective generation of these types of meshes.

The commercial application of this research is the integration of CAD technologies with advanced automated simulation techniques to be used within engineering design processes. These tools will reduce the time and costs associated with performing engineering analysis during design and increase the accuracy of the predictions obtained.

Title: SBIR Phase II: A Fast Parallel Grid-Free Method for Simulating Turbulent Incompressible Flow In/Around Time-Varying Geometries

Award Number: 0216671
Program Manager: Juan E. Figueroa

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $500,000

Investigator: Adrin Gharakhani, adrin@applied-scientific.com
Company: Applied Scientific Research
1800 E. Garry Ave., Suite 214
Santa Ana, CA 92705-5803
Phone: (949)752-7545

Abstract:

This Small Business Innovation Research (SBIR) Phase II project builds on algorithms developed for simulating turbulent incompressible flows in and around time-varying geometries. The Phase II project proposes to develop and commercialize a state-of-the-art computational fluid dynamics (CFD) package utilizing the algorithms developed. The computational engine is based upon an advanced parallel, adaptive fast multipole (FMM) implementation of a 3-D Lagrangian vortex-boundary element method. Turbulence is accounted for via Large Eddy Simulation (LES) using a dynamic Smagorinsky sub-grid scale model. The method is (1) grid-free in the fluid domain, (2) virtually free of numerical diffusion, (3) inherently solution-adaptive, and (4) capable of modeling inhomogeneous unsteady wall-bounded turbulent flow. During Phase II additional innovative algorithms will be developed for FMM to substantially increase it computational speed as well as accuracy. Additionally, an LES model for unsteady inhomogeneous flows will be implemented and tested rigorously using problems of potential interest to industry.

The software is ideal for simulation and analysis of complex laminar-through-turbulent flow phenomena involving massive flow separation, unsteady vortex shedding, transient jets in cross-stream, and wake-body interaction. Examples of interest to industry are flow over bluff bodies such as ground vehicles or buildings, in data storage units with rotating and moving parts; in internal combustion engines; and in and around rotating machinery such as pumps and fans.

Title: SBIR Phase II: Analytic Simulation Method for Oil/Gas Field Management and Optimization

Award Number: 0236569
Program Manager: Juan E. Figueroa

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $500,000

Investigator: Randy D. Hazlett, rdhazlett@integrity.com
Company: Potential Research Solutions
1818 Shelmire Drive
Dallas, TX 75224
Phone: (214)941-3907

Abstract:

This Small Business Innovation Research (SBIR) Phase II project provides the foundational R&D for new oil and gas reservoir management tools to optimize hydrocarbon recovery. It proposes extension of state-of-the-art analytic solution methods for potential flow in porous media from 2-D to 3-D. It incorporates 3-D analytic fluid flow simulation technology into large-scale optimization routines where reservoir recovery performance is required, such as in the optimum placement of new wells or the optimum operation of existing wells. Unlike previous analytic solution methods, complex heterogeneous reservoir architecture can be managed without a loss of accuracy. This project will provide a new class of reservoir management tools capable of rapidly and accurately screening what-if scenarios for field development. Phase II will: i) generalize analytic solution boundary element methodology to three dimensions, ii) build a prototype, 3-D, well optimization tool, iii) develop analytic stream-function technology for optimization of improved recovery operations, and iv) extend algorithms to additional geometric shapes for enhanced flexibility.

Powerful analytic solution technology has been developed that allows robust solution of fluid flow problems with complex, heterogeneous rock properties. This general analytic solution methodology is an industry first, providing the ability to generate a brand new line of desktop hydrocarbon reservoir management tools. In particular, the results of this project will provide software and services to optimally locate new wells within existing hydrocarbon reservoirs. While reservoir simulation and well planning software both exist in the marketplace, no current commercial product offers the ability to rigorously compute well productivity within a feedback loop of a powerful gradient search optimization method to automatically select the best drilling location for new wells. This technology also addresses the optimum performance of existing wells in improved recovery operations. Using analytic stream-function optimization, well configurations in mature fields can be optimized for maximum productivity and ultimate recovery, thus minimizing unrecoverable natural resources.

Title: SBIR Phase II: Visualizing Arbitrary Basis Functions for Advanced Engineering Analysis and Simulation

Award Number: 0238964
Program Manager: Juan E. Figueroa

Start Date: March 1, 2003
Expires: February 28, 2005
Total Amount: $500,000
Investigator: William J. Schroeder, will.schroeder@kitware.com
Company: Kitware Inc
469 Clifton Corporate Parkway
Clifton Park, NY 12065
Phone: (518)371-3971

Abstract:

This Small Business Innovative Research Phase II project will create general-purpose software tools for visualizing the results of advanced numerical simulation. Simulation techniques, which make up a large part of the multi-billion dollar CAD/CAM/CAE market, are widely used to design and build the majority of products manufactured today. Visualization plays an important role in this process by transforming simulation results into images which designers, engineers, and scientists can use to understand and communicate about their products. Recent advances in numerical simulation provide an opportunity for methods based on higher-order basis functions. These functions better model curved geometry and are more accurate than conventional techniques employing linear approximation functions. The use of this technology is limited by a lack of general-purpose visualization software tools for higher-order methods. Providing these tools will accelerate the adoption of this technology into the marketplace resulting in software that will produce superior product designs, in shorter time, and at lower cost. An adaptive tessellation process that converts higher-order basis into linear graphics primitives and preserves the visual accuracy of the solution, while maintaining interactive graphics performance, is proposed.

This technology will be licensed and add-on adaptors will be offered that will enable vendors to easily and efficiently interface their systems to this technology.

Title: SBIR Phase II: Computational Tool for Plasma Equipment Design Using a Non-Statistical Boltzmann Solver

Award Number: 0091572
Program Manager: Cheryl F. Albus

Start Date: March 15, 2001
Expires: February 29, 2004
Total Amt: $499,884

Investigator: Vladimir Kolobov, jls@cfdrc.com
Company: CFD Research Corporation
215 Wynn Drive, 5th Floor
Huntsville, AL 35805
Phone: (256)726-4800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop, validate and demonstrate a Computer-Aided Design (CAD) tool for plasma equipment/processes using a non-statistical Boltzmann solver for the analysis of charged particle kinetics. Phase I implemented a new Boltzmann module and clearly demonstrated the feasibility of coupling a Bolzmann solver to the company's plasma simulator for efficient kinetic description of low-pressure plasma reactors used in semiconductor manufacturing. The Phase II project will focus on: (1) the development of elliptic representation of the velocity distribution function (VDF) valid for arbitrary anisotropy of the VDF; (2) full integration of the Boltzmann solver with a commercial software; (3) kinetic simulations for industrial plasma systems; and (4) interfacing the Boltzmann module with plasma simulation codes developed by different research groups. Using an elliptic representation will extend the applicability of the Boltzmann solver to problems with arbitrary VDF anisotropy such as electron beams, ion kinetics, etc. The goal of Phase II will be to validate the new CAD tool for wide variety of plasma technologies and expand the software usage to new industries.

The total commercial markets of plasma etch and Chemical Vapor Deposition (CVD) equipment is currently in excess of $2 billion per annum with strong projections for growth. Commercial application of the proposed software tool will allow optimization of the performance of all hardware equipment of this market and to "smartly" design new equipment. It is projected to "save" millions of dollars of equipment and process development costs to Plasma Equipment Manufacturers and to semiconductor chip producing companies.

Title: SBIR Phase II: Battery Design by Using an Electronic Interface (ENTERFACE)

Award Number: 0109141
Program Manager: Cheryl F. Albus

Start Date: June 15, 2001
Expires: May 31, 2004
Total Amount: $500,001

Investigator: Robert M. Spotnitz, rspotnitz@batdesign.com
Company: Battery Design Co.
2277 Delucchi Drive
Pleasanton, CA 94588
Phone: (925)858-0699

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop prototype software for designing batteries based on user requirements. A user will specify an objective (such as maximize runtime) and use conditions (such as the electrical current), and the software determines, based on first principles (trade mark) models, the optimal design. The Phase I project successfully yielded, based on optimization of capacity, significant improvements in runtime for devices such as personal digital assistants (PDAs). The Phase II project will develop a user-friendly, prototype system that can handle multiple battery chemistries, simulate abuse testing, and predict battery life. The software serves as an intermediary between battery developers and users by capturing expertise from both groups, allowing them to accrue benefits of simulation. Aligning development cycles of batteries to devices leads to better products (with concomitant market penetration, share growth, and lower costs). The software protects confidential information of all parties, creating opportunities for broader partnerships.

The commercial benefits will come from the development of the software, which provides a ready outlet for academic research and a rational basis for product specifications. It is anticipated that if this project is successful it will open up the battery industry to innovation and will help to create new partnerships.

Title: SBIR Phase II: Characterization of Three Dimensional Discontinuity Properties from Digital Images of Rock Masses

Award Number: 0239119
Program Manager: Juan E. Figueroa

Start Date: March 15, 2003
Expires: February 28, 2005
Total Amount: $499,566

Investigator: Jeffrey Handy, jeff@spliteng.com
Company: Split Engineering LLC
110 S. Church Avenue
Tucson, AZ 85701
Phone: (520)327-3773

Abstract:

This Small Business Innovation Research Phase II project will further the investigation of two innovative technologies for characterizing fractures in rock masses. The first technology involves image-processing algorithms for the extraction of 3D fracture properties from fracture traces in digital images. The second technology involves the use of laser-scanners to extract the 3D properties of exposed fracture surfaces. The two technologies complement each other well and there are situations where the characterization of fracturing is best analyzed with one or the other or both technologies. The first objective of the Phase II research is to continue to improve the two technologies, and to integrate all the various algorithms into a single user-friendly software tool. The second objective is to thoroughly evaluate sources of error in both technologies through synthetic and field studies, and to develop a set of recommended field procedures and equipment for various applications to optimize the techniques and minimize errors. The third objective is to develop relationships with potential customers for the software and also groups interested in collaborating on software development and validation. Once a beta version of the software is developed, this software will be provided to some customers for validation and assessment.

Within the broad scope of the rock engineering market, four distinct market segments have been identified for this innovation. Each market segment has a separate end-use application: mining, geotechnical, petroleum, and environment. Market research and letters of support from various market participants have demonstrated that a market need exists for automation of tasks currently performed manually by rock engineering professionals.

Title: SBIR Phase II: Information Theoretic Learning and Application to Fetal ECG

Award Number: 0239060
Program Manager: Juan E. Figueroa

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $499,578
Investigator: Neil R. Euliano, neil@nd.com
Company: NeuroDimension Inc
1800 North Main St., Suite D-4
Gainesville, FL 32609
Phone: (352)377-5144

Abstract:

This Small Business Innovation Phase II Project will develop information theoretic methods to separate fetal electrocardiogram (FECG) signals from the noisy electrical environment of the maternal abdomen based on statistical properties of the mixtures (blind source separation). The separation is done using a recently introduced algorithm (Mermaid) that is computationally and data efficient. Phase I research showed that Mermaid is a marked improvement over prior methods of FECG separation. The project will develop the technology for a comprehensive fetal and maternal monitor including fetal heart rate, FECG, and maternal Electrohysterogram (EHG, which measures contraction information) in a very compact device. The project includes clinical studies designed to provide the information necessary to create and validate NeuroDimension's system and also to illustrate its effectiveness.

Potential markets include hospital-based fetal monitoring, home/physician's office fetal monitoring and stress tests, and use as a research tool. The monitor not only will be less expensive than current monitors, but also will provide additional information that can dramatically improve patient care and reduce costs by avoiding unnecessary procedures.

Title: SBIR Phase II: Advanced Formal Techniques for Dependable Reactive Systems

Award Number: 0091499
Program Manager: Juan E. Figueroa

Start Date: March 15, 2001
Expires: February 28, 2003
Total Amount: $499890
Investigator: Steven T. Sims, sims@reactive-systems.com
Company: Reactive Systems, Inc.
114 Bleeker St
Port Jefferson, NY 11777
Phone: (516)473-2931

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop the automated tool support that will enable engineers to deploy powerful and mathematically rigorous, yet easy-to-use and cost-effective, techniques to model, analyze and implement correct and reliable reactive software systems. Such systems are intended to maintain an ongoing interaction with their environment in order to provide appropriate responses to stimuli the environment generates. Examples include the embedded software found in medical, automotive, aeronautical, consumer-electronic, e-commerce, and telecommunications applications. Many of these are safety- or business-critical. Providing an enabling technology for the cost-effective development of correctly functioning reactive systems would thus be of great social and economic benefit to the nation.

The main tangible outcome of the proposed effort and the flagship product will be the React tool environment. React will allow reactive-system designers to create mathematical models of their systems; validate models via simulation and automatic verification; and automatically generate implementations or test suites from models. The key innovation of the proposed technology is its reliance on powerful formal techniques, developed by RSI for modeling systems and validating properties of these models in a fully automatic fashion.

Title: SBIR Phase II: A Newton-Krylov Based Solver for Modeling Finite Rate Chemistry in Reacting Flows

Award Number: 0216590
Program Manager: Juan E. Figueroa

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $500,000

Investigator: Michael J. Bockelie, bockelie@reaction-eng.com
Company: Reaction Engineering Intl
77 West 200 South
Salt Lake City, UT 84101
Phone: (801)364-6925

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop computational fluid dynamic (CFD) modeling technology that uses state-of-the-art techniques for modeling finite rate chemistry in chemically reacting turbulent flows with recently developed numerical methods for solving systems of non-linear equations. In Phase I an improved CFD solver was developed that used reduced chemical kinetic mechanisms to model finite rate chemistry effect and solved the resulting stiff system of partial differential equations with a matrix-free Newton-Krylov method. In Phase II two Newton-Krylov based CFD tools will be developed, one to model combustion from turbulent, diffusion flames and the second to model turbulent, pre-mixed flames.

The commercial potential for this work is the electric power industry, designers and builders of commercial chemical plants, and designers of chemical process heaters and other industrial furnace applications.

Title: SBIR Phase II: Problem Solving Environment for Reduced Kinetic Mechanisms

Award Number: 0091593
Program Manager: Juan E. Figueroa

Start Date: April 1, 2001
Expires: March 31, 2004
Total Amount: $500,000

Investigator: Christopher J. Montgomery, montgomery@reaction-eng.com
Company: Reaction Engineering Intl
77 West 200 South
Salt Lake City, UT 84101
Phone: (801)364-6925

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a computational Problem Solving Environment (PSE) for the creation, optimization, testing, and application of reduced chemical kinetic mechanisms. Inclusion of detailed chemistry into 3D simulations with turbulence-chemistry interaction will be computationally intractable for the foreseeable future. Practical simulation of reacting flows requires reduced mechanisms tailored to the application and conditions of interest. The PSE created in Phase I allows the user to rapidly create reduced mechanisms, set up multi-parameter test problems for comparison to detailed chemistry, and interrogate and visualize the results more thoroughly than was previously possible. Human effort for reduced mechanism validation is reduced from days to hours. Rigorous testing is necessary to make reduced mechanisms a reliable commercial product. In Phase II the PSE will be extended to automatically optimize reduced mechanisms to the users' specification, and produce reduced mechanism modules for a variety of applications that seamlessly integrate into a variety of Computational Fluid Dynamics codes.

These technologies will have commercial value due to the ever-increasing need to include more detailed chemistry into the design and analysis software used by scientists and engineers. The problem-solving environment provides the engineer with the ability to rapidly create reduced mechanisms, set up multiple test problems covering a multidimensional parameter space for comparison to detailed chemistry, and efficiently interrogate and visualize the results.

Title: SBIR Phase II: Inversion of Geophysical Measurements for Fracture Geometry

Award Number: 0110276
Program Manager: Sara B. Nerlove

Start Date: July 1, 2001
Expires: June 30, 2003
Total Amount: $492,251

Investigator: Stephen R. Brown, sbrown@ner.com
Company: New England Research Inc
76 Olcott Dr
White River Junction, VT 05001-2313
Phone: (802)296-2401

Abstract:

This Small Business Innovation Research (SBIR) Phase II project considers an innovative method for detecting and quantifying natural fracture systems in rock. The geometry of the fracture system controls the permeability of many oil and gas reservoirs and aquifers. Both oil and gas and environmental applications require new tools and techniques to quantify the fracture geometry, thus allowing prediction of permeability. During the Phase I research, an inverse method was developed for fracture geometry from diverse geophysical measurements. This was accomplished by combining forward models relating fracture geometry to various anisotropic, stress-dependent properties including permeability, electrical conductivity, and seismic velocity with a maximum entropy regularization criterion. It was demonstrated that a relatively small number of geophysical measurements could be used to invert for a statistical description of the fracture geometry with some predictive power. Following this proof of principle, in Phase II, this method will now be turned into an interactive tool for studying and understanding fracture system behavior for oil and gas and environmental applications.

To accomplish this, the forward models will be referenced, the inversion algorithm will be tuned for this specific problem, and the algorithms will be validated using case studies. This new capability will likely provide many improvements to exploration, development, and reservoir performance activities by defining realistic input parameters for reservoir fluid flow simulators. It is in our national interest to develop new innovative and cost effective exploration and reservoir simulation technologies which will extend the useful lifetime of oil and gas reservoirs, thus extending the period of time that competitively priced oil and natural gas can be produced in this country.

Title: SBIR Phase II: Next Generation Component Software for Simulation-Based Econometric Estimation

Award Number: 0132076
Program Manager: Sara B. Nerlove

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $499,604
Investigator: Jiahui Wang, jwang@insightful.com
Company: Insightful Corporation
Seattle, WA 98109-3044
Phone: (206)283-8802

Abstract:

This SBIR Phase II research project proposes to develop user-friendly component software for classical econometric estimation and inference based on simulation methods, such as maximum simulated likelihood, method of simulated moments, and efficient method of moments. In the last decade different simulation-based methods have been developed to tackle complex economic/statistical models, which cannot be estimated by conventional methods such as Maximum Likelihood Estimation (MLE) and Generalized Method of Moments (GMM). Although these simulation-based estimators have desirable theoretical properties, they have been utilized in academic research and have not become useful tools for practitioners because of the lack of user-friendly software. Building upon the Phase I research and development, Insightful (formerly MathSoft) plans to study two classes of models: mixed logit models for discrete choice analysis which represent cross sectional and panel data problems, and models for term structure of interest rates which represent discrete time and continuous time structural models. Extensive Monte Carlo experiments will be used to explore finite sample properties of various aspects of simulation, estimation and forecasting, with an aim of improving and stabilizing the current algorithms. The user-friendly component software will be developed using both object oriented S-Plus language and the state-of-art JavaBean technology, and it will provide intuitive graphical user interface.

The S-Plus functions of the technology proffered by Insightful for econometric estimation and inference will serve the purpose of quickly gaining a broad user base, while the JavaBeans can be used to develop custom applications. The software will help economists and practitioners in other fields such as the financial industry, social sciences, and biotechnology to conduct flexible and extensible model estimation and inference.

Title: STTR Phase II: Parallel Lattice Kinetic Software for High Mach Number Fluid Dynamics

Award Number: 0620490
Program Manager: Ian Bennett

Start Date: August 25, 2006
Expires: August 31, 2008
Total Amount: $500,000
Investigator: Hudong Chen, hudong@exa.com
Company: Exa Corp.
3 Burlington Woods Drive
Burlington, MA 01803
Phone: (781)676-8587

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will produce a novel parallel dynamic rule-based software tool for simulating high Mach number flows of interest for the ground transportation, aerospace and power generation markets. This work couples a multi-disciplinary interplay between algorithm design, modern cluster/grid computer architecture, parallel processing, and software engineering, and employs Lattice-Boltzmann Methods (LBM) with automatically generated grids with up to 100 million computational cells.

This new technology will enable virtual design within the ground transportation industry. Secondly, the ability of the parallel lattice kinetic software to address high Mach/Knudsen number problems should open important markets in aerospace, power generation, automotive, and other industries. Additionally, this new technology should establish markets for computer aided engineering (CAE), by numerical simulation of vehicles and powertrain components whose complexity have forced design/optimization using either physical experimentation or semi-empirical rules. The research will help to demonstrate the linkage between fundamental research and industrial applications, and emphasize the importance of non-equilibrium statistical physics methods as a core component in the commercial simulators.

Title: STTR Phase II: Modular Feedforward Adaptive Noise Control

Award Number: 0620496
Program Manager: Errol Arkilic

Start Date: August 23, 2006
Expires: August 31, 2008
Total Amount: $499,827

Investigator: Robert Collier, robert.d.collier@dartmouth.edu
Company: Sound Innovations
55 Railroad Row
White River Junction, VT 05001
Phone: (802)280-3020

Abstract:

This Small Business Technology Transfer (STTR) Phase II project seeks to develop an inexpensive, multi-purpose active noise reduction (ANR) module and associated software evaluation tools with broad commercial application to many occupational environments. This project will develop signal processing algorithms that improve the computational efficiency for ANR. The current Phase II objectives include: (1) developing a multi-purpose ANR module and associated ANR software modules capable of single- and multi-channel ANR for two markets: "quiet zone" ANR in commercial vehicle cabins and active noise abatement products for the noise consulting industry; (2) developing a corresponding suite of software tools to be used by noise consultants for turnkey retrofits of noisy environments with active noise abatement products, and (3) conducting full-scale in-situ evaluation of the ANR module, software, and tool suite in demonstration projects with the support of commercialization partners. The expected technical outcomes of Phase II include: (1) a manufacture-ready ANR hardware module with associated modular ANR software, (2) a suite of ANR evaluation tools for the noise consulting industry, validated through in-situ testing and (3) experimental results of the modular ANR concept from several full-scale demonstration projects.

The strong pull for new noise control technologies is the result of increasingly strict government and community regulations, industry standards, the growing body of scientific evidence of on noise-induced hearing loss (NIHL), and the multimillion dollar cost of occupational hearing disability compensation. The current business model is based on partnerships in which the proprietary 'Plug-and-Play' ANR module represents a branded embedded component for products manufactured and marketed by other industrial organizations and for installations by acoustical consultants.

Title: SBIR Phase II: A Decision Support System for the Train Schedule Design Problem

Award Number:	0548666
Program Manager:	Sally Nerlove
Start Date:	December 29, 2005
Expires:	December 31, 2007
Total Amount:	$512,000

Investigator: Ravindra Ahuja, ravi@InnovativeScheduling.com
Company: Innovative Scheduling
4548 SW 97th Terrace
Gainesville, FL 32608
Phone: (352)336-1257

Abstract:

This Small Business Innovation Research (SBIR) Phase II project entails developing a decision support system for the train schedule design problem, one of the freight railroad transportation's most significant optimization problems. Train scheduling is an important part of a railroad's operating plan that enables efficient movement of railcars. Designing such an operating plan is a very large-scale and very complex multi-objective optimization problem that, to date, has defied solution. Consequently, operating plan development at railroads is a lengthy, manual, and cumbersome process that may involve five to ten persons for a period of three to six months. Using cutting-edge operations research techniques, Innovative Scheduling, is developing a software product that can obtain a new operating plan within two weeks using two-three employees and can save a typical Class I US railroad over $50M annually. The train schedule design problem determines: how many trains to run; the origin, destination, and route of each train; the train arrival and departure times for each station at which it stops; the weekly operating schedule for each train; and the assignment of blocks of cars to trains. The train schedule must satisfy numerous practical constraints and business rules and achieve the minimum cost of transportation. This problem is a very large-scale multi-objective integer-programming problem containing trillions of decision variables. The proposed research will develop decomposition-based customized algorithms using state-of-the-art network optimization and heuristic techniques so that this problem can be solved within two hours of computer time on a workstation. These algorithms will be packaged into a web-based decision support system with attractive and friendly graphical and geographical interfaces, which will allow sufficient user control. The proposed research and development requires significant advances in modeling, algorithmic, and implementation technologies and will provide much needed software to schedule freight trains worldwide. This research will further be extended to develop a decision support system for passenger train scheduling. BNSF Railway, a Class I US Railroad, which is a Development Partner in this project and is providing supplementary funds, data and manpower.

The train scheduling decision support system is likely to be used by all freight railroads in their operating plan development process. A computerized method for train scheduling will make a railroad more responsive to traffic changes and enable it to change its schedule frequently. Optimal and timely train schedule will introduce greater efficiency in the system and significantly lower costs. Further, optimal train schedules require significantly less train miles, crew hours, locomotive hours, and railcar hours to transport the same set of shipments, thereby increasing our nation's energy efficiency and reducing pollution. The success of this product will lead to a greater acceptance of models and operations research techniques in railroad planning and scheduling. Railroads are then anticipated to embrace operations research models and introduce decision support systems in a variety of business processes including tactical operations and commercial strategy. The railroad industry will then be in a position to achieve a new level of productivity, resulting in lower freight charges for end users, and making America's products more competitive on the world market.

Title: SBIR Phase II: Web-Based Manufacturing Performance Management with Multi-Objective, Multi-model Optimization using Meta-Modeling

Award Number: 0548731
Program Manager: Ian Bennett

Start Date: January 13, 2006
Expires: December 31, 2007
Total Amount: $512,000
Investigator: Thomas Knight, tknight@invistics.com
Company: Invistics Corporation
5445 Triangle Parkway Suite 300
Norcross, GA 30092
Phone: (770)559-6386

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop a new Flow Path Management System (FPMS) representing an innovation in manufacturing software that: (1) Extends existing Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Manufacturing Execution Systems (MES) software by incorporating 'Lean Manufacturing' principles into a set of innovative simulation-based optimization algorithms; (2) Provides millions of dollars in inventory savings to existing and targeted manufacturing customers; and, (3) Is more available to virtual enterprises and smaller manufacturing companies than existing systems in that it can be delivered via the World Wide Web. The focus of this research project is the development of a meta-model-based simulation software for the analysis, prediction and optimization of manufacturing and supply chain processes. This software applies Kriging spatial optimization models - a proven interpolation-based response technique employed successfully in geo-statistics to solve complex and computationally intense manufacturing and supply chain problems.

The technology will be commercialized as a new module within the company's existing software suite, called the Flow Path Management System, and sold through three distribution channels: (1) on-site intranet installations at large companies; (2) delivery as a web service via the Internet to smaller companies; and, (3) licensing the algorithms to larger ERP/SCM/MES customers for incorporation in their software suites.

Title: SBIR Phase II: Multi-Environment Probability Density Function (PDF) Method for Modeling Turbulent Combustion Using Detailed Chemistry

Award Number: 0548752
Program Manager: Rosemarie Wesson

Start Date: February 10, 2006
Expires: January 31, 2008
Total Amount: $500,000

Investigator: Qing Tang, tang@reaction-eng.com
Company: Reaction Engineering Intl
77 W 200 S STE 210
Salt Lake, UT 84101
Phone: (801)364-6925

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will extend the applicability of the multi-environment probability density function (MEPDF) method to model turbulent combustion problems with realistic chemical kinetics within comprehensive Computational Fluid Dynamic (CFD) simulations of practical combustion equipment. The project aims to further advance the MEPDF method by extending it to simulate industrially relevant single-phase and two-phase combustion systems, such as chemical process furnaces fired with lean pre-mixed gas burners; oil fired utility boilers and industrial furnaces; and coal gasification equipment.

The proposed activities for extending the MEPDF method to simulate practical combustion systems using complex chemical kinetics would result in a tool that will enhance the scientific and engineering knowledge base for these processes. The advanced simulation tools produced from this project would provide a means for companies in the power generation, chemical process, mineral process, and incineration industries to improve product designs and services, which in-turn would benefit the environment, global competitiveness and national/homeland security.

Title: SBIR Phase II: Development of ModelGlove - A Virtual Clay Modeling System Using Force/Position Sensor

Award Number: 0620509
Program Manager: Errol Arkilic

Start Date: August 23, 2006
Expires: August 31, 2008
Total Amount: $500,000
Investigator: Kevin Chugh, chugh@tactustech.com
Company: Tactus
4250 Ridge LEA Suite 39
Amherst, NY 14226
Phone: (716)898-5923

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a Virtual Clay system comprised of a patent-pending sensor-enabled glove (called the ModelGlove), and a physics-based simulation engine which presents the user with a virtual 3D representation of modeling clay. The glove enables a designer to mold and shape the virtual clay with his or her fingers and hand, just as he or she would with physical clay. Clay modeling was pioneered by General Motors in 1914, and remains a popular technique. Since the early 80's, the computer aided design (CAD) market has grown dramatically, and 3D CAD has become the most technically-advanced tool for designing complex shapes. However, very little work has been done to merge the physical clay and CAD environments. Virtual Clay aims to fuse these environments, blurring the line between art and engineering and giving designers a unified modeling tool at all stages of development.

By advancing the state of the art in design and opening new worlds of design to mechanical engineers designing and modeling products, broad impacts are anticipated. The Virtual Clay system represents a significant advancement in wearable computing, where the user directly manipulates a virtual object with his or her hand. Further, a physics-based simulation of clay in a design environment promises to open new areas of exploration in the CAD world. By giving control to the user of not only the design, but the simulation environment itself (the user can control how soft or hard the clay is, for example), a whole new way of thinking about how simulation and CAD can evolve. Further, artists and engineers will benefit from being able to watch and decipher every manipulation that an expert modeler has completed on the virtual clay. Bringing a physical medium to a digital environment will thus open up numerous possibilities in design, assessment and analysis, testing, and collaboration.

Title: SBIR Phase II: Strategic Model for Manufacturing Organizations (DSMMO)

Award Number: 0646275
Program Manager: Ian Bennett

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000
Investigator: Lia DiBello, lia@wtri.com
Company: Workplace Technologies Research Inc.
1425 Russ Blvd.
San Diego, CA 92101
Phone: (619)232-8054

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project proposes a dynamic modeling technology that helps decision makers visualize and calculate the top and bottom line financial impact of changes made at the strategic, tactical, and operational levels of a business. The proposed research will make intellectual contributions regarding how technologies extend complex cognitive capabilities in high-performance business settings. The resulting tool promises to address two well-known problems faced by business executives: decision-making rigidity and the inability to think simultaneously on strategic and tactical levels.

The broader impacts of the proposed technology have already been indicated by the increased use and measurable success of these models in client engagements. However, the models in their current form, are not widely or easily accessed although demand for them is high. This tool will have important pedagogic value to university programs because it will enable students to think through the multi-level issues in organizations. The models themselves may also add to the understanding of how the different levels and functions in an organization interact.

Enterprise Systems

Title: SBIR Phase II: Workflows to Enable Agile Virtual Enterprises (WEAVE)

Award Number: 0110278
Program Manager: Juan E. Figueroa

Start Date: July 1, 2001
Expires: June 30, 2004
Total Amount: $499,881
Investigator: Robert Pokorny, pokorny@xsb.com
Company: XSB, Inc.
25 East Loop Road
Stony Brook, NY 11790-3383
Phone: (631)444-6800

Abstract:

This Small Business Innovative Research (SBIR) Phase II project, Workflows to Enable Agile Virtual Enterprises (WEAVE), is envisioned as an on-line service to manage workflow for virtual enterprises. Phase I feasibility was undertaken in the context of virtual enterprises that arise in supply chain management. Phase II will do full-scale implementation of WEAVE to efficiently establish and manage supply chains in an e-commerce environment. Traditional supply chains are built with a small number of long-term suppliers because of the high cost of finding and establishing new supply sources. The Web and a variety of legacy data sources provide abundant information about possible supply sources. But this information is often dynamic and unstructured requiring manual effort to discover. XSB, Inc has developed technology to infer supplier capabilities, giving manufacturers an instant view of 'who makes what' across their own supply chain as well as thousands of potential suppliers across the web.

WEAVE will implement this technology to locate sources of supply. This ability to locate sources for parts will be integrated with a system to plan and manage purchasing strategies for a user's complete bill-of-materials. Using WEAVE small-to-medium manufacturers can quickly create supply chains that is relevant for their enterprise. In the long-term WEAVE will serve as the infrastructure for establishing a peer-to-peer supply network.

Title: SBIR Phase II: Advanced Planning and Scheduling Tools for Extended Enterprise Systems

Award Number: 0450552
Program Manager: Juan E. Figueroa

Start Date: April 1, 2005
Expires: March 31, 2007
Total Amount: $394,965

Investigator: Guining Li, guining@yahoo.com
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1445 Starr Grass Dr.
Madison WI, 53719
Phone: (608)833-1189

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build upon the successful development of the Phase I project that developed models and algorithms for planning and job scheduling systems. The software tool described in this proposal will allow organizations to schedule their operations in real-time to generate the optimal plan to maximizing their operational targets. During Phase I, the team created new planning and scheduling algorithms and successful empirical studies using recent innovative research in the areas of large-scale optimization and the newly developed methodology of Nested Partitions. In Phase II the team plan to further develop the concept to create successful implementations in several manufacturing firms. The technology to be developed in Phase II will greatly enhance the capability of the current planning and scheduling software tools. This innovation brings the state-of-the-art decision and optimization methodology to the Advanced Planning and Scheduling software market. In addition, planning systems developed with the proposed methodology will add new levels of flexibility for companies to more quickly adapt to changing material, operational, and market conditions.

This SBIR project will make new planning and scheduling tools broadly accessible to virtually any manufacturing firm. The proposed scheduling and planning tools will enable them to communicate, collaborate, and integrate their planning and scheduling functionalities to obtain optimal results throughout their enterprise and their entire supply chain. It is expected that coordinated use of these tools will eventually create an integrated cyber-infrastructure for American manufacturing firms and create more efficient supply chains that will enable these firms to be more competitive in the global marketplace. Moreover, if successful, the development of this proposed tool will lead to fruitful attempts to develop and commercialize an advanced planning and scheduling software tools that can be used for many other sectors of the economy

Title: SBIR Phase II: Lean Physics: Streamlining the Supply Chain Using Factory Physics

Award Number: 0349659
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Keith DiAngelis, diangelis@factoryphysics.com
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Abstract:

This SBIR Phase II project involves the creation of an innovative Methodology and software Toolkit that can substantially improve the supply chain of virtually any manufacturing firm. The proposed Support Tools offers a comprehensive system that combines the best of the "software only" and the "best-practices" approaches with a framework to create a new paradigm for production system improvement. Algorithms based on this framework will provide important diagnostic and analysis tools that show how and where major improvements to the supply chain should be made. Execution algorithms that "bolt onto" existing supply chain management systems will provide the means to improve productivity, reduce inventory, and increase customer responsiveness without having to replace existing implementations. The toolkit can also be delivered over the Internet, providing a cost effective alternative to smaller companies.

Commercial versions of this innovation could enable widespread adoption of a new and more effective paradigm of manufacturing logistics. With the loss of 2.3 million jobs in the last three years, the issue of manufacturing productivity is critical as is the need for supply chain tools which integrate production software systems with operational initiatives to improve productivity and cost competitiveness. Widespread adoption of this methodology and tools could have a profound influence on the competitiveness of U.S. industry.

Title: SBIR Phase II: Evolving Object Neural Networks

Award Number: 0349604
Program Manager: Errol B. Arkilic

Start Date: February 1, 2004
Expires: January 31, 2006
Total Amount: $499,642
Investigator: David Fogel, dfogel@natural-selection.com
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La Jolla, CA 92037
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Abstract:

This Small Business Innovation Research Phase II research project will investigate the problem of generating evolutionary object neural networks for controlling characters in classes of entertainment software, with consideration given to genres of massively multiplayer online games. The objective of the research is to identify and develop general self-adaptive routines and software tools that can be incorporated in a software developer's kit (SDK) that is suitable for licensing to third-party developers. A series of experiments conducted within a statistical framework will identify first- and second-order effects of parameter choices for the evolutionary control of game characters, which will be incorporated into the SDK. R&D will be aimed at generating the most rapid evolutionary learning for game characters while having the smallest code "footprint." Additional research will facilitate automatic play testing and optimization of artificial intelligence in games. The scientific and technical understanding of hybridizing evolutionary computation and neural networks will be enhanced by the careful study of the nonlinear effects of parameter choices in the studied settings.

If successful this product will ease the transition of video games from development to products. The development of an SDK that will help reduce the time and cost of segments of video game production by 50-80%. The software developed may serve as educational classroom aids in university courses. Furthermore, the strong correlation between video games and military simulations suggests important contributions to dynamic planning in combat simulations, as well as extensions to optimizing courses of action in business operations, such as supply-chain management.

Title: SBIR Phase II: Uncertainty Analysis of Manufacturing Process Models

Award Number: 0348771
Program Manager: Juan E. Figueroa

Start Date: May 1, 2004
Expires: April 30, 2006
Total Amount: $499,235
Investigator: Ellen Meeks, emeeks@reactiondesign.com
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to create a robust software system for performing uncertainty analysis of process simulations for manufacturing. For simulations that are large or that contain many parameters, even the best Monte Carlo, or importance-based sampling methods for uncertainty analysis can be prohibitively expensive. Consequently, systematic uncertainty analyses are rarely implemented for complex systems. This proposal presents a plan to produce a commercially viable package of a new method for quantifying simulation uncertainty, based on polynomial chaos expansions. The method can determine the probability density functions of black-box model responses and can identify quantitatively which of the parameters contribute most to uncertainties in responses for multivariate inputs and outputs. The unique sampling approach enabled by the use of polynomial chaos expansions allows more accurate resolution of probability distribution functions at a very small fraction of the cost to achieve similar results with more traditional uncertainty-analysis methods.

While illustrative examples from the chemical manufacturing industries will be used to demonstrate the software functionality, the methodology has broad application to such fields as circuit design, risk management, allocation of experimental resources, chemical plant design and operation of production systems. Due to the ability to handle arbitrary or black-box simulations, the methods can be applied as easily to economic market analysis, or global climate modeling, as to chemical process design.

Title: SBIR Phase II: Supply Chain Management via the World Wide Web

Award Number: 0216212
Program Manager: Cheryl F. Albus

Start Date: July 1, 2002
Expires: June 30, 2004
Total Amount: $500,000

Investigator: Thomas Knight, knight@saklogistics.com
Company: SAK Logistics
5335 Triangle Parkway
Norcross, GA 30092
Phone: (770)559-6386

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop a new Flow Path Management System (FPMS) representing an innovation in Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) that is more effective than existing supply-chain management software paradigms, incorporates "lean manufacturing" principles, and is more available to smaller manufacturing companies than existing systems in that it can be delivered via the World Wide Web. The software has the potential to reduce inventory by 20% or more in companies with complicated manufacturing operations and/or supply chains. In addition, the software can recommend supply chain planning policies that increase throughput, decrease cycle times, and improve customer service.

The commercialization strategy is to use distribution channels: (1) on-site Intranet installations at large companies (2) delivery as a web service via the Internet for smaller companies, and (3) licensing the algorithms to larger ERP/SCM vendors for incorporation in their software suites.

Title: SBIR Phase II: Optimal Replenishment Algorithms for Service Parts Logistics Systems

Award Number: 0239030
Program Manager: Juan E. Figueroa

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $498,419

Investigator: Vipul Agrawal, agrawal@mcasolutions.com
Company: MCA Solutions LLC
230 South Broad Street, St 601
Philadelphia, PA 19102-4107
Phone: (215)717-2180

Abstract:

This Small Business Innovation Research Phase II Project will develop prototype software to provide optimal real time purchase and repair replenishment, and allocation of service spare parts used to provide after-sales support to mission-critical products. It will design, develop and test advanced optimization algorithms to ensure that the right part is ordered from the right source in the right quantity at the right time and then allocated to the right location. In Phase III these engines will be incorporated in MCA Solutions planned commercial enterprise software product Replenishment and Allocation Optimizer (RAO) and complement MCA Solutions current product Service Parts Optimizer (SPO).

The use of this tool will result in higher availability of service parts; increase products uptime and lower expense in service parts inventory. The target industries for this solution will be Defense, Aerospace, and manufacturers of Automotive, Computer, Telecommunications and Hi-Tech equipment. RAO will be the first commercial software product to support near real time optimization of inventory management in service supply chains. The requirement allocation optimizer software market is underdeveloped. The size of this opportunity is significant. Over 1,100 companies in the United States generate sales higher than $250 M/year in the original equipment manufacturer segment. Combined sales in this sector are $3.3 trillion with total inventory investment in service parts of about $250 Billion. Service parts inventory accounts for about 5 to 10% of product sales for an OEM. The technology has the potential to reduce these investments by 20% to 40, which in turn may pass some of the reductions to the customers.

Title: SBIR Phase II: Supply Chain Optimization and Product Explorer

Award Number: 0620233
Program Manager: Errol Arkilic

Start Date: August 1, 2006
Expires: July 31, 2008
Total Amount: $499,995

Investigator: Nainesh Rathod, nainesh.rathod@imaginestics.com
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West Lafayette, IN 47906
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Abstract:

This Small Business Innovation Research Phase II project will achieve higher retrieval accuracy for shape-based search for both the web and the enterprise. The proposed work in Phase II is to achieve higher retrieval accuracy supported by three key components: 1) pose determination for 3D models: bridging the space gap between 2D and 3D shapes by finding three intuitive and robust orthogonal orientations for 3D models; 2) 2D orthogonal view generation: representing a three orthogonal views along the pose orientations; 3) similarity measurement between 2D shapes: finding 2D and 3D shapes based on the user's query. A framework will be developed by focusing on three important modules: 1) 2D constraint detection and use of implied constraints with initial application in 2D and 3D views; (2) Enhanced multiple level-of-details in 3D representations, and (3) Human assisted system classification of large datasets.

Traditional options of finding part suppliers using catalogs, trade shows and prior business relationship limit the choice of suppliers. Current text-based search to find suppliers face challenges, such as context and language sensitivity, and is inadequate in overcoming the technological challenges posed by variations in how product or part information is specified across a global supply chain. The current effort proposes to use shape, which is the lowest common denominator, to link the OEMs and suppliers. This technology can also aid the current trend among companies in aerospace, automotive, medical equipments and other industries towards 3Ddata standards for fast retrieval, as it can provide a significant leap in terms of accuracy, speed and relevance in the search and retrieval of information. If successful, this technology can contribute significantly to research in areas where shape is important, such as bio-technology and pharmaceutical sectors, where rapid identification of molecules and their docking features help reduce time and cost involved in drug development. For the medical industry due to increased usage of CT scans and 3D imaging technologies, 3D shape search can be used for local feature identification in colonoscopy or other exploratory procedures, brain angiography, reconstruction, projection of malformation or location of polyps and ensure better and rapid diagnosis of disease. Development of methods for automatically parsing human sketches and determining constraints will enable many other research activities and broadly help in a more natural human machine interaction.

Title: SBIR Phase II: Reducing Lead Time and Inventory by Using Optimized Product Configurations

Award Number: 0620269
Program Manager: Errol Arkilic

Start Date: July 25, 2006
Expires: July 31, 2008
Total Amount: $499,818
Investigator: Roy Marsten, rmarsten@emcien.com
Company: Emcien
75 Fifth Street, NW
Atlanta, GA 30308
Phone: (770)621-5877

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the impact of product variety on the customer order fulfillment process. It aims to help the manufacturers of highly configurable products with many possible "variants" or "configurations" to maximize product availability and order fill rates. Prior research by Emcien has created a methodology for representing product variants, modeling customer demand, and computing an optimal set of product configurations to maximize margins. These stockers are optimal in the sense of satisfying the most demand while maximizing profitability, but they assume unlimited product inventory. In previous research, Emcien built a prototype simulation model to determine how well these optimal stockers would perform in practice. The prototype simulation model was used successfully by two of Emcien's clients. The Phase II project will turn this prototype into production quality software that will become a part of Emcien's suite of products that address product variety.

More manufacturers are moving in the direction of "mass customization", which means allowing each customer to choose the features and options they want. Mass production of a uniform product, or one with a small number of variants, is evolving into flexible production as more and more choices are offered to the customer. But customers not only want to customize their product, they also want to get it quickly. Pure build-to-order systems can result in unacceptably long customer lead times, especially when demand has seasonal ups and downs. This forces manufacturers to build partially finished or fully finished units for inventory, in order to smooth production and reduce customer lead time. This requires a delicate balance between the extra revenue and the extra costs of offering more variety. Emcien's mission is to help manufacturers profit from product variety as a competitive advantage, rather than being overwhelmed by the extra costs of supporting too much variety.

Title: SBIR Phase II: Parts Forecasting for Configurable Products

Award Number: 0723832
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,905
Investigator: Roy Marsten, rmarsten@emcien.com
Company: Emcien
75 Fifth Street, NW
Atlanta, GA 30308
Phone: (770)621-5877

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop a new methodology for parts forecasting for discrete manufacturing. Emcien is developing a software suite to enable a product manager to better manage a configurable manufactured product. This suite includes a method for forecasting the demand for a configurable product at the full configuration level of detail. This means forecasting unique configurations, each with an expected volume. The method depends on extracting customer buying patterns from the sales history for the product. The mathematical algorithms for extracting and representing these patterns, and forecasting using these patterns are the main contributions of the research. The set of parts needed to build a configurable product generally depends on combinations of options, so it is not possible to plan parts requirements from an aggregate forecast. By using a configuration level forecast, it is possible to expand each unique configuration into component parts, and then use the associated volumes to produce a complete parts forecast.

American manufacturers are specializing in complex, configurable, high-end products, as mass produced commodity products move offshore. Allowing customers to customize a product results in significant numbers of alternative product configurations. This variety increases costs in many ways. One important way is the increased difficulty of planning parts requirements. The current practice of basing parts planning on a few popular variants leads to excess inventory of some parts and shortages of others. Excess inventory incurs both holding and obsolescence costs. Shortages can interrupt production and cause both lost sales and quality problems. Emcien has developed a methodology that, among many other benefits, can improve the accuracy of parts planning.

High Speed Networking

Title: SBIR Phase II: Reconfigurable and Scalable Fiber-Optic Ultra-High-Speed Multi-Media Networks

Award Number: 0091601
Program Manager: Juan E. Figueroa

Start Date: May 1, 2001
Expires: April 30, 2004
Total Amount: $500,000

Investigator: Behzad Moslehi, bm@ifos.com
Company: Intelligent Fiber Optic Systems
650 Vaqueros Avenue, A
Sunnyvale, CA 94085-3543
Phone: (408)328-8610

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the next generation data networks, which will require terabit information handling capability. Future networks must be reconfigurable, highly secure and easily upgraded in both bit rate and number of nodes. The company will apply its extensive fiber optic expertise and its proprietary wavelength-division multiplexed (WDM) technology to the development of a reconfigurable high-speed fiber-optic backbone structure that supports the transmission of multiple data protocols between multiple network stations. The approach is based on the company's all-fiber, static and dynamic WDM network access designs which offer high efficiency, compactness and low cost. In Phase I a three-node, two-wavelength system was constructed with static access modules to demonstrate the feasibility of simultaneously transmitting different protocols such as ATM and Ethernet. Phase I formed a basis for Phase II engineering development where the researcher will employ dynamic access modules and expand the network to 8 nodes and 4 wavelengths to demonstrate network reconfigurability and scalability.

The market for fiber-optic networks is growing at a rate of over 20% per year and is expected to exceed $18 billion in 2001. Multi-protocol fiber backbones have applications in commercial platforms, such as enterprise networks, ships, airliners, automobiles, and integrated manufacturing equipment. Each optical fiber can replace hundreds of wires resulting in substantial drop in costs, component weight, and an increase in performance. The project will integrate well with the Internet-II, and SuperNet programs for the government-wide Next Generation Internet (NGI).

Title: SBIR Phase II: Hardware Support for 10 Gbps Intrusion Detection

Award Number: 0521902
Program Manager: Errol B. Arkilic

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $498,205

Investigator: Livio Ricciulli, livio@metanetworks.org
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will dramatically advance performance breakthroughs achieved by utilizing a Multiple Instruction Single Data (MISD) processing model applied to high-speed Intrusion Detection and Prevention System (IDPS) hardware. A multiple-chip implementation of the MISD processing model will further demonstrate the scalability and cost-effectiveness of the technology by increasing IDPS processing capacity to levels while reducing costs for the existing system. Current line speed stateful computations are limited by the cost and scalability of currently available content addressable memories. Ideas derived from memory caching architectures will be adapted to build a novel memory subsystem specifically designed to cost-effectively support critical, stateful, 10 Gbps security applications such as TCP stream reassembly and protocol normalization. Finally, the development of open-source interfaces will extend the use of these innovations to a large community of users who will certainly contribute to the advancement of IDPS technology through inter-organizational collaborative efforts.

Next-generation applications require high-speed network connectivity. For example, supercomputer clustering, medical image delivery, data storage networking, video conferencing, and tele-presence applications all need 10 Gigabit and higher speeds. Unfortunately, public and private communication infrastructures are today being destabilized by security compromises. Network viruses, worms and other attacks can propagate very quickly over the Internet and private networks, disabling commerce and resulting in significant productivity loss. The ability to detect and prevent these attacks from traveling through high speed links is a crucial requirement for fostering their adoption across organizational boundaries. Without proper intrusion detection and prevention, high speed links will introduce severe attacks in information systems and limit the commercial viability and far-reaching benefits of high bandwidth, next-generation applications. This Phase II project will dramatically improve the cost-effectiveness, openness and scalability of high-speed IDPS technology. This will facilitate a broader use of inter-organizational, high-speed connectivity and impact social, economic and educational progress

Title: SBIR Phase II: Scalable and Reliable Storage Infrastructure for Network Storage Environments

Award Number: 0450528
Program Manager: Juan E. Figueroa

Start Date: February 1, 2007
Expires: January 31, 2007
Total Amount: $500,000
Investigator: M.Firas Malouhi, firas@datareliability.com
Company: Data Reliability Inc.
3895 Metro Drive
Jackson MS, 39209
Phone: (601)944-0048

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build a scalable and reliable storage system for network storage environments. This outcome of this project is a revolutionary system that employs a combination of unique ideas to address the main challenges encountered in today's demanding storage environments namely scalability, availability, performance, and manageability. The ideas of this proposed solution are applied as a disk-based solution for the time-consuming network backup/restore problem. With the rapid growth of data-driven network services, traditional storage solutions are not able to keep pace with the rapidly expanding storage requirements. Unlike traditional solutions the proposed solution employs a new architecture that allows for independent and practically unlimited scalability of capacity, file access performance, and namespace access performance. The proposed product utilizes a unique, very fast coding technique called PND to ensure fast, reliable, and highly available access to data. It offers the opportunity of applying a more effective block-level edge caching technique, which enhances the performance and achieves better utilization of the valuable cache memory. It takes advantage of Data Reliability, Inc.'s innovative RAISTM storage engine to cost-effectively aggregate distributed islands of independent storage resources into a single virtual shared pool of storage. Project Phase I has clearly demonstrated the above advantages.

Many applications will exploit the competitive advantages of the proposed product including Web server farms; multimedia network services, content management, document storage and delivery, digital imaging, and file transfer services. In addition, the expected solution's ideas can be expanded to build general-purpose file servers that are not subject to performance bottlenecks and capacity limitations. Therefore, these ideas will have an important impact on building next generation NAS devices. The PND technique, pioneered by this project, provides a new class of codes that are expected to result in scientific advances in coding theory. In addition, the PND technique will contribute to enhanced performance and architectures of disk arrays. Applications of PND coding in areas other than data storage include mobile communications, reliable multicasting, audio/video streaming, and digital fountain systems. The company is partnering with Jackson State University (JSU) and will offer JSU students a tremendous educational experience. Since Jackson State University is an HBCU (Historically Black College and University) in the underrepresented state of Mississippi, the project will foster continuous collaboration and will increase the participation of underrepresented and minority groups in science and technology

Title: SBIR Phase II: Commoca Internet Protocol Phone - Making Communications Personal

Award Number: 0450436
Program Manager: Juan E. Figueroa

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $500,000

Investigator: Carlos Velez-Rivera, carlosvelez@comoca.com
Company: Commoca, Inc.
Calle Mendez Vigo 68E
Mayaguez PR, 680
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a suite of server based infrastructure software and applications to empower service providers with the ability to deploy, monitor, customize content, debug, and upgrade their VoIP (Voice over Internet Protocol) terminals remotely. The proposed Transactional Applications Delivery System (TADS) will allow service providers to define new revenue generating applications and corporate IT departments and third-party IT solution providers to develop vertically integrated, productivity enhancing data-voice applications. The proposed system will also provide a cost-effective means for service providers to move high-end VoIP terminals into the home consumer market, through, for example, multi-year service contracts in exchange for subsidized phones (the new revenue generating opportunities will allow service providers to do this). By addressing these needs, TADS will allow tighter integration between telephony features and IT based systems, taking better advantage of unified messaging (voice mail, e-mail, video mail, instant messaging, etc), collaboration, conferencing, presence, etc. It will also allow end-users access to ubiquitous features across different networks and different locations.

This project will define, develop, and deploy a complex software platform that will significantly accelerate the time to market of revenue generating and productivity enhancing advanced VoIP applications and services. In addition, the development of the proposed TADS technology will lead to new knowledge in the areas of human computer interaction, data mining, IP information appliances, and networking. The results to be obtained from this project will have a significant impact on the structure of the VoIP consumer market and the way converged voice-data applications are developed and deployed in the enterprise market

Title: SBIR Phase II: Automated Personalized Rich Media Broadcast Generation

Award Number: 0349740
Program Manager: Juan E. Figueroa

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $494,723

Investigator: Robert Rubinoff, robert.rubinoff@streamsage.com
Company: StreamSage, Inc.
1202 Delafield Pl., NW
Washington, DC 20011
Phone: (202)722-2440

Abstract:

This Small Business Innovation Research Phase II research project will create a prototype system that will cut through the overload of audio/video (rich media) content by generating personalized broadcasts from a library of rich media documents. Building upon existing expertise in dealing with rich media, the proposed research will apply and refine the techniques discovered in phase I to organize relevant material using both the context of the documents and the topics of the selected material. The prototype will also apply the phase I results to identify and fill in the critical gaps between segments of material extracted from the source documents with bridging text that will provide necessary context and structure, allowing the system to present the relevant material as a single coherent broadcast. This research will result in new techniques that allow separately obtained passages of audio/video (or even text) to be joined together coherently. It will also provide techniques for organizing information based on both contextual and topical cues. These techniques will be applicable in any context in which information in natural language form is being extracted from a source collection. Furthermore, the research results will provide cost efficiencies for a number of specific important vertical markets (e.g. finance, broadcast news monitoring, etc.).

The resulting software products will dramatically reduce the costs of the currently manually intensive information extraction process employed by firms in these markets. More generally, the software products that are derived from the company's current technology platform will also increase individuals' ability to find and absorb relevant information from diverse information sources, many of which are entirely intractable today. This ability is important in a wide range of communities such as academic institutions, intelligence agencies, homeland security agencies, financial institutions, and news broadcasters.

Title: SBIR Phase II: Advanced Proxies for Shared Wireless Internet Access

Award Number: 0348440
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Norman Abramson, nabramson@hokupaa.com
Company: Hokupaa Technologies, Inc.
521 Lake Street
San Francisco, CA 94118
Phone: (415)666-3223

Abstract:

This Small Business Innovation Research Program Phase II project will develop advanced forms of transparent network proxies for both satellite and terrestrial broadband wireless communications to the Internet. Shared wireless access links to the Internet often exhibit what has been called a traffic / cost anomaly. While almost 90% of the traffic in the network can flow from the Internet to the user, almost 90% of the cost of the access links can be attributed to the channel transmitting packets from the user to the Internet. Wireless Internet access from the user to the Internet is often implemented by means of some variation of a random access ALOHA channel. The interaction of ALOHA channels with TCP and other high level protocols used in the Internet can limit the effectiveness of both TCP and ALOHA for such access. The goal of this NSF SBIR research program is to understand this awkward interaction of standards in the high cost random access channel and to develop a strategy of migration to a more sensible access architecture based upon transparent proxies.

The societal and commercial impact of this project will be to increase the capacity of broadband wireless Internet multiple access channels thereby decreasing the cost per user of the channel. This decrease in the cost per user when shared with customers can increase the market for broadband wireless access to the Internet while increasing the profitability for wireless Internet Service Providers. These fast proxies will make wireless Internet access affordable for under-served and un-served end users in rural areas in the United States and in much of the rest of the world. Additionally the technical innovations of this research will serve to advance the current level of understanding of how TCP/IP protocols interact with other protocols in wireless data networks.

Title: STTR Phase II: Autonomous Undersea Systems Network (AUSNET)

Award Number: 0132084
Program Manager: Juan E. Figueroa

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $500,000

Investigator: Charles J. Benton, cbenton@simworks.com
Company: Technology Systems, Inc.
P.O. Box 717
Wiscasset, ME 04578-0717
Phone: (207)882-7589

Abstract:

This STTR Phase II project will result in the creation of an advanced network capability to enable ad-hoc networks to operate in a low bandwidth undersea environment. The specific application of the resultant capability will be to support Autonomous Undersea Systems Networks (AUSNET), which are fleets of unmanned robotic vehicles that can provide survey, search, and monitoring functions for customer bases including the oil industry, environmental monitoring, undersea communications infrastructure, search and rescue, and military applications. The capability will build upon the emerging standard Dynamic Source Routing (DSR) protocols to create a network that is entirely self-configuring, bandwidth conserving, and tailored to the unique requirements of cooperative undersea robotic operations. The two technical thrusts of the effort include AUSNET low-level protocol development, and higher level Application Programmer Interface specification and development. The cooperative Autonomous Undersea Vehicle (AUV) market is emerging and substantial. There are currently 17 companies selling undersea communications devices, each of which is a candidate licensee for AUSNET technology. Near term application of Phase II results is anticipated in Naval applications. Even greater application is to be found in support of offshore undersea operations addressing requirements of the oil industry, communications (undersea cable) installation and maintenance, environmental survey and monitoring, search and rescue operations, and exploration/scientific research.

Title: SBIR Phase II: Programmable, Scalable Wireless Information Infrastructure

Award Number: 0110460
Program Manager: Sara B. Nerlove

Start Date: October 1, 2001
Expires: September 30, 2004
Total Amount: $499,937
Investigator: John Chapin, jchapin@vanu.com
Company: Vanu, Inc.
One Porter Square, Suite 18
Cambridge, MA 02140-1496
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project has two primary objectives: to continue the research and development of clustered software radio technology begun in the Phase I project, and to use that technology to extend current waveform implementations to a fully functional base station. A high impact application of clustered software radio is for cellular telephone base stations, changing them from fixed hardware devices into flexible software devices that can support multiple commercial standards and also public safety needs. This Phase II project will develop a clustered software radio base station that interoperates with commercial GSM mobile units and switching centers. The goal is a base station sufficiently functional to be deployed in a field trial, which is the necessary next step in commercializing the technology. The project will include innovative technology development in timing control, wideband synthesis, and intra-cluster data transport.

In the telecommunications industry, many foresee that base stations for third-generation wireless systems will be software radios or software-defined radios. The development of clustered software radio technology by Vanu, Inc. for this market will improve interoperability, improve service to underserved rural areas, enable more efficient use of the radio frequency (RF) spectrum, provide substantial public safety benefits, and increase the pace of technological innovation in the wireless communication marketplace. Moreover, the firm's computing architecture has broad application to signal processing problems outside the wireless industry.

Title: SBIR Phase II: Enabling Sharable Infrastructure for the Human/Computer Interface

Award Number: 0238965
Program Manager: Juan E. Figueroa

Start Date: March 1, 2003
Expires: February 28, 2005
Total Amount: $500,000

Investigator: William B. Seales, seales@uky.edu
Company: Lumenware LLC
4241 Watertrace Drive
Lexington, KY 40515-0001
Phone: (859)885-4651

Abstract:

This Small Business Innovation Research Phase II project addresses the challenge of seamless interoperability among computer systems and user interface components such as displays and keyboards. Such components today are tightly coupled with the computer, which restricts the utility of both especially in mobile systems, where users invariably have to choose between usable displays and reasonable portability. The system being separates I/O devices from computing devices enabling a different mode of use of computers where a user can carry around much smaller computing devices and use shared larger I/O devices as available. The design and implementation of these enhancements will be guided by feedback from users of prototypes deployed in the field. In the long run, the widespread adoption of this approach has the potential to revolutionize the way humans interact with computers, by allowing computing devices to shrink out of sight, while freeing interfaces from the constraints of portability.

The technology has immediate commercial applications in health care and mobile computing as well, these markets will be explored through future strategic partnerships.

Title: SBIR Phase II: The Delivery of Content-Rich Traffic Information to Improve Driver Decision Making

Award Number: 0522320
Program Manager: Errol B. Arkilic

Start Date: October 1, 2005
Expires: September 30, 2007
Total Amount: $500,000

Investigator: Randall Cayford, rcayford@intellione.com
Company: IntelliOne Technologies Corporation
1776 Peachtree Rd NW
Atlanta GA, 30309
Phone: (404)969-3755

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop user interfaces, routing algorithms, and driver notification systems necessary to deliver content-rich traffic information to travelers en route. Large volumes of traffic data, of varying types over large areas, is being gathered by public and private agencies. To be useful to a driver while traveling, this data must be reduced to small amounts of information and delivered in a way that allows easy comprehension with minimal distraction. Key driver behaviors benefiting from traffic information are pre-trip departure time changes, pre-trip and en-route route changes, and en-route anxiety reduction through drivers knowing the estimated arrival time. These behaviors depend on collecting and analyzing the planned route under changing traffic conditions and comparing that route with possible better alternatives. This research will develop user interfaces to collect origin, destination, and route information from drivers, pre-trip via the web and en-route via cell phone. Algorithms to determine alternate routes will be developed through analysis of field collected route data. Notification methods that present the salient information with minimal distraction will be developed and tested. The research will result in the development of better traffic information services that truly support the decisions drivers make as they travel.

The results of this research have potentially broad impacts on society. Traffic congestion is a growing problem in U.S. cities. In some areas, it has become a limiting factor on economic growth. Emphasis has shifted in recent years from providing additional capacity to better utilization of the existing infrastructure. Broad dissemination of traffic information in a form suitable for making optimal routing and trip decisions allows efficiency improvements based on the decentralized decisions of many drivers. Trip modifications based on traffic information can save drivers an estimated $3.9 billion in lost productivity, 225 million hours of travel time, and 340 million gallons of fuel, per year. It is believed that such savings could support a viable commercial marketplace for personalized traffic information. Similar savings are possible for commercial travel through improvements in delivery routing, on-time delivery, and more efficient dispatching. Congestion management by public agencies strives for efficient use of the public infrastructure by shifting motorists onto less congested roads and would benefit from better interfaces between the traffic data collected and the individual drivers on the roads. The examination of route choice will advance the scientific understanding of how drivers choose their routes and how they alter those routes under changing external conditions.

Title: SBIR Phase II: Automatic Classification of Magnetocardiograms

Award Number: 0349580
Program Manager: Errol B. Arkilic

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $486,749
Investigator: Karsten Sternickel, karsten@cardiomag.com
Company: CardioMag Imaging, Inc
450 Duane Ave
Schenectady, NY 12304
Phone: (518)381-1000

Abstract:

This SBIR Phase II research project will incorporate machine-learning techniques into agneto-cardiography (MCG) that measures minute magnetic fields emitted by the heart's electrophysiological activity, based on SQUID technology and operable in typical (magnetically unshielded) hospital rooms, for early non-invasive diagnosis of heart disease. The overall objective of this project is to identify and localize, using MCG, cardiac ischemia, the leading cause of death in the US. The focus will be on excellent predictability, ease of tuning, and user transparency of machine learning tools. Upon successful completion of this project MCG has the potential to become the new gold standard for the detection of cardiac ischemia in patients presenting with suspicion of acute coronary syndrome. Worldwide, the lack of inexpensive and non-invasive cardiac diagnostic techniques causes unnecessary delays in the recognition of acute coronary heart disease and its treatment. The feasibility of MCG to diagnose heart disease has been demonstrated. Machine learning tools provide quantitative methods for the automated diagnosis of heart disease.

After successful completion of this project, physicians and nurses in leading U.S. hospitals can be trained in automated MCG diagnosis. It will also usher the use of machine learning tools for medical diagnosis in general.

Title: SBIR Phase II: A Computerized Test Battery to Evaluate Workplace Stresses

Award Number: 0078467
Program Manager: Sara B. Nerlove

Start Date: December 1, 2000
Expires: November 30, 2002
Total Amount: $379,144

Investigator: Robert Kennedy, 6kennedy@bellsouth.net
Company: RSK Assessments Incorporated
1040 Woodcock Road, Ste 227
Orlando, FL 32803

Abstract:

This Small Business Innovation Research Phase II project from RSK Assessments, Inc. will expand and improve upon the test battery implemented for Phase I, including cross validation, examination of other behavioral scoring approaches (signal detection theory, Bayesian methods), other agents (viz., sleep loss) as well as the interplay of these methods on special purpose hardware and new software. Phase I examined the feasibility of conducting human performance-based fitness-for-duty (FFD) testing as an alternative to chemically-based testing. The testing method was brief and inexpensive, and the tests were stable and reliable. Using a multiple cut-off analysis varying proportion of tests passed, they yielded 98+% specificity (minimal false positives) with 80% sensitivity for high dosages of alcohol (and 60% for low). The new battery tightens security, running within self-contained kiosks and providing data encryption and access via smart card usage. Improved managerial control will be implemented within the test system, including test control and scheduling, data analysis methods, and reporting. Additional means of quantifying behavioral decrements will be obtained from sleep deprivation research, analyses of past alcohol research, and an "alpha" test site. Data from these sources will yield a better assessment model and refine calculations for tradeoff between test length, specificity, and sensitivity.

RSK Assessments proffers a tool for testing human performance that could facilitate higher productivity in industrial plants, a means of testing employees while in the field, and reduction in worker on-the-job injuries.

Title: SBIR Phase II: Scanning Automultiscopic 3-D Visualization System

Award Number: 0216231
Program Manager: Juan E. Figueroa

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $499,998
Investigator: Tin M. Aye, tinmaye@aol.com
Company: Physical Optics Corp.
20600 Gramercy Place, Bldg 100
Torrance, CA 90501-1821
Phone: (310)320-3088

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a scanning automultiscopic 3-D visualization system. Current 3-D systems have very limited field-of-view or require intrusive headgear with head tracking to emulate look-around, and introduce inconsistencies between binocular convergence and eye accommodation. This project will develop a new class of 3-D displays based on proprietary liquid crystal scanner panels that time-sequentially project a large number of perspective images over a wide field-of-view into the view space in front of the display. The device will be a fully functioning full color, high resolution 3-D display system with large screen, large look-around field-of-view with many-perspective-image scanning at a flicker-free rate, using a high speed video projection system.

The proposed 3-D system will be used for visualization of multidimensional scientific and medical data, for 3-D design and simulation, training and education of government and civilian personnel in a collaborative 3-D virtual environment, and for telepresence and teleoperation

Title: SBIR Phase II: Auto-Tracking Using Trailing Templates and Skeletal Guides

Award Number: 0091510
Program Manager: Sara B. Nerlove

Start Date: May 1, 2001
Expires: April 30, 2003
Total Amount: $500,000
Investigator: Paul S. Mostert, pmostert@mostertgroup.com
Company: Mostert Group
3298 Roxburg Drive
Lexington, KY 40503-3432
Phone: (606)223-1490

Abstract:

This Small Business Innovation Research (SBIR) Phase II project continues research and development aimed at demonstrating the feasibility for automatic video tracking of the motion of animals and humans in unconstrained environments. The Phase I study succeeded by designing low-level intelligence into predictive search algorithms that were able to confine their search for the correct position in a succeeding image to specific, small regions predicted by the system. The objective is to create a software system, easily operable by an unsophisticated user that can quickly and accurately track multiple points or regions of a moving animal or human through a sequence of video images. This tracking can be done despite background clutter and intermittent occlusion, and without attaching any distinguishing markers to the subject. In Phase I, a user interface was designed that allowed the user to choose a 'skeletal template' to be tracked with a pointing device (a mouse) by selecting vertices of closed polygons and connected rotation points. By sensing the direction and speed of motion of the system, the model-based tracking algorithm told the search mechanism where it should look in the next image to match a 'trailing template' derived from previous locations and orientations of the template. In Phase II, more sophisticated modeling and prediction algorithms, including supervised learning of constructed models, and a pyramided coarse-to-fine scale-space, constructed at video load time, will be brought to bear that will increase speed and efficiency of the tracking algorithm and improve the robustness of the model-based approach. At the same time, the user interface will be redefined to improve the 'look and feel' and give it a more intuitive structure.

Applications for this software have a ready market demand. Present commercial tracking technology of biological motion requires the placement of intrusive control targets at critical positions on the subject. The commercial need for tracking and characterizing general biological motion will be exploited, including tools for animal behavior analysis, and predicting and improving motion efficiency in athletes. In addition, this technology has applications in diagnostics and medicine/health applications, surveillance, and other uses ranging from NASA's space research, to ergonomic design, to the fingering of musical instruments.

Title: SBIR Phase II: Handwriting Based Interface for Mathematical Notation

Award Number: 0296216
Program Manager: Sara B. Nerlove

Start Date: December 19, 2001
Expires: December 31, 2002
Total Amount: $398,707

Investigator: Peter Garst, pgarst@mathsoft.com
Company: MathSoft Eng & Educ, Inc.
101 Main Street, 16th Floor
Cambridge, MA 02142-1519

Abstract:

This Small Business Innovation Research Phase II project will develop a prototype handwriting based input system for mathematical notation which demonstrates the ease of use, recognition accuracy and editing power required to make computer input of mathematical equations easier than writing them on a pad of paper. This will solve the persistent problem of tedious and difficult input methods for text formatters, technical assistants and other systems, which require input of mathematical notation. The proposed work includes collection of handwritten mathematical data, investigation of a usable interface and editing system, and research into a fast and accurate recognizer for handwritten notation. The market for natural and efficient input of mathematical notation is potentially very large, spread across a range of innovative products for students and professionals in many technical, business and educational fields. Potential applications include easy electronic communication of mathematical notation; far more productive word processors for technical notation; handheld calculators which accept symbolic problems as easily as numeric ones; and others.

Title: SBIR Phase II: Exploring Computer Biological Concepts in an Interactive 3-D Learning Environment over the Internet

Award Number: 0239238
Program Manager: Sara B. Nerlove

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000
Investigator: Douglas B. Seifert, dbseifert@comcast.net
Company: Syandus, Inc.
836 Robert Dean Drive
Downingtown, PA 19335-4469

Abstract:

This Small Business Innovation Research Phase II project will create a 3D, interactive learning system to communicate complex scientific concepts from biological and medical science, which are difficult to grasp via long narrative scripts. The detailed technical specifications formulated in Phase I will be developed into a software solution distinctive from what is available today. This learning tool allows the user to inquire about objects in a visualization context, where specific aspects of these objects can be manipulated. Syandus has adapted sophisticated real-time 3D rendering technology common to video games as follows: 1) by creating the ability to interact with time driven, 3D process models of complex scientific phenomena; and 2) by associating textual information with these visualized objects and processes. At a user's mouse click, objects intelligently reveal what they are about in deeply layered text, illustrations and linked files. This interface can aggregate all kinds of information, such as all of a pharmaceutical company's technical information on a disease. Finally, Syandus is building the software to be delivered across the Internet through a standard browser interface or launched from a CDROM and automatically updated via a narrowband Internet connection. The differentiation among pharmaceutical products is ever increasingly grounded in rapidly evolving complex science, thus making essential a mechanism for aggregating and communicating scientific information that relates how drugs work to disease states. Focusing on the pharmaceutical industry as the firm's first target market, Syandus proposes to create a tool to help physicians understand the breakthrough medicines to treat complex disease states that adversely impact people's lives.

The firm's custom projects will result in enduring resources for medical students, professionals and healthcare consumers. As the technology matures, the firm will pursue higher education markets. Through Internet connectivity, the product can reach wide audiences across the globe.

Title: SBIR Phase II: Smart Instrument Controls with Feel Display

Award Number: 0091589
Program Manager: Sara B. Nerlove

Start Date: June 1, 2001
Expires: November 30, 2004
Total Amount: $499,995
Investigator: George V. Anastas, janastas@immersion.com
Company: Immersion Corporation
801 Fox Lane
San Jose, CA 95131-1601
Phone: (408)467-1900

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build on Phase I results to take advantage of an exciting opportunity to revolutionize the way people interact with the machines they encounter in everyday life. Visual displays have progressed remarkably in past decades. Aircraft cockpits that used to have hundreds of gauges and dials now have just a few color displays that provide rich visual information that changes depending on the situation. Yet physical interfaces--knobs, buttons, sliders, etc.--remain as primitive as ever. Regardless of context, these interfaces always feel the same and can serve only a limited number of functions. Phase I results demonstrated the potential human factors benefits of Smart Instrument Controls with programmable feels-- operator performance improved, especially when visual attention was critical, such as during a driving simulation task. These systems also could simplify interfaces by reducing the number of separate controls. One control could operate several functions, each function having a distinctly separate "feel". Phase II will continue human factors studies and expand to include research into novel sensor and actuator technologies for Smart Instrument Controls in order to develop a technology that simplifies elaborate system interfaces while improving or maintaining operator performance.

Immersion Corporation proffers a man-machine interface technology that enhances an operator's experience and in many cases can improve performance by leveraging the underutilized sense of touch. These benefits have attracted companies.

Title: SBIR Phase II: Numerical Techniques for Human Oriented Interaction

Award Number: 0239344
Program Manager: Juan E. Figueroa

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,979

Investigator: Christopher J. Ullrich, ullrich@immersion.com
Company: Immersion Corporation
801 Fox Lane
San Jose, CA 95131-1601
Phone: (408)467-1900

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is focused on research and development of whole hand interaction with computer aided design (CAD) models. This project incorporates advanced numerical constraint optimization techniques, tessellated and algebraic collision detection algorithms, and CyberGlove-based input devices to interactively manipulate the kinematics of large commercial CAD models. Immersion will develop techniques for enforcing graphical non-penetration of virtual avatars with CAD models. Grasping and manipulation-state machines will permit users to naturally grasp and manipulate CAD parts. Force feedback will be calculated and displayed to users with CyberForce hardware devices. A client-server infrastructure for offloading the computationally intense algorithms from desktop workstations will be developed. All CAD related development would occur in CATIA V5 from Dassault Systeme SA.

The technology has potential for a broad impact on virtual prototyping of consumer products and processes. Enabling real-time interaction with a virtual design will facilitate higher quality products with reduced development costs. Virtual prototyping of manufacturing processes will reduce laborer stress and injury by allowing detailed analysis of human factors before a factory work-cell is developed. Immersion will realize commercial returns from this project through a combination of increased hardware sales, product revenue, intellectual property licensing, and contract opportunities.

Title: SBIR Phase II: Artificial Intelligence and Character Animation

Award Number: 0548723
Program Manager: Errol Arkilic

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $499,996
Investigator: Michal Hlavac, michal@ingeeni.com
Company: Ingeeni Studios
271 Windsor Street
Cambridge, MA 02139
Phone: (617)818-7547

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is to build and launch simple and intuitive software tools that allow for the creation of interactive 3D graphics within Macromedia Flash (a 2D vector graphics package). Combined with the existing technology, this collection of technologies will provide the first version of the revolutionary Artificial Intelligence Platform for the creation and delivering of interactive animated characters with emotional intelligence. The systems provide the characters with autonomous behavior selection (what should I do?), emotion (how do I feel?) and learning (have I seen this before?). Such a unique blend of technologies opens opportunities for the study of the theories of the human mind and creates an entirely new class of interactive media.

The broader impacts of this work are scientific, educational, and economic. The technologies advance discovery and understanding of the workings of the human mind by giving a rapid prototyping environment for computational theories of the mind. Scientists and non-scientists alike can create AI networks and see the resulting characters "twitch" on screen in real time. This work promotes teaching, training and learning as Ingeeni will work with UC Irvine and MIT Media Lab to develop curriculums for Synthetic Characters classes that use the platform. Massive adoption of Ingeeni's technologies is the company's main goal, and it is developing libraries of detailed step-by-step tutorials freely available online.

Title: SBIR Phase II: Development of a Tunable Filter for Mini Hyperspectral Imager

Award Number: 0724494
Program Manager: Juan E. Figueroa

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $499,421
Investigator: Dennis Zander, dennis.zander@infotonics.org
Company: SpectralSight
5450 Campus Drive
Canandaigua, NY 14424
Phone: (585)919-3029

Abstract:

This Small Business Innovative Research (SBIR) Phase II research project will address the need to see beyond ordinary human vision, which is critical to improvements in health care delivery, development of precision agriculture methods, guarantee of front-line responder safety and protection, and processing a safe food supply. Hyperspectral imaging, with its ability to capture hundreds of continuous spectra, delivers a valuable tool that provides enhanced visualization and analysis. Current systems tend to be space- or air-borne, large bulky modules that do not lend themselves to portable or hand-held solutions. This mini hyperspectral imager has at its core a novel MEMS monolithic, Fabry-Perot tunable filter and optical system and will be portable and handy, similar in size to a zoom camera in a cell phone.

This research and development effort will develop a family of innovative miniature hyperspectral imaging systems that potentially can have a significant impact. These systems can alert our modern war fighter and emergency first responders by seeing beyond our vision and identifying terrorist threats. It can safeguard our nation's water and food supplies by utilizing affordable hyperspectral systems to identify e-coli and other bacterial contaminations before they are consumed.

Title: SBIR Phase II: Robust Speech-to-Text Messaging

Award Number: 0724271
Program Manager: Ian Bennett

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Ashwin Rao, ashwin@travellingwave.com
Company: TravellingWave
1200 Mercer St Suite 412
Seattle, WA 98109
Phone: (425)273-6933

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project proposes to develop techniques for the hands-free input of text to mobile devices. Specifically, this project extends the results of the Phase I effort to produce a speech-recognition system for mobile devices and personal appliances that is robust in the presence of background noise. To increase the speech recognition accuracy, four techniques are employed: 1) Spellation where the users have to speak and partially spell the words as they dictate, 2) VoiceTap which requires that, for each character, the user says that character and the following character in the alphabet, 3) Voice Predict where the user has to say the word and input the first character of the word using the keyboard or VoiceTap, and 4) multi-modal speech to text, where the user speaks and uses the keyboard simultaneously. The research effort will focus on developing modules that allow speech to be dictated using a combination of whole words and spelled words.

The outcome of the proposed research has significant commercial potential. Because the front end or client-side can be ported to a variety of operating systems and processors, the flexibility of this technology should enable wide licensing of the technology to telecommunication device manufacturers. The mobile wireless industry is very large and growing industry, and multi-modal input technology is important to mobile customers who demand more efficient and accurate methods for communication. Improvements in accuracy could be very significant and would potentially have widespread applicability.

Information Management and Retrieval

Title: SBIR Phase II: Semi-Automatically Constructing Wrappers to Access Internet-Based Information Sources

Award Number: 0090978
Program Manager: Juan E. Figueroa

Start Date: April 1, 2001
Expires: March 31, 2004
Total Amount: $490,210

Investigator: Steven Minton, minton@fetch.com
Company: Fetch Technologies
4676 Admiralty Way
Marina del Rey, CA 90292
Phone: (310)448-8275

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on developing technology for semi-automatically creating wrappers that extract data from semi-structured web pages. The key innovation is a bootstrapping method for wrapper generation, so that experience in wrapping previous sites can be automatically re-used to minimize the effort required to wrap new sites. The proposed technology will make it practical to create thousands of highly accurate wrappers almost completely automatically, creating new opportunities for web-based information integration.

The proposed technology will enable Fetch Technologies to scale our current wrapper generation technology far beyond what his now practical. Thousands of Internet services create value for their users by aggregating and integrating information from Internet sources. The proposed technology will make these types of services radically simpler to implement. Applications include portal sites, comparison-shopping services, auction sites, finance integration, and competitive intelligence-gathering services.

Title: SBIR Phase II: Building a Large-Scale, Effective, Self-Maintainable and Customizable News Metasearch System

Award Number: 0522271
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000
Investigator: King-Lup Liu, kliu2002@yahoo.com
Company: WebScalers L.L.C.
121 Conque Drive
Lafayette LA, 70506
Phone: (337)984-3968

Abstract:

The Small Business Innovation Research (SBIR) Phase II project develops a metasearch capability engineered for news searching. Searching is the second most popular activity on the Internet behind emailing and it already has a multibillion dollar advertising market. News searching accounts for a major percentage of all searches. News items are available from a large number of online sources but the current technologies for news search are not scalable to effectively cover all of these sources in a timely manner. This project is to develop a new technology to tackle this problem via constructing a large-scale, highly effective, self-maintainable and customizable news metasearch engine. High effectiveness is achieved by automatically selecting the most appropriate search engines to access for each user query and by effectively identifying the correct meanings of the terms in each query. By employing highly automated techniques to incorporate search engines, this system can automatically adapt to changes that are made to the connected search engines and users can customize by adding their favorite news search engines.

Highly automated solutions employed herein reduce labor costs for development and maintenance, which translate to lower advertising costs and make online advertising more affordable for "small players", including small, local media Websites, individuals and small companies. This project advances large-scale information integration, large-scale distributed information retrieval, information extraction, automatic system self-maintenance, and customization on demand. The proposed technology empowers ordinary users in their search for more relevant and more up-to-date news items from a large number of news sources. It also empowers them to customize the search system to suit their information needs

Title: SBIR Phase II: Assessing Status and Trends of Threatened Species from Uncertain Monitoring Data: Methodology and Software

Award Number: 0514541
Program Manager: Errol B. Arkilic

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $499,785

Investigator: H Akcakaya, resit@ramas.com
Company: Applied Biomathematics Inc
100 N Country Rd
Setauket NY, 11733
Phone: (631)751-4350

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop and implement as software methods for entering, processing, and analyzing species distribution monitoring data, which is one of the most basic forms of biological information that comes from surveys, censuses, and other routine assessments. These methods will use basic monitoring data to (1) assess the status and trends of the monitored species at the population-level, and (2) estimate the input parameters for the more advanced quantitative models, thereby increasing the use of these models, which include population viability analysis models, habitat models and other GIS-based methods, and quantitative risk criteria, such those used by the World Conservation Union (IUCN) and the NatureServe. One of the major innovations of the proposed software will be its treatment of uncertainty. Ecological data are often scarce and uncertain, including spatial and temporal variation, measurement and sampling errors, and demographic variance. The methods to be implemented in the proposed software will account for this uncertainty and incorporate it into the assessment of status and other outputs produced.

Broader impacts of the project will include standardization of the monitoring process for a broad spectrum of species, significantly reducing the cost of processing and analyzing monitoring data and increasing the use of advanced quantitative models in relation to environmental issues. This will, in turn, increase the use of scientific information in environmental decision-making and policy formulation. The methods developed in this project will also allow incorporating data uncertainties in an objective, transparent, and credible way, thereby providing scientifically credible and sound summary of the status and trends of the species monitored. The proposed methods will be implemented as software. Expected commercial applications include software sales and contracts for specific applications of the software.

Title: SBIR Phase II: A Hydro Optical Analysis System (HOPAS) for Environmental Monitoring of Water Quality

Award Number: 0349581
Program Manager: Errol B. Arkilic

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $491,760
Investigator: Francis O'Brien, fjobrien@cox.net
Company: System Science Applications, Inc.
121 Via Pasqual
Redondo Beach, CA 90277
Phone: (310)375-9803

Abstract:

This Small Business Innovation Research (SBIR) Phase II research proposes to complete the development of an environmental information system - the Hydro-Optical Analysis System (HOPAS). HOPAS combines an advanced radiative transfer model with a powerful nonlinear programming algorithm to enable transforms of optical water measurements into information on the composition and concentration of materials that effect water quality. For the first time, measurements of the light field from satellites, aircraft, moorings, and ships can be rapidly inverted to obtain accurate estimates of phytoplankton, suspended mineral particles, and dissolved materials. HOPAS will enable scientists, environmental engineers, and aquatic resource managers to use easily obtained in situ or remotely sensed optical data to understand and manage aquatic ecosystems.

HOPAS will alleviate the need for expensive, labor-intensive laboratory analysis of water samples for use in addressing water quality issues, including microbial growth in drinking water supplies, surface pollutants from farms, industries, vessels, and domestic sources, algal blooms, fisheries and mariculture, and protection of coral reefs and sea grass beds.

Title: SBIR Phase II: Authentication of Mobile Video Recordings (MVRs) Based on Real-Time Hybrid Digital Watermarking

Award Number: 0349602
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Zhenyu Wu, zhenyu.wu@ieee.org
Company: MY EZ Communications LLC
580 Lake Drive
Princeton, NJ 08540
Phone: (609)713-3465

Abstract:

This Small Business Innovation Research (SBIR)Program Phase II project is aimed at the refinement and commercialization of the authentication technology developed during Phase I that enables the deployment of digital Mobile Video Recordings (MVR) system. A very large fleet of patrol vehicles operated by the law enforcement community that record events involving contact with civilians collects MVR data daily. Due to staggering costs associated with operating current analog, non-indexing system, there is an overwhelming needs for a computerized digital MVR technology. However, its deployment is hindered by legal acceptance, because digital medium can be easily altered. Authentication plays a critical enabling role by providing an effective means to safeguard the integrity of MVR content. To capitalize upon this emerging trend of digital MVR, the company proposes as a commercialization strategy to market the innovative technology in a package in an authenticated acquisition system, consisting of a digital video camera and a software suite for on-the-fly video watermarking, off-line MPEG compression and watermark verification. This compact and low-cost acquisition system leverages on existing in-car laptop for processing and storage, and is specifically designed to meet stringent operational requirements set forth by next generation MVR system. It integrates seamlessly with existing IT infrastructure and computerized MVR management systems. MVR has provided an effective way of protecting law enforcement agencies, their officers and the public they serve.

The MVR authentication provides an enabling technology for the acceptance and deployment of cost-saving computerized MVR technology for the law enforcement community nationwide. It allows for safe elimination of the labor-intensive process associated with safeguarding the integrity of MVR content, because watermarking is done on the fly and there is no time window at which MVR data are ever unprotected. With the deployment of digital MVR system equipped with watermark authentication technology, the costs associated with operating the system will be greatly reduced allowing for the savings to be redeployed to other law enforcement endeavors. Within the next three years a comprehensive national digital facial database will be created to support Homeland Security. As an integral component of the in-car laptop, this technology will serve as the front line in capturing the data for submission to the national database.

Title: SBIR Phase II: Animated Real-Time Road Traffic Visualization for Broadcast and the Internet

Award Number: 0349460
Program Manager: Juan E. Figueroa

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $510,000
Investigator: Andre Gueziec, andre@trianglesoftware.com
Company: Triangle Software
1265 W. Knickerbocker Dr
Sunnyvale, CA 94087
Phone: (408)893-8798

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at 2D/3D visualization of real-time traffic/traveler data (incidents, speed/density, public events) and computer traffic simulations. The rapid production of data-driven, information-rich animations has previously proved very difficult. With the notable exception of weather forecast animations, requiring highly expensive complex multi-computer systems, quality animations are routinely produced weeks ahead of time for television documentaries. Traffic/traveler data represents particular challenges such as the fact that data changes very frequently and becomes stale in minutes. Much of this data is in textual form, as reported on-scene by police or emergency crews. Reliability and utility to the traveler are concerns. Consequently, the four major weather broadcast companies have scarcely addressed the traffic market. This project will develop traveler data processing algorithms for predicting travel time, mining large databases of traffic information, and intelligent text- processing. It will also develop traffic micro-simulations, automating data-driven animation, and exploiting programmable graphics hardware for broadcast-quality real-time informative animations.

The expected results of this project are: (1) algorithms providing useful information to travelers/commuters from raw real-time police reports and sensor data; and (2) a product animating real-time traffic/traveler information for TV broadcast and the Internet, exploiting gradual improvements of raw data, as departments of transportation equip highways with speed/density sensors, and enforcement agencies open their servers. The Federal Highway Administration reports that the cost of traffic congestion in 1999 came to $78 billion nationwide, including 4.5 billion hours of lost time and 6.8 billion gallons of fuel wasted. Most transportation experts estimate that the ability to quickly provide accurate traffic information as proposed in this project has many benefits: (1) for drivers to plan alternative routes, keep on their schedules, and to reduce stress; (2) for overall congestion and better road maintenance; (3) for safety and road-rage mitigation; and (4) for improved pollution control

Title: SBIR Phase II: Speculative Compilation for Energy Efficiency

Award Number: 0348966
Program Manager: Errol B. Arkilic

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $500,000

Investigator: Csaba Moritz, andras@bluerisc.com
Company: BlueRISC Labs
28 Dana Street
Amherst, MA 01002
Phone: (413)545-2442

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop energy-aware compiler techniques to reduce power and energy consumption in microprocessors, without affecting performance. Over the past few years, energy consumption by computers has emerged as a major area of intellectual and commercial activity. A key principle behind this approach is to use speculative information available at compile time to reduce power and energy consumption. The key qualifier is speculative: the information does not have to be provably correct. Speculative information that turns out to be correct will enhance energy reduction; if it is incorrect, the worst that will happen is that a penalty (in terms of energy) will have to be paid. The use of such speculative compile-time information opens up a largely unexplored dimension in compilers and computer architectures, to target energy efficiency.

The outcome of the proposed effort will not merely be a set of products, but also a vastly increased understanding of the means by which compile-time information can be exploited for energy savings. It is expected that this development effort will have a considerable impact on the theoretical underpinnings of compilers and compiler-architecture interaction, as well as a significant commercial impact. With the increasing prevalence of battery-powered computing devices such as PDAs, mobile telephones, and notebooks, power-aware computing is becoming increasingly important commercially.

Title: SBIR Phase II: MPI-2: A Systematic Study, Design, and Commercialization of the Extended Message Passing Interface for NOWs and Parallel Computers

Award Number: 9983413
Program Manager: Juan E. Figueroa

Start Date: June 15, 2000
Expires May 31, 2003
Total Amount: $516,645

Investigator: Rossen Dimitrov, rossen@mpi-softtech.com
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110 12th Street North
Birmingham, AL 35203
Phone: (205)314-3471

Abstract:

This Small Business Innovation Research Phase II project builds on MPI Software Technology, Inc.'s (MSTI's) extensive MPI-1 implementation experience with our MPI-2 design developed in Phase I in order to continue research and advanced prototyping of a quality implementation of the MPI-2 standard for clusters of workstations . In Phase II, we build upon prototypes created in Phase I, while continuing our investigations into scalable dynamic process startup, advanced and poly-algorithmic approaches to one-sided communications, collective operations, and parallel I/O. Our research and development outcomes will enable the high-performance computing community to unlock the potential of the latest workstation and networking technology, providing access to architectural enhancements of systems and software, and more complex computational environments. Rationale for undertaking this effort is that the scientific community needs enhancements to its most important parallel processing environment, MPI, and that workstation cluster targets comprise the fastest growing component of parallel processing environments. Inventing MPI-2 capability for HPC represents widely enabling technology for scientists and engineers to produce new science, while incorporating computer-science challenges of its own, both of a research and advanced development nature. Significant software, protocol, and algorithmic challenges must be tackled in order to create a useful MPI-2 environment. MPI-2's dynamic process management would support several classes of new scientific applications, and computation strategies. These include computational servers, growing/shrinking parallel applications, and multi-disciplinary codes. Support for the one-sided model would enable classes of applications that need fine grain communication support, including certain sparse matrix algorithms, as well as quantum chemistry codes that utilize global array-type algorithms (e.g., Focker-Planck computations).

Support for effective intercommunicator collective operations would simplify and enable applications that work with dataflow models, including composite parallel simulation and visualization techniques. Support for MPI-2's I/O techniques would support myriad out-of-core and database-type applications, including growing interest in financial modeling with MPI, but also the traditional scientific problems in areas of climate and weather modeling, and others with large, out-of-core datasets needed in conjunction with parallel computing.

Title: SBIR Phase II: Computer-Assisted Document Interpretation

Award Number: 0078525
Program Manager: Juan E. Figueroa

Start Date: September 1, 2000
Expires: February 29, 2004
Total Amount: $750,000

Investigator: Dan Sokol, dsokol@cohesia.com
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Dayton, OH 45402
Phone: (937)224-1414

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the outdated methods by which companies use material and process specifications. Specifications are a fact of life for any organization involved in complex manufacturing (e.g., aerospace, automotive, materials). Specifications are comprehensive and voluminous documents, covering hundreds of different key characteristics. The constant reading, checking, and analyzing of specifications is extremely labor-intensive, quality-impacting, and time-consuming. During Phase I research, the feasibility of the concept was successfully determined, and a conceptual design solution for tools was created which provides computer-assistance in the interpretation of specification requirements. The conceptual solution is based on the theories of Information Extraction and the analysis of specification content within the context of a meta-specification created as a result of prior NSF-sponsored research. This meta-specification provides an ontology for capturing the semantic knowledge contained in the text of specifications. The Phase II objectives are to build a working prototype of the solution as the foundation for potential full-scale commercialization. The tools created as a result of this prototype will be used to convert existing text-based specifications into the computer-sensible ontology. The Phase II solution is not attempting to totally automate the interpretation process. Instead, the focus is on innovative approaches for providing computer assistance in the semantic analysis of a limited domain of documents.

The organizations which have their processing, inspecting, and testing controlled by specifications are extremely interested in using tools that access specifications in an intelligent, computerized format. These organizations include the United States Government as well as suppliers and prime contractors in American industry. This effort could 'jump-start' an entire industry related to providing tools for the computer-assisted analysis of specification requirements.

Title: SBIR Phase II: Information Extraction from Synthetic Procedures

Award Number: 0110478
Program Manager: Sara B. Nerlove

Start Date: August 1, 2001
Expires: July 31, 2004
Total Amount: $499,923
Investigator: Paul van Eikeren, paul.van.eikeren@intellichem.com
Company: IntelliChem
20310 Empire Avenue, Suite A-102
Bend, OR 97701
Phone: (541)382-7043

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is directed at developing a collection of software tools for use in selective extraction of information from the running text of synthetic recipes. Synthetic procedures are batch recipes used in the creation and discovery of new chemical entities for drug discovery. The ultimate aim of the project is to automate information extraction and place the information in a computer-understandable data structure that fully captures the data and semantics of the synthetic recipe. The Phase I program successfully demonstrated feasibility of the approach by constructing a prototype system and using it to solve a range of representative synthetic-recipe-related information extraction problems. In Phase II, the objectives are to (1) refine and extend the features of the prototype system; (2) implement machine learning capability for extraction rule induction, (3) construct focused demonstration applications, and (4) test, evaluate and validate the software system in conjunction with pharmaceutical-company research-collaborators. The ultimate goal of the program is to develop a commercial software toolkit that enables chemists to easily construct systems for information extraction from synthetic recipes.

Recipes for more than 19 million unique compounds are contained in the public literature, and there are a comparable number in the archives of pharmaceutical companies. The vast majority of these procedures are maintained as unstructured running text. Intellichem, Inc. proffers tools for extraction of synthetic recipe information into computer-understandable data structures that will benefit the following: database construction and updating, summarization, chemical process discovery, knowledge reuse, improved productivity of the chemist, and chemistry-related
e-commerce.

Title: SBIR Phase II: Xtractica - A System for Extracting Coherent Data from Documents

Award Number: 0238863
Program Manager: Juan E. Figueroa

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,942
Investigator: Tatyana Vidrevich, tatyana@xsb.com
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Stony Brook, NY 11790-3383
Phone: (631)444-6800

Abstract:

This Small Business Innovation Research Phase II project will implement a software system that allows domain experts to specify programs that transform unstructured or partially structured data from a variety of document sources, such as World Wide Web sites, PDF files, and text into structured, coherent, and readily usable information. The system will consist of a set of tightly integrated syntactic and semantics-driven data extraction technologies that are managed from a graphical user interface. The goal will be to retrieve information that was created for human understandability, and work with it to create knowledge that can support automated decision-making and transactions. The system will empower users, who are knowledgeable about their application domains but are not necessarily trained as computing technologists, to rapidly structure data into knowledge. The Phase II implementation effort will build upon the results from the Phase I feasibility study to produce a fully functional system.

Phase III will make the system commercially available to clients with diverse business interests including content aggregation, e-procurement, ERP, and supply chain management vendors.

Title: SBIR Phase II: Ultrafast Block Retrieval for Optical Storage

Award Number: 0216379
Program Manager: Juan E. Figueroa

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $498,950
Investigator: Bunsen Fan, fan@reveo.com
Company: Reveo Inc
3 Westchester Plaza
Elmsford, NY 10523-1609
Phone: (914)345-9556

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize an ultra fast block data retrieval method for the company's patented chiral film-based optical data storage system. The technology will combine ultrahigh storage capacity with ultra fast retrieval speed. The current retrieval rates of CD-ROM, DVD-ROM and MO technology is inherently limited for applications such as image retrieval for medical diagnosis or target recognition. The company's block retrieval technique is a new method for solving the bottleneck of data retrieval. Using imaging and pattern recognition techniques, data is retrieved in 2D blocks. This retrieval method will result in orders-of-magnitude increases in throughput and increases in storage density.

Since the need for high density, high-speed storage is continuing to escalate; there will be a ready market from storage system vendors who supply products to the myriad of industries whose business depends upon volumes of storage and quick retrieval.

Title: SBIR Phase II: Surface Enhanced Raman Scattering (SERS)-Based Nanoparticles as Covert Taggants for Anti-Counterfeiting Applications

Award Number: 0548687
Program Manager: Errol Arkilic

Start Date: February 7, 2006
Expires: January 31, 2008
Total Amount: $499,624

Investigator: Sharron Penn, sharron.penn@oxonica.com
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Mountain View, CA 94043
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project will continue the development of an anti-counterfeiting solution for the brand security market, built around a series of covert, nanoscale taggants, called SERS nanotags. Three technical hurdles remain for the innovative tags to be accepted by customers: (1) ability for to develop cost-effective, commercial scale manufacture; (2) the demonstration of a handheld reader; and, (3) seamless integration into printed products.

Because of its mushrooming growth and profound economic impact, the FBI has called counterfeiting "the crime of the 21st century". Part of the problem is that current anticounterfeiting technologies offer extremely limited performance and are themselves easy to counterfeit. SERS nanotags embody all of the features of the, much needed, next generation of anti-counterfeiting technologies. Therefore, if successful, this technology will have an impact across many commercial and government sectors.

Title: SBIR Phase II: Unsupervised Extraction of Relational Data from the Web

Award Number: 0548699
Program Manager: Errol Arkilic

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $499,936
Investigator: Steven Minton, minton@fetch.com
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El Segundo, CA 90245
Phone: (310)414-9849

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enable software systems to make use of data on the Web that is embedded in HTML pages. The semantic web is intended to allow data to be shared and used by software applications. Unfortunately, in the present world, data on the Web is generally inaccessible to most applications because it is presented in a format intended to be usable by humans, as opposed to computers. The goal of this project is to create a relational view of data on the Web, so that applications can access Web data based on entities and their relations. The approach uses unsupervised machine learning to extract data from web sites for conversion into relational form. This project will result in a new generation of Web harvesting technology that has clear commercial value.

Web harvesting is an area of growing commercial interest for a variety of vertical markets, including Sales Intelligence, Market Intelligence, News Aggregation, and Background Search. However, web harvesting technology is limited today, since the collection of rich, detailed data must be done on a site-by-site basis. The approach described here, if successful, will enable a new generation of intelligent web harvesting technology that can scale to the entire Web. Ultimately, our approach will enable applications to query the entire Web as if it were a relational database. This has tremendous commercial value, and will enable many new types of web applications to be developed. In addition to the commercial value, the technical approach is novel and has significant merits on its own. If it is successful, the proposed method should generalize to other complex domains (such as scene understanding and natural language processing) where multiple heterogeneous types of structure must be analyzed to discover underlying meaning.

Title: SBIR Phase II: Improving Infection Control Through Radio Frequency Identifier (RFID)-Based Patient Tracking

Award Number: 0548737
Program Manager: Errol Arkilic

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $495,856
Investigator: Daniel Kokotov, dkokotov@vecna.com
Company: Vecna
5004 Lehigh Rd B
College Park, MD 20740
Phone: (301)864-7253

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will provide hospitals with a way to analyze and prevent hospital-associated infection outbreaks based on integrating a location tracking system with live hospital microbiology data, building on research done in Phase I. The goal is the design, implementation, deployment and clinical validation of two tools: (1) a visualization and analysis tool for investigating propagation dynamics of past and current infection outbreaks; and, (2) a simulation tool for evaluating response measures to potential outbreaks. The research will center on clinical acceptance and usability. The involvement of medical and infection control experts will ensure that the models of infection spread are accurate, the visualization and analysis tools are intuitive, and the simulation tools cover the important infections and scenarios.

Every year tens of thousands of lives, and billions of dollars, are lost to infections acquired in health care facilities. The envisioned product will give hospitals powerful tools for reducing these numbers, allowing them to better understand why infections happen and what counter-measures are effective. Hospital-associated infections' impact goes beyond the immediate sickness they cause, forcing treatment of the infection in addition to the underlying illness, and dissuading many from seeking necessary care because of the fear of acquiring infections.

Title: SBIR Phase II: Visualization Toolkit for 3D Photography

Award Number: 0724338
Program Manager: Errol Arkilic

Start Date: September 15, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Siavash Zokai, zokai@brainstormllc.com
Company: Brainstorm Technology LLC
514 West 24th Street, 3rd Floor
New York, NY 10011
Phone: (516)668-1393

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to develop a comprehensive 3D photography toolkit for importing the geometry of existing large-scale urban structures into the computer. The goal of the project is to minimize the effort of building models of high geometric and photometric accuracy that are suitable for efficient rendering, manipulation, and analysis. The proposed Phase II work will build upon the feasibility study conducted in Phase I. The Phase I effort introduced a novel algorithm that successfully integrated multiview geometry with automated 3D registration to produce realistic visualizations of complex, reconstructed, real-world 3D models with minimal human interaction. The goal is to build approximate lightweight 3D models directly from a collection of photographs of the scene. The proposed workflow treats a photograph as tracing paper upon which 2D shapes are defined prior to extruding them into 3D models.

The commercial application of this Phase II project is the introduction of a comprehensive software toolkit for 3D photography. The ultimate goal is the reconstruction and visualization of detailed models of urban sites, i.e. digital cities. The creation of digital cities drives other areas of research as well: visualization of very large data sets, creation of model databases for GIS (Geographical Information Systems) and combination of reconstructed areas with existing digital maps. Other applications include video game development, entertainment, architecture, virtual tourism, fire/police/urban planning, urban design, disaster prevention, archaeology, and historical preservation.

Title: STTR Phase II: Nonintrusive Electrical Monitor (NEMO)

Award Number: 0646585
Program Manager: Errol Arkilic

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $500,000
Investigator: John Rodriguez, NEMOmetrics@aol.com
Company: NEMOmetrics
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Charlestown, MA 02129
Phone: (617)242-0050

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and qualify a Non-Intrusive Electrical Monitor product (NEMO) to provide inexpensive, accurate, in depth monitoring of electrical usage, permit expanded energy savings and provide additional information, like potential equipment faults and failures. NEMO increases the amounts and kinds of diagnostic information that can be gleaned from a single set of electrical measurements, thus lowering the cost of monitoring building energy management systems. By analyzing the transient signatures produced when different electrical equipment draws power, NEMO can identify which of multiple loads turn on and off and assess their condition. The objectives of the research are to determine: the reliability of NEMO algorithms in the presence of multiple loads, prioritize several possible diagnostic analyses for the commercial product, and maximize the automation of NEMO data analysis while minimizing the need for human scrutiny and intervention. Phase I demonstrated the value of NEMO systems in monitoring and diagnostics with air conditioning units. The Phase II research plan calls for continuing the development work and installation of a qualified prototype in commercial buildings.

Data analysis will reveal inefficiencies in building operation and effectiveness of the algorithms themselves. This project will develop a system for non-intrusive detection and identification of multiple electrical loads with major energy conservation and other benefits. Time of use data can be used to create new automated algorithms that minimize energy use and optimize heating, ventilation, and air conditioning system operation without affecting occupant comfort, while electrical health diagnostics can signal when a motor is nearing failure or a valve has jammed. A reduction in the cost of in-depth monitoring allows more commercial facilities to reap energy and maintenance savings from these algorithms and the NEMO product that contains them. Actual measurement rather than estimation of initial and ongoing electrical power consumption of electrical equipment within a commercial building enables verification of upgrade performance. It also facilitates design and operation of intelligent, energy efficient buildings and assists in attaining Leadership in Energy Efficient Design (LEEDTM) certification. By promoting energy efficiency in buildings, NEMO will enable customers to reduce their energy costs, reduce or eliminated unscheduled maintenance and increase profitability.

Title: SBIR Phase II: Digital Starlab

Award Number: 0321598
Program Manager: Sara B. Nerlove

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $499,827

Investigator: Jane Sadler, jsadler@starlab.com
Company: Learning Technologies Inc.
40 Cameron Avenue
Somerville, MA 02144-2404
Phone: (617)628-1459

Abstract:

This SBIR Phase II project will develop a planetarium system based on a new computerized digital projector. Learning Technologies Inc. will make use of recent developments in new micro mirror devices and simulation software. The proposed planetarium system will be capable of projecting an accurate, simulated night sky with the capacity for a multitude of motions and displays and dynamically changing information displays of the earth, including plate tectonics, weather patterns, and biological distributions. The small size of the projector with supporting laptop computer and inflatable dome will allow the units to be shared within school systems and loaned out by museums and educational cooperatives. Standardization will encourage adept teachers and planetarium educators to distribute their programs and activities. Integrated help screens and tutorials will aid in supporting teachers who wish to learn how to master this equipment. The new system will build on the firm's portable planetarium systems, which are now used by an estimated 5% of the school age children in the U.S.

A small digital-projection planetarium system will expand the market for small planetariums to teachers interested in earth science and multidisciplinary topics, geology, volcanism, meteorology, oceanography, and biological population studies. In addition, the connections between science and the humanities can be illustrated by coupling the historical age of exploration with the science of celestial navigation. For schools with limited resources, the system's portability will facilitate shared use. Such a system will have a broad impact on the teaching of astronomy and earth science. It will use the latest astronomical and Geographic Information System (GIS) data, and it will aid in teaching the content of the national standards, especially earth science at the elementary and middle school level. Professionally produced interactive shows can be a new venue for astronomers and earth scientists to inform large numbers of students of their results and of the nature of the scientific enterprise.

Title: SBIR Phase II: Sketchpad for Young Learners of Mathematics - Dynamic Visualization Software in Grades 3-8

Award Number: 0521981
Program Manager: Ian M. Bennett

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $499,808

Investigator: Nicholas Jackiw, njackiw@keypress.com
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1150 65th Street
Emeryville CA, 94608
Phone: (510)595-7000

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to overcome barriers to the effective use of The Geometer's Sketchpad software in elementary and middle school math classes, and to deliver on the software's potential for transforming education at these levels. This research-based educational technology tool and its "Dynamic Geometry" interaction paradigm are well known at the secondary and higher level for their ability to foster visualization and exploration in mathematics and to enhance student learning. This project responds to clear calls for the software's application and adaptation to younger grades coming from teachers, from curriculum development and research communities, and from standards bodies such as the National Council of Teachers of Mathematics (NCTM). The proposed research, led by the team that created and maintains Sketchpad, first identifies and prototypes modifications to the software to add scope and age-relevant functionality and to remove barriers to access for young learners; and second pioneers new classroom activities-structures, materials, and vehicles-for supporting and extending standards-based curricula in grades 3-8 through the agency of Dynamic Geometry technology. The intellectual merit of the proposed activity reflects (a) the degree to which the activity responds to perceived pedagogic need (as cited, e. g., in the NCTM Principles and Standards 2000) for Dynamic Geometry technology at the elementary and middle school level; (b) the opportunity to extend the broad base and literature of research that exists on Dynamic Geometry at the secondary level to significantly earlier grade levels (particularly with respect to effective Dynamic Geometry activity design and Dynamic Geometry impact on student affect and cognition in the early grades); and (c) the resources this proposal brings to the question of how best to integrate effective, standards-based curriculum (in this case, the Connected Mathematics Project, Everyday Mathematics, and Math Workshop curricular programs) with effective, standards-based technology. The project brings together research experience in both curricular and software design; project staff includes Sketchpad's authors and project consultants include the author teams of each of the named curricula.

The broader impact of this project reaching its objectives will be the creation and availability, in primary and middle grades, of age-appropriate Dynamic Geometry mathematics education technologies and supporting curriculum similar to those which define Sketchpad at the secondary level, where the software is considered the "most valuable software for students" (Becker, 1999) by mathematics teachers across the country; and of research-driven solutions to the challenge of supporting standards-based curricula effectively with educational technology.

Title: SBIR Phase II: Digital Microscopy with Collaborative Learning

Award Number: 0450650
Program Manager: Ian M. Bennett

Start Date: April 15, 2005
Expires: March 31, 2007
Total Amount: $500,000
Investigator: Timothy Hall, tim@prime-ent.com
Company: Digital Blue Incorporated
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Phone: (770)579-0501

Abstract:

This SBIR Phase II project seeks to provide a model for integrating digital microscopy and web-based on-line collaborative learning in order to improve science education. In Phase I, Digital Blue developed a collaborative worksite, www.planetmicro.com and enrolled +400 students. In Phase II Digital Blue proposes to further this inquiry by building, in conjunction with the Concord Consortium, a state-of-the-art website where students use common digital microscopes and engage in a true collaborative educational experience. Digital Blue will undertake this work by scaffolding the website to improve interaction between members; improving the work flow in which users "tag" their digital images thus optimizing search engine productivity; developing common curriculum modules; developing an online professional development utility to empower teachers to use this technology in their coursework; and adding thousands of members to foster an innovative and successful collaborative community.

Digital Blue proffers an innovative product and service for the education market, namely Planetmicro.net, a collaborative workspace that is fully integrated with a proprietary digital microscope. The site would be the first collaborative workspace that interacts seamlessly with affordable digital laboratory equipment in each classroom. Other collaborative learning environments offer common methods and processes but fail to integrate uniform tools, creating a gap between the hands-on activity of the lab and the virtual activity. In contrast, Planetmicro.net would make it easy to integrate collaborative learning with traditional science pedagogy

Title: SBIR Phase II: Customizable Question Answering System for Homeland Security and Commercial Applications

Award Number: 0450599
Program Manager: Ian M. Bennett

Start Date: September 15, 2005
Expires: August 31, 2007
Total Amount: $499,717

Investigator: Munirathnam Srikanth, srikanth@languagecomputer.com
Company: Language Computer Corporation
1701 North Collins Blvd.
Richardson TX, 75080
Phone: (972)231-0052

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will result in a novel question-answering technology. The features of this technology are as follows: (1) Automatic filtering of questions. During Phase I, Language Computer Corporation (LCC) developed a system that decomposes high-level questions into low-level, fact-seeking questions. Some of these questions, however, turn out to be nonsensical. In Phase II, the firm proposes to submit all of the decomposed questions to a knowledge-based system, which will eliminate questions that are inconsistent with tacit knowledge. All of the questions that survive filtering will be passed back for processing by the question-answering system. (2) Aligning domain ontologies with a large reference ontology. During Phase I, LCC developed a tool that generates domain ontologies from raw text. During Phase II, the firm will extend this tool so that the domain ontologies are automatically aligned with an overarching domain-independent ontology. This alignment will permit deeper expansion of query concepts, because it will allow domain-independent concepts to be augmented with domain-dependent content. (3) Formal evaluation of semantic relations. The foundation of the question-answering system is semantic relations extracted from queries and documents. These relations will be evaluated to assess the relative contribution of each one to question answering. The result of this evaluation will establish which aspects of semantics are most useful to question- answering.

This project will have a direct impact in the following areas: (1) The system can be deployed in commercial and government settings where the accuracy, coverage, reliability, and usability of the retrieved information are crucial. Ideal applications for the technology include homeland defense, CRM, education, medicine, and the law. (2) The system bridges the gap between domain-independent and domain-specific content. Domain ontologies are constructed automatically, and these ontologies are automatically aligned with a large reference ontology, so that queries can be simultaneously expanded into the terms appropriate to many different domains.

Title: SBIR Phase II: A Model for Virtual Dialogues with Master Teachers

Award Number: 0450567
Program Manager: Ian M. Bennett

Start Date: March 15, 2005
Expires: February 28, 2007
Total Amount: $500,000

Investigator: William Harless, wgharless@idrama.com
Company: Interactive Drama Inc.
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Bethesda MD, 20814
Phone: (301)654-0676

Abstract:

This Small Business Innovation Research (SBIR) Phase II project describes software that combines speech recognition, digital video, and personal computer technologies to allow PC users to have "face-to-face" dialogues with video characters that are real people. This software, called Conversim (Registered Trademark), incorporates an independent speaker recognition engine so that any English-speaking user can spontaneously say the words and phrases known to the system and be understood. All Conversim (RT) programs include a non-directive, intelligent prompting algorithm. Each time the virtual character responds to the user, the system dynamically selects statements and questions that are specifically relevant to the character's last response and then displays three choices in a rhythmic scroll. Between questions, the character's active image remains on the monitor as if waiting for the next question. The Conversim (RT) dialogue model is unique since it enables the user to have a virtual conversation with a real person whose intellect, personality, and personae are intact and available. This very personal model opens the door to numerous innovative applications in education. Scientific research has shown that most users enjoy the virtual dialogue experience; many have significant, often accelerated, learning gains; and almost all feel as though they have met the person with whom they have been "talking." These findings strongly indicate the method merits further research in conventional educational settings.

This model represents a new paradigm in education, one that allows the student to learn through a one-on-one interview of the master teacher. The paradigm involves non-directive, independent learning by conducting face-to-face dialogues with master teachers in cyberspace, who are always present, always available, and always willing to converse with people who wish to engage them. Multimedia presentations can be used in concert with the dialogue to clarify concepts and complex topics. Also, the power of the computer for tracking and innovative, dynamic evaluation strategies are inherent in this model. The broad objective is to make this model and this new paradigm available in all educational institutions that would benefit from its use. It has potential to provide a means for students everywhere to gain access to and learn by engaging in dialogue with some of the best minds in the country; to be used to educate a broad range of students, from high school to the post-graduate level; to help students whose education is restricted by geographic location or economics; to enhance learning for all students by making them active participants in the learning process; and to provide high-quality education while significantly reducing per student costs.

Title: SBIR Phase II: Use of a Visual Programming Environment to Promote Bioinformatics Education

Award Number: 0450526
Program Manager: Ian M. Bennett

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $500,000

Investigator: Maciek Sasinowski, maciek@incogen.com
Company: Incogen Inc
263 McLaws Cir Ste 200
Williamsburg VA, 23185
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Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to provide a tool to improve bioinformatics education. This tool, VIBE-Ed, is a software product designed to augment bioinformatics at the college and university level by creating an interactive, integrated, and comprehensive approach to bioinformatics education using visual programming. During the Phase I project, INCOGEN demonstrated that its existing research tool, VIBE, provides an excellent foundation for an educational tool given its inherent technological attributes. VIBE employs visual programming for bioinformatics, and in this respect, VIBE-Ed will provide a novel approach to bioinformatics classroom instruction. The Phase I work demonstrated the effectiveness of visual programming in the learning process. In addition to visual programming, the architecture of VIBE supports the inclusion of extensive information about the bioinformatics tools contained therein, making VIBE-Ed well suited to host the large and complex amount of resources and documentation required by an educational tool. Finally, VIBE was created to be extensible, allowing it to be naturally extended into VIBE-Ed. As the bioinformatics community discovers and validates new analysis tools, these can easily be incorporated into VIBE-Ed, along with the educational features to support them.

Bioinformatics education is a growing field, driven by the great need for trained bioinformaticists in biological and biomedical research. Recent years have witnessed notable increases in the number of bioinformatics courses and degree programs at colleges and universities worldwide. Textbooks and lectures alone do not expose bioinformatics students to hands-on data analysis and, by themselves, they are insufficient for bioinformatics education. Despite the growing trend in bioinformatics education and the need for educationally focused tools, there is a significant lack of commercially available software tools specifically designed for bioinformatics education. Currently, bioinformatics instructors fill this gap by using either complicated and expensive research tools or collections of web-based tools. Bioinformatics research software is often cost prohibitive for an educational application, and the software itself is geared toward experts in the field rather than toward students. Web-based tools are often free of charge, but they are also frequently dispersed throughout the web, requiring excessive time and sometimes also requiring programming skill to combine the use of several tools. Many of the tools are not accompanied by instruction or related conceptual information, making them less suitable for education. VIBE-Ed successfully addresses these concerns and promises to have immediate impact on bioinformatics education and, ultimately, in knowledge discovery on life science research

Title: SBIR Phase II: Cheminformatics Teaching Tools for the Cheminformatics Virtual Classroom

Award Number: 0450457
Program Manager: Ian M. Bennett

Start Date: March 1, 2005
Expires: February 28, 2007
Total Amount: $519,956

Investigator: Norah MacCuish, norah.maccuish@mesaac.com
Company: Mesa Analytics & Computing, LLC
212 Corona St.
Santa Fe NM, 87501
Phone: (505)983-3449

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the development of virtual classroom software tools for cheminformatics training in academia and industry. Mesa Analytics & Computing, LLC provides a commercial, integrated suite of the leading-edge cheminformatics software tools for the pharmaceutical and biotech industry. However, these tools, incorporating the most recent research in cheminformatics by Mesa, and integrated with other leading cheminformatics vendors` software (OpenEye, eduSoft, ChemAxon, and AccuSoft), are for use in large-scale research and industrial applications, where the users already have experience in cheminformatics software, most often obtained through on-the-job training. The research goals of this project are to develop an easy to use, comprehensive, and competitively priced cheminformatics virtual classroom. This project will further the advanced research and development of software tools for interactive distance learning in cheminformatics topics, such as finding compound substructure commonalities, generation and use of structural and property compound descriptors, similarity searching, cluster analysis, compound library design, 3D drug design, compound databases, and Quantitative Structure Activity Relationship (QSAR). The project will produce a beta version of the cheminformatics virtual classroom ready for testing and marketing to the academic and industry markets.

There are a growing number of university departments worldwide offering courses and degrees in cheminformatics, across a range of life science disciplines. However, there is no comprehensive cheminformatics virtual classroom product. Software products used in the pharmaceutical and biotech industry are expensive, difficult to install, and of limited utility for introductory training. Converting Mesa`s tools and other vendors` software into a coherent set of Web-based training tools for concept learning, with the help of six diverse academic testing sites, will provide the necessary training tools for academia and industry. Web delivered training software is a cost effective means to provide distance learning for rural and urban academic institutions and industry sites here and abroad. The virtual classroom will help to lower the cost of on-the-job training for early phase drug discovery research efforts found in the pharmaceutical and biotech industries. The long term goal is to increase the quality and quantity of new researchers, with the potential benefit of increasing the number of drug leads, thereby improving the chances of finding more effective drugs for a wider range of serious diseases, and possibly lowering the cost to consumers.

Title: SBIR Phase II: Enabling Pedagogical Choice and Cost-Efficiency in the Development of Web-based Curricula

Award Number: 0450380
Program Manager: Ian M. Bennett

Start Date: September 1, 2005
Expires: August 31, 2007
Total Amount: $500,000

Investigator: Linda Chaput, lchaput@thinkfive.com
Company: Agile Mind Inc
1100 South Main St
Grapevine TX, 76051
Phone: (650)906-8721

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build a first-release Web-based system for content authoring and delivery that supports multiple approaches to pedagogical practice and provides efficient, easy to use methodologies with which course designers can employ system capabilities. Specifically, this project will continue the work started and demonstrated to be feasible in Phase I to create online authoring and complementary course management systems, which have features and benefits that are immediately available to innovative instructional designers. The goal is to enable the development of technology-mediated instruction through cost-effective means for producing new content and to do so with a focus on supporting instructional design innovation without compromising the capabilities of the technology. The goal is an innovation that will empower content providers to use principled learning theories and pedagogical practices for creating new online curricula that support technology-mediated instruction. The project will produce a new type of authoring and delivery system in which the functionality available to create course structure; manage multimedia content development; translate course specification into reliable production delivery; and access course-related activities for learners and their teachers or mentors, including dynamic learning interactions and real-time behavior tracking and reporting reflects the authors' preferred learning theories and pedagogies.

This project seeks to provide a set of enabling tools that support the development of technology-mediated instruction through cost-effective means for producing content, focused on supporting instructional design innovation without compromising the capabilities of the technology. The commercial applications of the research result are sales and licenses of the created systems, both with and without content, to content developers, publishers, and also middle and high schools, districts, and other local entities for use by individuals and groups who desire to create and to publish content and assessments for communities of practice and who are impeded by cost and time constraints. The resulting systems will address a major problem in education: the consolidation of content development and dissemination in the hands of a small number of publishing conglomerates and the consequent lack of quality and diversity of choice that have been a result of that consolidation. With an extensible authoring system, the company would be positioned to tap into a large market with a business model that supports both new business development and the legacy assets of publishers and eLearning providers, and to create major new opportunities for many other types of content providers.

Tite: SBIR Phase II: Modular Online Simulations for Math and Science with Integrated Assessment of Complex, Standards-Aligned Learning Objectives

Award Number: 0422116
Program Manager: Sara B. Nerlove

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,246

Investigator: Paul Cholmsky, pcholmsky@explorelearning.com
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P.O. Box 2185
Charlottesville, VA 22902
Phone: (434)293-7043

Abstract:

This SBIR Phase II project will produce a commercial version of PathfinderPlus, an online system that integrates assessment of complex, standards-based instructional objectives within interactive simulations and makes the resultant data available in a timely and efficient manner to students, teachers and administrators. In order to effectively implement curriculum standards-based educational reforms (e.g., as mandated by the No Child Left Behind Act), teachers need guidance in linking students' day-to-day learning to these standards and in adapting subsequent instruction based on students' progress against the standards. Existing educational technology products, however, are explicitly correlated only to the macro-level terminal objectives in each state's curriculum standards. As a result, these products do not provide diagnostic information regarding component knowledge and skills, and they thereby fail to support teachers in understanding more precisely where students are having difficulties within a given terminal objective. PathfinderPlus provides a comprehensive online library of highly interactive learning objects that track student' actions as they use them. The system analyzes the generated data to create assessment probes which yield results that are indexed against a hierarchy of component knowledge and skills related to each state's terminal objectives. This analysis provides students, teachers and other educational stakeholders with a roadmap to success in meeting their state's curriculum standards. In terms of broader impacts, the successful production of a fully functional, commercial PathfinderPlus product will break significant technical ground in the field of large online repositories of interactive learning objects. The deployment of ExploreLearning's XML specification HILO ML (Highly-Interactive Learning Object Markup Language) separates the pedagogical logic of a learning object's adaptive behavior from its technical instantiation. This separation enables the efficient development of the volume of scripts required by a system that covers entire courses (e.g., Algebra). The use of a four-tiered architecture to link fine-grained pedagogical events (i.e., pedagogically-meaningful interactions between students and the online simulations) to macro-level terminal objectives provides a flexible, modular foundation for the system.

In terms of impacts on K-12 education, PathfinderPlus will foster alignment with standards-based curricula, support teachers in integrating technology effectively and efficiently into their classrooms, and provide a new approach for measuring the impact of educational technology on student learning. In addition, the system's use of interactive simulations as the medium for assessment enables a broader range of more complex, higher-order instructional objectives to be assessed (e.g., problem solving strategies and skills), as compared to traditional probes used in computer-based applications such as multiple-choice questions.

Title: SBIR Phase II: Personal-Knowledge-Management eLearning System

Award Number: 0423443
Program Manager: Sara B. Nerlove

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $491,956

Investigator: Robert London, blondon@taxonomize.com
Company: Taxonomize
10980 Northsky Square
Cupertino, CA 95014
Phone: (408)725-1658

Abstract:

This Small Business Innovation Research (SBIR) Phase II project improves access to knowledge by auto-organizing unstructured data to respond to specific individuals, groups, and their activities. Taxonomize Resource Aid (TRA) uses syntactic, semiotic, semantic and statistical techniques to generate and update resource taxonomies, which are multi-level indices into the information corpus (documents, web sites, etc.) specific to users' activities. These active taxonomies are practice-relevant and personalized, and they provide applications of enhanced search, auto-produced portals, personalized content management, and knowledge discovery. For example, TRA's coordinated knowledge directories produce discovery of trends in time-based documents (such as discussion groups); extraction of information from unstructured data (such as distributed themes); and notifications from monitoring multiple information sources for patterns of confluences (e.g., news relevant to collaborating partners) or discrepancies (e.g., knowledge missing in one area that can be filled from another). Phase II development will take the successful prototype that was tested in educational settings, and create a commercial product (initially as a SOAP/WSDL web service) that will be licensed to firms selling software solutions in the areas of e-learning, search, and knowledge management. Taxonomize Resource Aid (TRA) will provide knowledge tailored for individuals, groups, and activities, and thus will provide people who have been limited by accessibility, resources, or background ready access to resources of knowledge, instruction, and collaboration. The TRA prototype has already been shown to provide significant benefits to some university students who were learning how to do primary research. Those who have difficulty with the culture, language, or technology gain the greatest benefits from TRA, because it gives them accelerated access to knowledge that is automatically selected for relevance to their activities, based on Taxonomize's powerful auto-categorization capabilities. TRA can help in any field where people need to organize, manage, access and use large amounts of information and resources.

TRA can help improve education, healthcare, defense, and government organizations process information quickly, especially when dealing with immediate and critical situations. It can also help disadvantaged people find necessary resources, and keep updated with changes that would otherwise be infeasible to monitor. TRA improves knowledge accessibility, flexibility and adaptability and affordability of general learning capabilities, and so may benefit formal and informal learning in every area

Title: SBIR Phase II: Interactive Earth: Tools for Earth Systems Science

Award Number: 0349784
Program Manager: Sara B. Nerlove

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $531,998

Investigator: Kirk Bergstrom, worldlnk@well.com
Company: WorldLink Media, Inc.
San Francisco, CA 94115
Phone: (141)593-1695

Abstract:

This SBIR Phase II project proposes to research and develop ways to increase accessibility and utilization of Earth systems science data and visualizations for secondary school teachers and students. The commercial product will consist of a DVDROM, curriculum, and web site. Building on WorldLink Media, Inc.'s previously published CD product, Interactive Earth, the firm will develop an integrated tool set for data display and image interpretation that will enable students to inquire, hypothesize, analyze, discover, and communicate with peers-replicating the work of real scientists. Much more than a static software program, the Interactive Earth DVD-ROM will be part of a "learning platform" that includes an in-depth curriculum package, access to a rich archive of global data via the web, and professional development opportunities. Partnerships with NASA's Earth Observatory web site and the World Resources Institute's EarthTrends project will enable classroom access to extensive global data sets and visualizations. TERC, a research and education organization, will develop a curriculum that aligns with the National Science Education Standards. This SBIR project recognizes the vital interplay between a curriculum developer (TERC), data providers (NASA and World Resources Institute), and a media designer and tool-builder (WorldLink) in creating exemplary learning materials. Earth science is of national strategic importance as a field of research and innovation.

The potential contribution to our schools and students is not just in Earth systems science, but in the broader applicability of the skills developed by students to related domains of science, math, geography, and other fields. These thinking skills include inquiry, visual literacy, understanding systems and models, and the ability to apply knowledge and problem solving to a range of real-world issues.

Title: SBIR Phase II: Affordable Handwriting Capture Device for Augmenting Communications Within Groups

Award Number: 9983371
Program Manager: Sara Nerlove

Start Date: May 15, 2000
Expires: April 30, 2002
Total Amount: $396,006
Investigator: Kurt Goszyk, kurt@cyberscan.com
Company: CyberScan Technologies
82 Walker Lane
Newtown, PA 18940
Phone: (215)860-8082

Abstract:

This Small Business Innovation Research Phase II project provides an affordable means of electronically enhancing the nation's installed chalk, white, and drawing board base of 2.5 million units. By adapting conventional writing surfaces rather than replacing them with expensive electronic white boards or graphics tablets, academic institutions, corporations, and governments could save approximately $10 billion in new equipment and installation costs. CyberScan Technologies proposes to develop a retrofittable, low cost, area adaptive product that can optically capture notes, drawings or sketches to a computer or to the Internet. CyberScan will refine the feasibility of digitizing hand strokes in real time that it demonstrated in Phase I using a small optical sensor and an optically transmitting pen or chalk holder. CyberScan's objective is to convert written information on standard school chalk board surfaces of nine feet by four feet into electronic data suitable for display on a PC SVGA display screen and posting on Internet Web pages.

Potential commercial applications of the research include: CAD/CAM digitizers, low cost and portable electronic white board alternatives, video conferencing input devices, medical patient charting, and academic, corporate, military, and government interactive presentation devices. Because of the serious interest of three potential marketing partners in the electronic white board field, rapid commercialization of products beyond Phase II is extremely likely.

Title: SBIR Phase II: Web-Based Touch Display for Accessible Science Education

Award Number: 9983472
Program Manager: Sara B. Nerlove

Start Date: June 1, 2000
Expires: December 31, 2003
Total Amount: $500,623

Investigator: George Anastas, janastas@immersion.com
Company: Immersion Corporation
801 Fox Lane
San Jose, CA 95131
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Abstract:

This Small Business Innovation Research Phase II project from Immersion Corporation takes advantage of an opportunity to turn an emerging mainstream computer technology into a universal accessibility tool. During Phase I, researchers at Immersion Corporation and at Oregon State developed enabling software technologies for Web-based force feedback and put them to use by designing a physics computer laboratory module. The module allowed students to actually FEEL forces while holding a simulated charged particle in an electric field, take data points, and then feel a plotted curve using prototypes of a force feedback mouse. Such mice have received excellent reviews from mainstream users who enjoy the ease-of-use and excitement of feeling GUI objects and computer feel effects and have met with enthusiasm from blind users, who require the best touch interfaces at the lowest cost. Phase II will expand the enabling technology, curriculum, and evaluation work begun in Phase I, and it will add interaction with accessibility software developers. Enormous potential exists for accessibility research to push the cutting edge of force feedback technology and for accessibility applications to take advantage of mass market economies of scale, creating a true universal accessibility success story. Over 110 million computer mice are sold each year. Web-based applications will substantially drive the adoption of force-feedback mice.

The proposed Internet force feedback innovations will accelerate market penetration. Development of educational applications will boost the market for accessible science education. The technology could also give a competitive advantage to screen reader companies.

Title: SBIR Phase II: Three Dimensional Video Motion Detection for Science and Mathematics Learning

Award Number: 0078672
Program Manager: Sara B. Nerlove

Start Date: September 1, 2000
Expires: August 31, 2002
Total Amount: $399,937

Investigator: Nathan Kimball, nathan@albertiswindow.com
Company: Alberti's Window, LLC
304 Pleasant Street
Watertown, MA 02472
Phone: (617)923-8450

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will complete the research and development to product of a low-cost tool for exploratory science and math learning, a three-dimensional motion detector. This device uses a passive optical detection scheme with two ordinary home video cameras as sensors. For at least 15 years, systems that capture and display motion in real-time have been used for studying the meaning of graphs and to investigate physical phenomena, and their educational effectiveness has been researched and documented. To date, all low-cost systems have been constrained to one dimension, and generally use ultrasonic echo location. This project will make 3D-motion detection affordable and competitive with one-dimensional systems when used with schools' existing video equipment. It offers great learning potential by allowing students to build a bridge from their universal 3D-world experience into mathematical space. The Phase II project proceeds along three fronts: refinement of the signal processing hardware, coding of the 'host' software for capture, display, and analysis of the 3D data, and the development and testing of educational activities. The software and activities are targeted for high school mathematics and physics.

This small business proffers a hands-on exploratory system to allow students multiple views and ways of understanding the complex study of motion. Several of the largest national distributors of educational electronic laboratory equipment have demonstrated interest in selling and promoting the motion detector.

Title: SBIR Phase II: Digital Cadaver - An Immersive Environment for the Direct Reconstruction of Anatomical Data Sets

Award Number: 0078774
Program Manager: Sara B. Nerlove

Start Date: August 1, 2000
Expires: July 31, 2002
Total Amount: $399,713

Investigator: Thomas McCracken, tmccracken@visiblep.com
Company: Visible Productions LLC
201 Linden Avenue, Suite 301
Fort Collins, CO 80524
Phone: (970)407-7240

Abstract:

This Small Business Innovation Research Phase II project will continue research and development of the Digital Cadaver Environment -- software that makes available to students multiple views of virtual cadavers with improved visual quality of the computed image, an increase in the size and attributes of the data sets used for rendering images, support for automatic configuration of imaging parameter using heuristics, and support for interpolation of missing sections of a user stain document. Marking a unique approach to the application of computer technology to the undergraduate anatomy and physiology curriculum, this environment supports an interactive work model where students engage in the cycle of observation, interpretation, and action that characterizes the historic "dissect & sketch" paradigm. The Digital Cadaver environment allows students to produce an individual and unique record of their investigations. The Phase I demonstrated the feasibility of implementing the core functionality of the environment as a Java application and produced a beta version of the software. Phase II of the research will focus on research extending this development in four areas: 1) Tools for collaboration between students will be created, and an intuitive project management system implemented for managing collections of images and documents; 2) Imagery from Visible Productions will be introduced into the environment to overcome defects in the Visible Human (VH) data sets; these images may also serve as links to other content, such as animations, photographs, or other images and documents that serve to augment the current environment; 3) tools will be expanded to include volume rendering of images in all viewing planes (i.e., sagittal, coronal, and axial) and arbitrary slicing of any image set; the data sets available to the student will be expanded to include selected cryosections of the female VH data set and selected MRI (magnetic resonance imagery) and CT (computerized tomography) imagery from the male and female; and 4) on the server, a more sophisticated illumination model will be implemented for added realism, user selectable image display properties will be included (i.e., setting some tissue layers to transparent), and higher resolution images will be used; improved support for higher resolution images will complete the Digital Cadaver Immersive Environment.

Title: SBIR Phase II: Real-Time Image Processing Based Motion Detection for Science and Mathematics Learning

Award Number: 0321625
Program Manager: Sara B. Nerlove

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $499,957
Investigator: Paul Antonucci, paul@albertiswindow.com
Company: Alberti's Window, LLC
304 Pleasant Street
Watertown, MA 02472
Phone: (617)923-8450

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will create a software-based, real-time, single camera, direct-to-computer, two-dimensional motion analysis system for education using image-processing technology. Image processing has not previously been used in educational motion detection. Compared to the commonly used methods--real-time one-dimensional graphing and frame-by-frame analysis of stored video—this innovation has many advantages, such as the simultaneous real-time display of video and graphs, multidimensional operation, ability to operate over any distance scale, display of the shape and orientation of objects, and the automatic generation of stroboscope-like images. This innovation creates the opportunity to surpass in learning effectiveness and ease-of-use the technologies now used widely in high school and college physics for the study of motion. In addition, it will potentially reach a much larger group--mathematics classrooms from middle school through college. The system will operate with ordinary classroom computers and ordinary digital video cameras.

Used in conjunction with inquiry-based curricula, Alberti's' Windows' system will be primarily used in physics and mathematics education classes. Improving the teaching of physics and mathematics is basic to science literacy and is essential to creating a technologically capable workforce. Ultimately, the following potential markets can also be explored: CAD/CAM, physiological/medical testing, sports, industrial monitoring and control, videogames, and security.

Title: SBIR Phase II: Understanding 'Construction/Deconstruction' and the Role of Resistance in Accelerated Learning

Award Number:	0091356
Program Manager:	Sara B. Nerlove
Start Date:	April 1, 2001
Expires:	March 31, 2004
Total Amount:	$499,959

Investigator: Lia A. DiBello, lia@wtri.com
Company: Workplace Technologies Research Inc.
1425 Russ Blvd.
San Diego, CA 92101
Phone: (619)232-8054

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the need to improve the success rate at which new technologies can be introduced into the workplace. A methodology and service, ATTAIN(TM), has been conceived to accelerate the integration of technology by rapidly and aggressively identifying critical processes and practices in the organization and shifting them in value-added ways at the level of worker cognition and operational specifics. This method has been shown to be highly successful, but is labor intensive, expensive, and requires highly skilled practitioners. Furthermore, the method upon which ATTAIN is based is not sufficiently targeted. That is, more often than not, businesses have only 3-4 workplace processes or practices that need to be changed in order to increase the company's competitiveness. The original method does not single these out as more important than other elements of the workplace. To date, increasing the effective incorporation of new technology by changing workplace practice and worker cognition through specialized simulation training has been successful. A significant remaining challenge lies in increasing the effective incorporation of new technology by identifying the most appropriate target for the technology implementation or change has been very successful. The work of Phase II will involve integrating the current methods with those of another company. Their method has been shown to identify the "vital few" practices that mitigate a company's overall competitive survival and which are the most appropriate targets for change. Phase II has two goals. First, a hybrid method that is quicker and more targeted will be developed. Second, a practitioner training approach and supporting materials that make it possible for professionals without extensive experience to deliver the method in a high quality manner will be developed.

Training and licensing practitioners in a hybrid method of workplace learning will contribute significantly to the problem of efficient and successful technology integration and implementation of new technologies.

Title: SBIR Phase II: Development of a Scanning Electron Microscope (SEM) Simulator for Use in Education

Award Number: 0321679
Program Manager: Sara B. Nerlove

Start Date: June 1, 2003
Expires: May 31, 2005
Total Amount: $499,820
Investigator: Gary S. Casuccio, gcasuccio@rjlg.com
Company: RJ Lee Group Inc
350 Hochberg Road
Monroeville, PA 15146-1516
Phone: (412)325-1776

Abstract:

This SBIR Phase II project will result in a low cost PC based interactive scanning electron microscope (iSEM) simulator incorporated into modules to enhance existing science curricula. Although the Scanning Electron Microscope (SEM) is an essential scientific tool and has major impact on our nation's industrial competitiveness, its utilization in education has been modest. Only a handful of high schools in the U.S. have access to instrumentation of this nature, and availability at colleges and universities at the undergraduate level is limited. The premise of this project is that the essence of microscopy instruments can be captured in a software-based simulator running on a personal computer such that entire classrooms can become virtual laboratories, with each student exploring a lesson using microscope-simulator software coupled with appropriate imagery and lesson material. The researchers will use the FERA (Focus, Explore, Reflect, and Apply) Learning Cycle model to develop iSEM enhancement modules and supporting materials to extend current curricula such as the National Science Resources Center's Science and Technology for Children (STC) and the Lawrence Hall of Science series of Full Option Science System (FOSS) and will include a component of professional development.

The iSEM will not only enable schools to perform more sophisticated scientific experiments and help schools meet the standards mandate, it will also help prepare students for joining tomorrow's workforce in this evolving age of nanotechnology. The educational component of the project that will be developed is inquiry-based, encourages explorations and is inexpensive enough that schools and students can afford to purchase it.

Title: SBIR Phase II: Connecting Science and Mathematics Through Data

Award Number: 0216656
Program Manager: Sara B. Nerlove

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $496,761
Investigator: Timothy E. Erickson, tim@eeps.com
Company: eeps
5269 Miles Avenue
Oakland, CA 94618-1044
Phone: (510)653-3377

Abstract:

This Small Business Innovation Research (SBIR) Phase II project creates new technology and materials that emphasize data analysis in science education. Data analysis makes scientific concepts and processes concrete and gives students another way - besides memorization or analytical understanding - to learn quantitative science, often bypassing the need for advanced symbolic mathematics. This project will emphasize physics classes in high school and beyond, where labs are often cookbook demonstrations of phenomena and the data analysis mere verification. The first phase of this research, with the help of new technology, provided evidence that, with the help of new technology, those students' understanding and competence could be improved beyond their previous capabilities. This project enhances that technology-Fathom Dynamic Statistics Software (KCP Technologies 2000) - to make it more useful in the science classroom, and it develops curriculum materials that use this software. Specifically, the firm will produce complete manuscripts for two supplemental books in physics appropriate for the high school, AP, or college introductory course: a lab manual and a book of problem sets. In addition, Epistemological Engineering will begin to explore and prototype additional materials in physics, materials for other sciences, and staff development offerings.

The proposed research will lead to significant enhancements to Fathom software and open the door to creating curriculum materials in science education using tools previously available only to math educators. Epistemological Engineering proffers technology that will contribute to strengthening science education in this country by teaching students to thoughtfully approach the world with a zest for measurement and prediction.

Title: SBIR Phase II: Web-Based Urn Sampler and Statistical Authoring Environment

Award Number: 0091412
Program Manager: Sara B. Nerlove

Start Date: April 1, 2001
Expires: March 31, 2003
Total Amount: $500,000

Investigator: Peter C. Bruce, pbruce@cytel.com
Company: Cytel Software Corporation
675 Massachusetts Avenue
Cambridge, MA 02139-3309
Phone: (617)661-2011

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will create web-based courseware featuring software (the "Urn Sampler") built around the simulation/resampling method in statistics, which focuses on the process of formulating a statistical test. This courseware will also feature a statistics text (Statistics: Making Sense of Data by Stout, Marden and Travers), self-assessment tools, a "Virtual Professor" help system, a "Virtual Statistics Consulting Lab," and entry-level spreadsheet-based statistical software. The target market is students in introductory statistics courses, who will purchase the product just as they now purchase texts. The courseware aims to leverage the latest and most standard web technologies that are anticipated to be in place at the conclusion of the project's development phase.

The plan combines the power of a web-based structure with the new resampling techniques to create a unique learning environment for statistics students. The Urn Sampler will be an open and flexible lab tool that will let teachers create exercises to supplement class lectures and other course materials. It will make it easy to teach the new compute-intensive resampling methods that have proven successful in teaching statistical inference. It addresses a diverse audience, including undergraduate and graduate students taking a required course in quantitative reasoning or statistics, students taking an undergraduate major or minor in statistics, graduate students studying statistics, and continuing education students. Additional product sales will come through purchases of parts of the web product by students whose instructors have adopted a text other than the Stout, et al. text.

Title: SBIR Phase II: Interactive Tools for Active Learning (ITAL)

Award Number: 0110363
Program Manager: Sara B. Nerlove

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $499,855
Investigator: Yakov E. Cherner, ycherner@ATeLearning.com
Company: Ate Learning
87 Stanley Road
Swampscott, MA 01907-1454
Phone: (978)282-1119

Abstract:

This Small Business Innovation Research (SBIR) Phase II project, ITAL-2 (Interactive Tools for Active Learning) will develop a comprehensive e-Learning solution for conventional academic Science, Mathematics, and Educational Technology (SMET) education and for corporate training. The project product, 'Active Learning Suites' (ALS), is a highly interactive online learning content delivery and management system. It includes an Active Shell, Simulations and Virtual Experiments, interactive lessons, a Problem Solving Tutor, a scriptable Instructor's Agent, an Assessment system, Authoring tools, and more. ALS uses real-life objects and situations, such as those related to home, telecommunications and sports, as the context for science investigations. Immersion in these contexts that are populated with appropriate sets of objects enables learners to discover the connections between the scientific theory and its practical applications in technology. Authoring tools helps instructors to easily assemble a single e-learning environment from heterogeneous educational resources and the WWW. ALS can facilitate both problem-based learning and more conventional learning strategies. It can be used on a campus or in a school equipped with either stand-alone computers or a local network, at home (self-learning), in a corporate setting, or via distance learning over the Intranet and Internet.

Active Learning Suites (ALS) offer a wide variety of lessons that can be designed to address many different audiences: (1) two-year college students enrolled in science, technology and engineering programs; (2) non-science majors; (3) high school students taking science and technology courses; and (4) instructors and technicians of telecommunications companies. The approach of immersing students or technicians in practical problems has great potential for facilitating understanding of science.

Title: SBIR Phase II: Advanced Software for Interactive Chemistry Tutoring

Award Number: 0132003
Program Manager: Sara B. Nerlove

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $500,000
Investigator: Benny G. Johnson, johnson@quantumsimulations.com
Company: Quantum Simulations Inc
5275 Sardis Road
Murrysville, PA 15668
Phone: (724)733-8603

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will produce a set of completed and commercially viable intelligent tutoring systems for chemistry education, building upon a rule-based, model-tracing, cognitive modeling tutor prototype for chemical equation balancing. Teachers, students, parents and administrators state that existing chemistry education software does not satisfy their need for truly interactive and on-demand computer instruction. Current approaches are rigid and linear, offering only a limited number of fixed and statically scripted problems. They do not deal with the individual student's own work in any meaningful or intelligent way. By simulating reasoning using chemical principles rather than compiling a database of problems and answers, artificial intelligence methods can provide a route to overcoming these serious fundamental limitations. Although the technology proffered by Quantum Simulations, Inc. is technology that will assist all students, those students of average or marginal performance will benefit the most.

Creating tutoring systems that can function as guides and not just as graders of student work is an important step in realizing the full value of computers in education. The proposed work takes a significant step in this direction. Moreover, the technology has been designed in a general way such that it can be applied to other educational topics beyond chemistry and can work together in a synergistic, value-added fashion with other tools and curricula in a multi-resource learning environment. Quantum Simulations, Inc., customers are driven by strong end user needs and include textbook publishers, software provides, and distance learning companies.

Title: SBIR/STTR Phase II: Census Microdata in the Classroom

Award Number: 0131833
Program Manager: Sara B. Nerlove

Start Date: March 1, 2002
Expires: February 29, 2004
Total Amount: $499,831

Investigator: William F. Finzer, bfinzer@keypress.com
Company: KCP Tech
1150 65th Street
Emeryville, CA 94608
Phone: (510)595-7000

Abstract:

This SBIR Phase II project proposes to research ways to increase accessibility and utilization of microdata from censuses of the U.S. and other countries in secondary school and college courses in mathematics. A seamless, XML-driven interface to a web server at the Minnesota Population Center will make it possible for teachers and students to specify, request, and import this microdata into Fathom Dynamic Statistics software. Enhancements to Fathom software will increase its already considerable ease and power for working with census microdata; curriculum materials in mathematics will provide teachers with effective ways to begin working with this highly motivating data--both to teach existing content and to teach data literacy. Phase I research suggested strong similarities between census microdata and school census microdata data that is gathered by K-12 schools about student demographics and performance, course offerings, and classroom practice. Accordingly, Phase II leverages this overlap to produce greatly needed interfaces for easily accessing school census microdata, survey tools for producing it, and extensions to Fathom for analyzing it. KCP Technologies' census microdata project exploits the merging web connectivity in American schools, thus symbiotically fitting a larger pattern of evolution of school technologies.

The project offers a product that supports analysis of complex data through an easy-to-use interface, which will contribute to data analysis and learning from data analysis. U.S. education is very much in need of the kinds of software and curriculum resources to be produced under this project.

Title: SBIR Phase II: Education on Demand for Technique Training

Award Number: 0239180
Program Manager: Sara B. Nerlove

Start Date: March 15, 2003
Expires: February 28, 2005
Total Amount: $499,716
Investigator: Cesar Bandera, bandera@ieee.org
Company: Creneaux
145 Avenue of the Americas
New York, NY 10013-1548
Phone: (212)337-3203

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and evaluate a delivery platform for interactive rich media and effective simulation-based e-learning. The platform will interface with learning content authoring and management systems that are scaleable to commercial operation without further development. Interoperability is achieved through verified compliance with the Advanced Distributed Learning Initiatives Shareable Content Object Reference Model, and the ability of the platform to directly admit and reuse e-learning assets in all pervasive formats. Rich media is represented in an object-oriented fashion that retains the identity of each media asset in order to: (1) facilitate courseware maintenance and reuse; (2) allow referenced server bandwidth and storage utilization, and system scalability; (3) enable data rights management of individual assets and diverse revenue models; (4) render content as an interactive multimedia engagement that promotes attention retention and the reinforcement of learner skills without the need for special hardware; (5) tailor content to diverse client platforms, distribution channel configurations, and the individual demographics, curriculum certification, and physical handicap of the learner; and (6) enable client-side rendering of high-definition content not possible to deliver pre-rendered over conventional Internet access.

The proposed system enables learners to receive courseware of higher audiovisual quality, greater interactivity, more referenced personalization, and with greater learner retention than that possible with current streaming technologies. Interoperability with existing learning content management systems, and scalability to large and diverse audiences strengthen commercialization potential. Enabling technologies that rely on rich-media delivery, such as collaborative visualization and distributed interactive simulation, are also supported by the proposed object-oriented rich media representation.

Title: STTR Phase II: Lifelike Virtual Tutors to Support Authentic Learning

Award Number: 0620486
Program Manager: Ian Bennett

Start Date: August 24, 2006
Expires: August 31, 2008
Total Amount: $497,843
Investigator: Edward Sims, eds@vcom3d.com
Company: VCOM3D, Inc.
3452 Lake Lynda Dr. Suite 260
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Phone: (407)737-7310

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop proof-of-concept, Web- or CD-delivered Virtual Reality (VR) simulations that incorporate lifelike virtual tutors, capable of demonstrating and performing science experiments and communicating in written or spoken English or sign language, for Grades 5-8 curricula.

This project provides an opportunity to broaden participation of under-represented groups in authentic learning experiences, through the use of lifelike virtual tutor avatars. Originally conceived as a means to explain concepts visually and with sign language to deaf students with low English skills, these virtual tutors will benefit a broader range of learners who are otherwise isolated by language or reading barriers, or by lack of access to laboratory equipment.

Title: SBIR Phase II: Cognitive Agility Assessment Tool

Award Number: 0548631
Program Manager: Sally Nerlove

Start Date: January 6, 2006
Expires: March 31, 2008
Total Amount: $532,000
Investigator: Lia DiBello, lia@wtri.com
Company: Workplace Technologies Research Inc.
1425 Russ Blvd.
San Diego, CA 92101
Phone: (619)232-8054

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of an assessment tool that will enable users to profile a decision-maker's cognitive agility and expertise in high-level business situations. It is appropriate for evaluating decision makers in organizations and students who aspire to leadership roles. This version of the product can also be self-administered. It is based on results from recent basic research conducted by Workplace Technologies Research Inc. (WTRI) that revealed the cognitive mechanisms involved in the thinking of highly accomplished experts in business. It uses knowledge elicitation technology that WTRI has developed over several years to support research on the identification of intuitive expertise (in the sense of Dreyfus 1997). The proposal outlines a plan to develop an on-line Internet based version that is self-scoring and tested among well-known experts. The product will be field-tested for its ability to predict general vs. industry specific expertise. The expected outcome is an easy to use tool for professional evaluators, professors, students or individuals, which will assist in staff development and education. The profiles generated by the product will identify hidden strengths, areas of weakness, and suggestions for further development. The long-term goal is distribution by recruiters, coaches, universities and consultancies.

In the current climate of rapid workplace change, decision-makers need to continually evaluate their ability to adapt to changes and re-invent their organization's value and competitive future. Few assessment tools address the cognitive underpinnings of the skill set involved. Rather, they evaluate personal traits or sub-skills that have some correlation with leadership, broadly defined. Using an empirically verified model of expertise in business strategy development and performance prediction, the research team at WTRI has built an assessment tool that locates an individual with regard to this model; much like chess players are evaluated against a notion of a Chess Grand Master. When applied to individual client situations, this tool has been shown to have powerful predictive capability and thus has successfully informed staff development efforts. Its distinctive feature is assessment of the ability to analyze disparate sources information in order to make strategy level decisions and supporting tactical plans. Making the tool more widely available and usable by non-scientists could importantly contribute to efforts to increase the performance of both organizations and decision makers. Organizations, distributors and several institutions of higher learning have expressed interest in this technology, which they consider to be addressing an area of unmet need.

Title: SBIR Phase II: Visualization of Massive Multivariate Adaptive Mesh Refinement (AMR) Data

Award Number: 0548729
Program Manager: Sally Nerlove

Start Date: January 23, 2006
Expires: February 29, 2008
Total Amount: $430,385

Investigator: Lisa Avila, lisa.avila@kitware.com
Company: Kitware Inc
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Clifton Park, NY 12065
Phone: (518)371-3971

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the lack of visualization technology for hierarchical structured grids created through an advanced simulation process known as Adaptive Mesh Refinement (AMR). Although the AMR structure makes possible simulations that are too computationally expensive using a uniform grid approach, it leaves the scientist with a lack of visualization tools to properly render the resulting volumetric data. With the successful completion of this Phase II effort, Kitware will meet this need by developing visualization tools that are focused on efficiently and effectively rendering the large, multivariate, time-varying data produced using the AMR technique. The primary technical accomplishment of the Phase II effort will be the development of a high performance volume rendering strategy for AMR data that runs across a variety of platforms from a standard desktop system to a large cluster of high-end workstations. Advanced transfer function techniques will aid scientific discovery by allowing scientists to visualize relationships in their data. Packaging these visualization tools into a user-friendly application will make this complex technology accessible to researchers. In addition, Kitware will adapt this technology to the clinical medical visualization market, where large, multivariate, hierarchical data will become commonplace in the near future.

The state-of-the-art AMR visualization technology developed during this Phase II project will be donated to the scientific community as part of two open-source packages. This technology will be available to software developers through the Visualization Toolkit (VTK), a C++ class library of visualization, graphics, and image processing algorithms. This technology will also be incorporated into the end-user scientific visualization application ParaView, which can run on a desktop computer or across a high performance cluster. Through the use of extreme programming principles, these open source packages are developed, tested, and released daily, allowing Kitware to deliver the latest technology for immediate use by the scientific community. In return, this provides Kitware with continual feedback from users and developers that will help the firm to improve not only the open source software, also the firm's commercial products that are built on top of this code base. Kitware intends to leverage the Research Opportunities for Undergraduates (REU) and Research Opportunities for Teachers (RET) programs to build a team of students and teachers who will generate educational material from the software including lesson plans, presentation materials, animations, and suggested projects. This material will be distributed to educators at the high school and undergraduate levels.

Title: SBIR Phase II: Advancing an Interactive Learning Platform by Integrating Multiplayer Game Technology

Award Number: 0548732
Program Manager: Sally Nerlove

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $500,000
Investigator: Douglas Seifert, douglas.seifert@syandus.com
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760 Constitution Drive
Exton, PA 19341
Phone: (610)321-2500

Abstract:

This Small Business Innovation Research (SBIR)Phase II project advances Syandus's interactive learning platform by integrating multiplayer game technology. Syandus's current interactive delivery platform allows pharmaceutical firms and content experts to communicate complex concepts to physicians and patients through interactive presentations, discussion groups or self-directed learning. The addition of network-enabled collaboration afforded by this proposed project creates the opportunity for interaction between users and content experts without the constraints of geography. The integration of multiplayer game technology into Syandus's platform requires the innovative application of this technology to serve a new purpose. This proposal will support modification of the existing platform to function in a collaborative setting, building a collaborative engine to synchronize application data between users, integration of a third party multiplayer networking solution and development of a prototype application to test collaborative functionality. Syandus has completed projects with several of the top 20 pharmaceutical companies for the delivery of innovative medical education products based on the existing platform. In the first business application derived from this proposed concept, physicians will be able to remotely connect with nationwide content experts to interactively learn the latest best practices and medical science in a more compelling way than currently available.

The pharmaceutical industry strives to communicate medical science innovation and new treatment methods through an information cascade from international and national level thought leaders, to regional physician thought leaders, to practicing physicians and their patients. The anticipated results from the proposed concept will be a learning tool for pharmaceutical companies that allow groups of physicians nationwide to have an interactive dialog about a disease state and appropriate treatment. Longer term, in the educational realm, Syandus's technology could be used to develop more sophisticated collaborative learning environments that allow students, regardless of geographical location, to assemble in a virtual biological world or system (such as a cell or organ) and work together as individuals or in groups to solve problems and optimize processes. A highly rewarding learning experience can be created through the free exchange of information and ideas enabled by a collaborative network coupled with compelling visuals, rich interactivity and the underlying intelligence of mathematical models. Transforming Syandus's existing platform with multi user capability adds rich human interaction into the remote learning process, brings scientific models to life, and allows greater dissemination of knowledge.

Title: SBIR Phase II: Developing a Cost-Effective Method for Creating Cognitive Models for Cognitive Tutors

Award Number: 0548754
Program Manager: Sally Nerlove

Start Date: January 9, 2006
Expires: December 31, 2007
Total Amount: $509,999

Investigator: Stephen Gilbert, stephen@clearsighted.net
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Suilte 4210
Ames, IA 50010
Phone: (515)233-5137

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will make the creation of effective intelligent tutoring systems (ITSs) easier, and it will enable the dissemination of that technology to a broader audience than currently realized. ITSs have proven to be highly effective in delivering computer-based instruction, but they have historically been expensive and difficult to build, requiring specialized skill in artificial intelligence and production systems programming. Building upon Clearsighted's Phase I accomplishments, the firm will: (1) finish a fully-functional software development kit (SDK) that will allow non-cognitive scientists to create the cognitive model that powers an ITS; (2) develop technology that will enable an ITS to communicate to the vast majority of third-party software; (3) develop techniques that will allow an ITS to work with an institution's existing on-line learning system; and (4) evaluate the research team's work with respect to both time-savings in building ITSs and customers' return on investment. Two main results are anticipated: (1) a two- to three-fold decrease in the amount of time it takes to author an ITS; and (2) an estimated savings to customers of 30% per hour of the cost of traditional training time.

The success of ITSs is well documented (e.g., Koedinger, Anderson, Hadley, & Mark, 1997; Corbett, 2001; Morgan & Ritter, 2002). However, ITSs have not been broadly deployed, due to the high level of expertise needed and the cost to create. Furthermore, lack of viable options to interface the cognitive model of an ITS with already existing software impairs wider dissemination of that technology. By increasing technological understanding of how to reduce the amount of the expertise needed to create an ITS and how to accomplish interfacing ITSs with existing software, the result of this supported work will be a wider distribution of ITSs. Clearsighted is well poised to become a market leader in on-line technical training by leveraging this technology. Clearsighted has partnered with Carnegie Learning, the ITS leader in K-12 education to assist in these goals, and it has the additional expertise needed to perform the required work. By transitioning ITS technology from its currently very small market to a wider audience that includes not only education, but also corporate and industrial applications, the costs to the many companies and institutions that do on-line training will greatly decrease, and the productivity of their workers will increase.

Title: SBIR Phase II: Incorporation of Knowledge Base into Statistical Machine Translation

Award Number: 0548763
Program Manager: Sally Nerlove

Start Date: January 11, 2006
Expires: December 31, 2007
Total Amount: $500,000

Investigator: Yookyung Kim, kim@sehda.com
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Mountain View, CA 94043
Phone: (650)864-9900

Abstract:

This Small Business Innovation Research (SBIR) Phase II project embodies an innovative approach to machine translation. The proposed model aims to overcome two important bottlenecks in the development of a high quality statistical machine translation (SMT) system: (1) inability to handle structural problems and (2) dependence on huge amounts of parallel texts. The inability of statistics to sufficiently handle grammatical problems such as word order becomes more evident when the language pair is very different in structure and morphology, such as with English and Korean. The dependence on a huge amount of parallel texts is a great challenge especially to speech translation. Based on successful tests in the Phase I project, this project proposes a method to learn linguistic knowledge crucial to handling word order and non-local dependencies automatically from input and incorporate it into SMT along with simple transformations, maximizing the strength of both knowledge-based approaches and statistical approaches, and minimizing the need for ever-increasing amounts of bilingual data. The proposed approach aims to build a syntactic-phrase-based statistical machine translation engine that not only is more accurate than the existing word-based ones, but also can decrease the need for large data sources.

The primary impact of the proposed project is the potential for achieving automatic translation quality as high as the quality of the best knowledge-based machine translation engines; but with a minimum of handcrafting of knowledge and therefore at a much lower cost in terms of development time and human resources. While the research is specifically concerned with MT between English and Korean, the resulting translation models would potentially be usable for translation between any pair of languages. The result of the research will be used to develop a speech translation device, in particular to overcome language barriers in communication with patients in hospitals. It will provide a key technology that will accelerate development of speech translation applications in order to reduce costs of healthcare providers and to enhance the quality of healthcare. Additionally, the proposed method of learning linguistic features will have an impact on many different applications including speech recognition, search engines, genre and topic detection, and document search and query. Finally, the proposed research will have beneficial impacts nationally and globally by helping to solve the 'automatic translation' problem, an area of paramount importance to the economic welfare and security of the United States and the rest of the world.

Title: SBIR Phase II: Creating New Learning Opportunities: Platform-Independent, Wireless, Task-Oriented Communities

Award Number: 0620327
Program Manager: Ian Bennett

Start Date: August 3, 2006
Expires: July 31, 2008
Total Amount: $499,958
Investigator: Michael Curtis, curtis@goknow.com
Company: GoKnow
2084 South State St
Ann Arbor, MI 48104
Phone: (734)929-6602

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aimes to design and develop a challenging and critically important layer of communications' software that enables K-12 educational software developers to incorporate explicit support for collaborative learning activities into their existing applications quickly and at low-cost. The Elmer Software Development Kit (SDK) will enable students to collaborate using a broad range of handheld (or even desktop/laptop) computer platforms (Windows CE & XP, Linux, Mac OS X) since classrooms, as they are already beginning to experience, will be using non-homogenous computers side-by-side. The Intellectual Merit of this proposed effort stems from the need to construct new algorithms to automatically detect other devices, to reformat communications' messages to enable cross-platform (and cross-operating system) communication on a range of platforms. The outcome of this effort should be a software development kit that engenders the incorporation of collaborative learning strategies.

K-12 education is the cornerstone of America's democracy. As No Child Left Behind (NCLB) act acknowledges, America has some serious work to do in reinventing how we educate our children in order for America to continue to provide its people with the standard of living that is the American Promise. Technology is today's generation's tool of choice outside of school; we need to make technology an integral tool inside of school, too. Advocating for technology is the easy part - making the technology accessible, useful, and enjoyable remains the challenge. Our SBIR project goes directly to the core of helping K-12 realize the vision of technology positively impacting teaching and learning. In particular, the proposed research will enable educational software developers to create, quickly and at low cost, collaboration-enabled applications that teachers demand and that students find enjoyable and productive.

Title: SBIR Phase II: Providing Tools for Richer eLearning Assessment

Award Number: 0620380
Program Manager: Ian Bennett

Start Date: August 3, 2006
Expires: July 31, 2008
Total Amount: $500,000
Investigator: Linda Chaput, lchaput@thinkfive.com
Company: Agile Mind
1100 South Main St
Grapevine, TX 76051
Phone: (817)424-2863

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will study effective models for carrying out assessments employing challenging puzzle-like questions that incorporate distractor analyses in which meaning is assigned to complex responses. Such distractor analyses apply where there is the possibility that the test taker can give alternative correct, partially correct, and incorrect answers. Metadata and distractor analyses will be combined to provide in-depth reports on student test performance. This new rule-based solution to distractor analysis meets a significant challenge in being able to include engaging problems in assessments of student progress in quantitative courses, such as Algebra and Geometry. The research will further develop question authoring and test construction tools.

As a consequence of this work, educators using these new technologies will be able to move beyond online testing based solely on multiple-choice, single-answer questions that are known to be unmotivating for many students. The goals are twofold: to provide varied, interesting, and even gamelike learning interactions that incorporate motivational and pedagogically valuable feedback; and to do so in a form in which empirical evidence can be used to improve the assessment corpus - both the metadata and the rules used for defining distractor analysis, especially where the items are novel question types.

Title: SBIR Phase II: Understanding the Nature of Science

Award Number: 0620590
Program Manager: Ian Bennett

Start Date: September 15, 2006
Expires: August 31, 2008
Total Amount: $499,930
Investigator: Timothy Erickson, tim@eeps.com
Company: BigTime Science
5269 Miles Ave
Oakland, CA 94618
Phone: (510)653-3377

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will deliver simulations over the web for secondary and post-secondary science instruction which focus explicitly on students coming to understand the "nature of science." The nature of science implies that both the underlying logic of scientific discovery and the way that science is organized around the acquisition and dissemination of data and ideas. This is the big picture in science learning -- establishing the relationship between experiments and hypotheses; the idea that theories are models and not reality, and that the test of a theory is its predictive power. The research focuses on the careful design and testing of both the simulations and the lessons in which they are embedded, to ensure that they are as effective as possible.

Tomorrow's citizens need to know how science works. This project will help erase dangerous misconceptions about the origins and extent of scientific knowledge, and give students tools to evaluate scientific (and quasi-scientific) claims more effectively. This project also probes unusual models for both delivery of instruction and commercialization in the education world: it will use the Internet not to deliver content but to mediate a simulation and promote inter-group communication, usually within a single classroom rather than more widely; and will do so using subscriptions - a way that is cost-effective to the teacher in the short term.

Title: STTR Phase II: Intelligent Instruction Systems using Augmented Reality

Award Number:	0646587
Program Manager:	Ian Bennett
Start Date:	March 15, 2007
Expires:	February 28, 2009
Total Amount:	$499,022

Investigator: Jayfus Doswell, juxtopia@hotmail.com
Company: Juxtopia
6581 Hickman Terrace
Alexandria, VA 22315
Phone: (703)989-1199

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project investigates the creation of intelligent instruction systems that exploit adaptive software mechanisms (i.e. intelligent software agents) and augmented virtual reality (AVR) techniques. Since it is common that production-line employees are required to wear goggles, intelligent agents could transfer their instructions via goggle-like wearable computers (i.e. AVR) that overlay the actual visual field with text and computer graphics. The proposed techniques will facilitate the real-time assessment of employees undergoing training and will allow the software agents to automatically and proactively reinforce weaker areas based on these assessments. An overall assessment model of all employees can characterize the entire workforce for a particular facility. For example, this overall assessment can be used to enhance resource management triggered by absenteeism or other factors, allowing planners to use such assessments for optimizing manufacturing processes by refactoring traditional, perhaps obsolete, production processes.

The broader impacts of the technology result from the use of intelligent agents to manage and direct the cross-training of employees in typical work environments where absenteeism and workforce turnover are important issues. Additionally, this technology, through workforce training broadly impacts the workforce to become more adaptive and agile with the resulting positive impact on overall product quality and productivity.

Universal Access

Title: SBIR Phase II: Intelligent World Wide Web (WWW) Access for the Visually Impaired

Award Number: 0091590
Program Manager: Sara B. Nerlove

Start Date: July 1, 2001
Expires: December 31, 2003
Total Amount: $455,568
Investigator: Marcus J. Huber, marcush@marcush.net
Company: IRS
4976 Lassen Drive
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Phone: (760)806-1497

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop screen reading software (used by the visually disabled to access computers) that responds to changes in task context. The proposed software will allow screen readers to automatically generate task-specific scripts--sophisticated macros that determine the behavior of the screen reader in response to the current state of an application--based on an analysis of the user's actions while performing a specific task. The end result of this project will be a functioning prototype screen reader (based on Henter-Joyce's JAWS (Job Access With Speech) screen reader) with the ability to observe the user's actions, identify the user's goal based on those actions (referred to as plan recognition), and then either create a script that automates the task of achieving that same goal in the future or remind the user that such a script already exists. Throughout the course of the project, feedback will be sought from members of the visually impaired community through user trials, focus groups, and formal experimentation. While investigators will work exclusively with the JAWS screen reader during Phase II, many of the algorithms developed during this project will be applicable to other screen readers. The software developed will be licensed to others to improve the performance of existing and new screen readers.

The enhanced screen reading software will provide a number of significant benefits. First and foremost, the visually impaired will have significantly improved access to computers for both personal and job-related activities. They will be able to use computers for tasks that were previously impossible or impractical, and they will be able to perform their current activities faster and more effectively. Second, employers will be more open to employing the visually impaired because of the reduced cost in time and effort of job training and the increased level of productivity; visually impaired employees will be able to do more jobs, will be able to learn jobs faster, and will be able to do their jobs better than before.

Title: SBIR Phase II: Accessible Electronic Mathematical Content

Award Number: 0522308
Program Manager: Ian M. Bennett

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $499,959
Investigator: Neil Soiffer, neils@dessci.com
Company: Design Science, Inc.
140 Pine Ave
Long Beach CA, 90802
Phone: (562)432-2920

Abstract:

This Small Business Innovation Research (SBIR) Phase II project makes mathematical expressions in common electronic formats seamlessly accessible to people with print disabilities. Print disabilities include blindness, low vision, dyslexia and other learning disabilities. While others have explored aspects of accessibility in stand-alone applications, none have integrated access to mathematical content for those with print disabilities into users' existing screen readers or other assistive technology. The advantage of this project's approach to math accessibility is that it allows documents containing math to be read with standard browsers and document viewers. The electronic formats supported by this project are web pages that encode math using MathML, Microsoft Word documents, and PDF. Accessibility is achieved by providing software add-ons to Internet Explorer, Word, and Adobe Reader, and modifications to the industry leading authoring and publishing workflow tools to embed MathML into these formats. The project brings together work on various aspects of making mathematical content accessible. It pushes forward the state-of-the-art in audio rendering of mathematical expressions, navigation of mathematical expressions with audio feedback, and audio rendering synchronized with highlighting of the sub expression being spoken. The project provides a platform that allows other NSF-funded research projects to convert MathML to Braille math codes and other formats.

Accessibility of electronic content is a requirement of the Rehabilitation Act Amendments of 1998, Section 508. Many states have adopted similar requirements for state-funded entities. The Individuals with Disabilities Education Act (IDEA) mandates accessibility of school materials. Accessibility laws apply to all forms of content, not just textual content. Current solutions for math accessibility are so costly and time consuming that access to materials in a timely manner is not always provided to those that need the access despite legal mandates. The results of this project will present a fast and inexpensive route for publishers of textbooks with mathematical content to satisfy these laws. It will also provide a simple and painless way for people who author documents with math in them to make the document accessible to people with print disabilities. The availability of books and other material coupled with accessible authoring of mathematical content has the potential to dramatically enhance the way students with print disabilities are taught and learn mathematics, science, engineering and other technical fields

Title: SBIR Phase II: Commercial Combustion Synthesis of Homogeneous Lots of Carbon Nanotubes

Award Number: 0522093
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $499,482

Investigator: Henning Richter, hrichter@nano-c.com
Company: NANO-C, Inc
33 Southwest Park
Westwood MA, 02090
Phone: (781)407-9417

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is designed to achieve a pilot-plant demonstration of the technical and commercial feasibility of cost- and energy-efficient large-scale conversion of natural gas to single-walled carbon nanotubes (SWCNT). The research will include: (1) exothermic and selective synthesis of SWCNT by premixed combustion of natural gas after introduction of catalyst precursors with the cold gas mixture; (2) continuous collection of material by means of a bag-house filter; and, (3) detailed understanding of the correlations between operating conditions (pressure, type of catalyst, fuel-oxygen ratio, dilution with inert gas, cold gas velocity) and characteristics of the carbon nanotubes (single-, double-, or multi-walled, diameter, length, conductivity).

Results of this project are expected to have a significant impact on the development of the US nanotechnology sector and to strengthen its international competitiveness. Projected sales price of not more than $50/g will lead to a pronounced increase of the number of economically viable SWCNT applications.

Title: SBIR Phase II: Tactile Graphic Array

Award Number:	0450169
Program Manager:	Ian M. Bennett
Start Date:	February 1, 2007
Expires:	January 31, 2007
Total Amount:	$500,000

Investigator: Oleg Tretiakoff, oleg@catechnology.net
Company: C. A. Technology, Inc.
9500 S. Ocean Drive
Jensen Beach FL, 34957

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will conduct research leading to the development of working prototypes of new low cost and compact Tactile Graphic Displays and Braille Displays. The dominant technology today, displays driven by piezo-electric actuators, has two major deficiencies. It is very expensive, about $12 to $16 per tactile dot, and the actuator shape, a 50 to 70 mm long reed, significantly increases the volume of feasible displays, essentially limiting their use to single line Braille displays for desktop or portable devices. During the Phase I of the project, C.A.Technology performed extensive research on the design of a new Shape Memory Alloy single dot actuator and has demonstrated the feasibility of tactile displays based on this technology. This actuator uses a short and very thin Titanium-Nickel alloy wire, which will bring the cost per dot down to about $3 to $4, and will considerably reduce the display volume, allowing its use in hand-held devices. The Phase II effort will include the following: 1) detailed design, construction and user testing of the new tactile arrays; 2) development of software to interface these displays with various portable and hand-held devices, such as C.A.Technology's own Portable Print Reading Device; and 3) preliminary design of manufacturing tools and facilities.

In the mid-seventies, the appearance of the first electronic Braille displays changed the lives of blind individuals. Today, many have immediate and selective tactile access to textual information through refreshable electronic Braille displays. However, the high cost of these devices still severely limits their diffusion. By reducing their cost, their size and their weight, this new technology will increase the market penetration of Braille displays, making them accessible to many more blind and deaf-blind individuals and significantly improve their employment opportunities. Access to graphic symbols widely used for example in mathematics, chemistry and access to plain graphics is still only possible through slow, bulky and very costly graphic embossers. If a picture is "worth a thousand words", then a compact, low cost refreshable graphic tactile display proffers a significant new opportunity for the lives of blind students, blind engineers, blind physicists and blind people involved in almost any intellectual activity. In addition, it will also be important to those with low vision.

Title: SBIR Phase II: Assistive Reading Device for Persons with Disabilities

Award Number: 0321686
Program Manager: Om P. Sahai

Start Date: November 1, 2003
Expires: October 31, 2005
Total Amount: $495,114
Investigator: Irene Schipper, schipper@pageflip.com
Company: Pageflip, Inc
111 Woodmere Blvd South
Woodmere, NY 11598
Phone: (516)374-1607

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an assistive reading device for persons with disabilities. The device, an electromechanical page turner, will serve to automate the mechanical tasks associated with page turning, an important ancillary process of reading. With the touch of a button/pedal, the page turner will automatically grab the next page of a book, turn it, and keep the book opened flat during the entire process. In the prior Phase I work, a novel turnstile design was introduced, and data was collected on bending stiffness, static and dynamic coefficients of friction, and the mechanical characteristics of paper. The Phase II project will integrate the Phase I results into an engineering effort to optimize the design and improve the performance and reliability of the page turner.

The commercial application of this project will be in the area of assistive technologies for people with disabilities, the elderly, musicians, and avid readers.

Title: SBIR Phase II: Creating Accessible Science Museums for Blind and Visually Impaired Visitors with User-Activated Audio Beacons

Award Number: 0421973
Program Manager: Sara B. Nerlove

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $499,710

Investigator: Steven Landau, sl@touchgraphics.com
Company: Touch Graphics
330 West 38 Street
New York, NY 10018
Phone: (646)515-3492

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will demonstrate the effectiveness of a new system for guiding visitors in science museums and other public spaces. Touch Graphics will design, implement, and evaluate an apparatus that will allow any museum visitor to dial in to, and then interact with, a computerized attendant, using the visitor's own cell phone or one lent to him/her. A special feature will allow blind and visually impaired users to navigate independently by following sounds from environmental audio beacons that they will control by pressing keys on their phones. Once a visitor arrives at the requested exhibit component, his or her phone will serve as an audio explainer and control interface. While the development of this concept has been motivated by the desire to accommodate the needs of visually impaired museum-goers; in Phase II, the small business will configure the system as a mainstream audio guide product that includes optional accessibility features. The small business will create an experimental installation of the envisioned system in a large science museum in New York City, where it will undergo two rounds of human subject testing. As part of this installation, an interactive touch model of rockets that are part of the museum's collection will be designed, fabricated and tested to study the effectiveness of users' cell phones as an accessible control interface for individual exhibit components. The project will also be complemented by a parallel study in which user-activated audio beacon technology is deployed in a different context; a phone-based navigation tool will be implemented and tested as a travel aid for blind and visually impaired bus riders in Austin, Texas who need to find public access information.

This user-activitated audio-beacon technology has the potential to improve access to important public resources, particularly science museums for individuals who have been excluded due to disabilities. It seeks to provide opportunities for the blind and visually impaired to experience the enrichment and entertainment offered at hundreds of facilities around the country. These institutions offer opportunities for informal science education that can inspire people to pursue careers in science and technology, and the Nation as a whole stands to benefit when more qualified young people are encouraged to enter these crucial fields. Improved science literacy for all citizens, young or old, is an important goal that this project seeks to promote.

Title: SBIR Phase II: Accessible Scalable Vector Graphic Authoring and Editing Applications

Award Number: 0422218
Program Manager: Sara B. Nerlove

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $493,942
Investigator: Vladimir Bulatov, bulatov@viewplustech.com
Company: ViewPlus Technologies, Inc.
1853 SW Airport Ave.
Corvallis, OR 97333
Phone: (541)754-4002

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will support development and testing of Windows applications for creating and making available highly accessible SVG files. Scalable Vector Graphics (SVG) is a graphics markup language supporting features critical to accessibility by individuals with print disabilities. One application permits authors easily to create and/or edit mainstream graphical information as SVG files fully usable by individuals with print disabilities. Full accessibility requires only that authors supply names of important graphics objects, a task easily done with the SVG Editor. Most individuals with print disabilities can comprehend graphical information better by moving the mouse over text or graphics objects displayed in the ViewPlus SVG Reader, whereupon they hear the text or names of graphics objects spoken aloud. Blind users and those unable to use a normal mouse can also comprehend such information by creating a tactile copy on a ViewPlus Tiger embosser which can then be read with their fingers after placing it on a ViewPlus Touchpad. Sighted users can obtain an embossed color image with the new Color Embosser. Availability of an appropriate embosser and Touchpad means that even individuals with severe print disabilities can access mainstream graphical information without assistance by another human being. Computer users with severe print disabilities currently have good access to words but very poor access to graphical information. Lack of good access to graphs, charts, and diagrams severely affects quality of life and educational and professional opportunities, particularly in the STEM fields, i.e., science, technology, engineering, and mathematics.

Graphical information today is "made accessible" largely by written or verbal description. There is currently no practical way to make most graphical information available in a form usable by individuals who are severely dyslexic or for blind people, who may or may not read Braille. These new SVG applications will provide a user-friendly technology that fills that need. Graphical information can simply be created and displayed on the web or in electronic documents as SVG files that are usable by everybody. The hardware technologies needed by blind or severely dyslexic people should cost no more than a present-day Braille embosser, so it should be affordable for libraries and institutions to provide this capability thus to serve these clientele. The largest user base for the SVG Reader will probably be individuals with less severe print disabilities who can improve their comprehension by supplementing visual with audio information.

Title: SBIR Phase II: The Accessible Semantic Web

Award Number: 0349718
Program Manager: Sara B. Nerlove

Start Date: March 1, 2004
Expires: February 28, 2006
Total Amount: $532,208
Investigator: Edward Sims, eds@vcom3d.com
Company: VCOM3D, Inc.
3452 Lake Lynda Drive
Orlando, FL 32817
Phone: (407)737-7310

Abstract:

This Small Busees Innovation Research Phase II Project proposes to develop an Accessibility Markup Language (AML) that annotates digital representations of English text with linguistic information needed for proper translation into other modalities, as required by persons with physical or cognitive disabilities. As an exemplar of the technology, VCom3D will develop, demonstrate, and evaluate the application of AML to making Web content accessible in American Sign Language (ASL). This development will entail the implementation of an Encoder to create AML from English text, and a Decoder to generate grammatical ASL from AML. Multinational corporations and institutions have recognized the economic and social need to make information and instruction accessible to persons around the world for whom English is, at best, a second language. To address this issue, international organizations, including the World Wide Web Consortium (W3C) are defining methodologies for using Controlled Languages, systems of annotation and, in the future, the Semantic Web to increase accessibility in other languages. These same emerging technologies and infrastructure can provide an unprecedented opportunity to make information available to underserved Americans with sensory, cognitive, and cultural differences. This project will demonstrate the application of emerging information technology to make information accessible to Deaf persons, and will provide resources for further research into ASL linguistics.

The initial commercial product based on this technology will be a translation and authoring tool that substantially automates the creation of grammatical, animated ASL from English text. This product will be used to increase access by Deaf and Hard of Hearing children and adults to digital information and to promote inclusive education and employment in accordance with the New Freedom Initiative, recent amendments to Section 508 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA), and Section 255 of the Telecommunications Act.

Title: SBIR Phase II: Mobility Agents for Persons with Cognitive Disabilities

Award Number:	0349663
Program Manager:	Sara B. Nerlove
Start Date:	March 1, 2004
Expires:	February 28, 2006
Total Amount:	$500,000

Investigator: Alexander Repenning, alexander@agentsheets.com
Company: Agentsheets, Inc.
6560 Gunpark Drive, Suite D
Boulder, CO 80301
Phone: (303)530-1773

Abstract:

This Smal Business Innovation Research (SBIR) Phase II project will develop Mobility Agents that help persons with cognitive disabilities use public transportation systems. The realization of an operational system that wirelessly connects users to real-time bus information through Mobility Agents depends on the fact that public transportation systems are increasingly equipped with GPS (Global Positioning System) systems connected to control centers through dedicated wireless networks. Controllers use this infrastructure to schedule and optimize operations and avoid organizational problems such as bunching. Agentsheets proposes to use this existing infrastructure to compute highly personalized information and deliver it on PDAs or cell phones to persons with cognitive disabilities. Wireless devices with location aware Mobility Agent services that help travelers use public transportation systems, permit caregivers to customize these agents, and monitor the progress of travelers by means of utilizing The Pragmatic Web, a framework for highly customizable Web information; and Deductive Tracking, a combination of sensor fusion and minimalist common sense AI that creates more reliable tracking information. Agentsheets will explore design and implementation issues for agent-based real-time user interfaces on handheld devices; build the system, and test it in a real-world setting using the Boulder bus system as a public transportation test bed.

The Mobility Agents technology turns general GPS-based information into personalized, practical information. Customization mechanisms range from simple preferences to rule definition, and are relevant to the fields of End-User Development/Programming, Visual Languages, and Human Computer Interaction. Deductive Tracking contributes to Sensor Fusion and Artificial Intelligence. Parts of a Phase I 3D engine, used in the real-time transportation visualization, have been made available to other research organizations and are already in use. This technology proffers assistance to persons with cognitive disabilities. The elderly and other groups will also benefit from the same technological developments. This technology creates new service organizations. It reduces the need for human escorts, increases the autonomy of persons with cognitive disabilities, and decreases the need for federal support.

Title: SBIR Phase II: Affordable Braille Display Using Novel Microactuators

Award Number:	0078660
Program Manager:	Sara B. Nerlove
Start Date:	August 15, 2000
Expires:	July 31, 2003
Total Amount:	$762,000

Investigator: Frederick Lisy, lisy@orbitalresearch.com
Company: Orbital Research Inc
4415 Euclid Ave.
Cleveland, OH 44103
Phone: (216)649-0399

Abstract:

This Small Business Innovation Research Phase II project from Orbital Research Inc. will design and test an affordable, multiline refreshable Braille display system (RBDS) able to display computer screen information either from the hard drive or the Internet. The proposed RBDS will combine state-of-the-art microelectromechanical (MEMS) actuators with cutting edge electronic assembly technology to assure ease in manufacturing and robustness. Additionally, Orbital Research will implement a modular architecture that allows for unprecedented versatility through tailoring the Braille surface for various applications requested by the end users. Traditionally, MEMS actuators are very small, cost efficient and low power. However, traditional packaging of the MEMS devices results in a much larger and much more expensive component. In Phase I of this project, Orbital Research as produced a MEMS actuator capable of producing Braille dots. In this phase, Orbital Research will integrate a flexible assembly process to overcome the traditional complexities associated with packaging MEMS actuators. Orbital Research will take full advantage of the features offered by cutting edge manufacturing processes such as MEMS, IC processing, flip-chip and surface mount technologies to assure the final proposed RBDS is light weight and small in size, cost affordable, robust, modula, enables tactile acuity, and is "user friendly." The refreshable Braille Display system proffered by Orbital Research will enhance access to electronic information on the job or at home. It will also provide for enhanced educational and employment opportunities for visually impaired individuals in line with the requirements of the Americans with Disabilities Act.

This device will create employment and research opportunities for the visually impaired, especially for those whose interests extend to mathematics, scientific, and technical fields that require frequent access to reference works in order to perform their tasks efficiently.

Title: SBIR Phase II: Mathematics Multimedia for Children with Hearing Loss

Award Number:	0079350
Program Manager:	Sara B. Nerlove
Start Date:	July 1, 2000
Expires:	December 31, 2002
Total Amount:	$400,000

Investigator: Marjorie Cappo, Marge@learn.motion.com
Company: Learning in Motion, Inc.
500 Seabright Avenue, Ste 105
Santa Cruz, CA 95062
Phone: (408)457-5600

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the need for customized learning tools in mathematics education for primary students with physical disabilities, in particular, those with significant hearing loss. The Phase II study focuses on modifying and testing sections of existing multimedia so that they will be appropriate as instructional tools for PreK-K children with significant hearing loss. The need is critical: 2 out of every 1,000 young children in the U.S. have hearing loss severe enough to adversely affect learning. In addition, resources for these individuals are normally allocated to the development of language acquisition; thus, the development of mathematical computation and reasoning often is not addressed until a significant learning window has lapsed. The National Action Plan for Mathematics Education Reform for the Deaf recommends that more resources address mathematics instruction for children with significant hearing loss. Learning in Motion intends to modify a research-based, field-tested multimedia program for early learners of mathematics. This program was the direct result of Phases I and II of a NSF SBIR project. The multimedia program includes three-dimensional graphics and characters, completed game logic, and four interactive game areas that are suitable for modification. The study's main objectives: (1) design, program, and test modifications to existing software games for students with hearing loss, (2) conduct and use subjective observations from teachers and researchers to further refine the modifications, and (3) initiate a testing plan for the complete modified program.

Ultimate results include: salable multimedia for the under-represented group of students with significant hearing loss and publishable design guidelines for others electing to produce specialized software. Learning in Motion seeks to provide a completely modified mathematics multimedia program for hearing-loss children. Design guidelines informed by the WGBH guidelines will also be produced, encouraging commercial collaboration with other publishers looking to produce similar programs.

Title: SBIR Phase II: Visible Light Audio Information Transfer System

Award Number: 0079323
Program Manager: Sara B. Nerlove

Start Date: August 1, 2000
Expires: July 31, 2004
Total Amount: $400,000
Investigator: Roderick Hinman, rod@talking-lights.com
Company: Talking Lights Co
28 Constitution Road
Boston, MA 02129
Phone: (617)242-0050

Abstract:

This Small Business Innovation Research Phase II project will develop an inexpensive Visible Light Audio Information Transfer System (VLAITS) that transmits information to small Personal Audio Receivers (PAR) for blind, hard of hearing, non-physically impaired and non-English speaking users. VLAITS uses already-installed visible lighting fixtures like fluorescent lights to provide modulated light as a carrier medium for data. The PAR receives this modulated light and presents audio to the user. VLAITS is remarkably inexpensive because it requires no additional equipment or special wiring other than typically used in existing lighting fixtures. There is no perceptible visual flicker in light because of data coding schemes. Phase I demonstrated VLAITS, qualified commercial visible light as an information carrier, and demonstrated wayfinding and aural assistance with blind and hard of hearing users. This project seeks to design and refine a commercial VLAITS system and validate system functions and capabilities with blind and hard of hearing users. Included are miniaturization and reduction of production cost of the computer-controlled light ballast transmitter and computer-controlled portable receiver. The receiver will also be designed to be compatible with currently installed infrared systems.

This project proffers a solution for the communication of information to people, particularly to those with disabilities, that leverages existing infrastructure in an innovative and cost effective way. Commercial products will be modified light ballasts, personal audio receivers and design of assistive networks.

Title: SBIR Phase II: Software Tools for Authoring American Sign Language

Award Number: 0238882
Program Manager: Sara B. Nerlove

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $499,247

Investigator: Daniel R. Roush, dannyr@vcom3d.com
Company: VCOM3D, Inc.
3452 Lake Lynda Drive
Orlando, FL 32817
Phone: (407)737-7310

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a fully functioning prototype software tool that will allow educators, interpreters, and linguists skilled in American Sign Language (ASL), but not in computer 3-D animation, to create fully grammatical synthesized ASL. This technology will provide language access for Deaf individuals to Internet web pages and CD-ROM based media. This project builds upon the Principle Investigator's commercial Sign Smith products, which were developed, in part, under an earlier NSF SBIR grant. The current technology allows users to generate unique sentences composed of signs that are in citation, or non-inflected form and to add facial expressions. The resulting sign and sentence structure approximates English grammar and the reference represents a transliteration, also known as Signed English. Although Signed English does provide some access to digital media, the absence of many elements of ASL grammar limits the use of the technology by the larger segment of the Deaf population who require grammatical ASL for access. These tools will enable the user to dynamically compose and inflect ASL signs from parameterized components using several spatial frames of reference. These sign types include pronouns, indicating and locative verbs, and classifier predicates.

The final commercial product will be a new integrated tool within the Principle Investigator's commercial Sign Smith Studio Authoring Tool. This tool will allow educators and multimedia developers to create engaging, grammatically correct, ASL animations for language access to digital information on Web Pages and in CD-ROM titles. The software interface not only allows authors to spatially inflect signs, but also it can be used to create signs as well. This capability opens opportunities for quickly building libraries of technical and scientific terms to be used in educational and scientific curricula. It also affords the potential to create libraries of foreign sign languages, the reference making it possible for the product to enter international markets. Content can be viewed using a proprietary licensed software Player. This product will increase access of Deaf and Hard of Hearing children and adults to digitally based information and promote inclusive education and employment approaches which accords with the language and intent of the New Freedom Initiative, recent amendments to Section 508 of the Rehabilitation Act of 1973, the Americans with Disabilities Act, and Section 255 of the Telecommunications Act. Not only does this technology have a viable commercial market, it also has broad societal benefits for Deaf and Hard of Hearing individuals in America and beyond.

Title: SBIR Phase II: The Use of Gestural Interface and Robotics Technology to Facilitate Language Development

Award Number: 0239183
Program Manager: Sara B. Nerlove

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,620

Investigator: Corinna E. Lathan, lathan@alum.mit.edu
Company: AnthroTronix, Inc.
387 Technology Drive
College Park, MD 20742
Phone: (301)405-0156

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to enhance functionality and clinically evaluate an interactive robotic system to facilitate receptive and expressive language development of children with disabilities. Developed by Anthrotronix, Inc., a rehabilitation engineering, consulting, and product development company, this child-friendly robot is controlled by various interfaces adapted to individual needs, regardless of physical limitations. The child controls the robot via gestures and voice activation. Gestures may include reaching for a button, operating a joystick, or activating wearable sensors through body movement. The child can play and record sound and movement commands and interact with the robot in the context of programmed games. The robot allows the child to interact with its environment. The controlling software can be updated so that the robot continues to hold the child's interest and imagination over time. This robotic technology is designed to provide reinforcements and motivation for learning and therapy. Objectives are to (1) finalize the design and manufacture of the robotic systems hardware and software and (2) evaluate the systems ability to provide interventional activities, motivation, and positive reinforcement in speech/language therapy.

Over 10% of all children have one or more disabilities. The number of children with speech and language impairments is higher than that for any other disability. A total of 1,050,975 students between the ages of 6 and 17 have a primary speech and language impairment and another 441,410 students have a secondary diagnosis of speech and language impairment. Anthrotronix is addressing the market need for therapists to have effective tools that support an approach that integrates speech/language development with children's educational development and social development, such as communication and interpersonal skills. There is a clear opportunity for products that enable therapists to provide increased motivation and education of children with disabilities while performing therapeutic functions.

Title: SBIR Phase II: An Information Handling System for Low Vision

Award Number: 0132058
Program Manager: Sara B. Nerlove

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $498,629
Investigator: James C. Bliss, jim@jbliss.com
Company: JBliss
100 W. El Camino Real
Mountain View, CA 94040
Phone: (650)940-4115

Abstract:

This Small Business Innovation Research Phase II project will develop software and hardware products that assist people with low vision to efficiently read and process information from many sources. These products will combine optical character recognition (OCR), speech synthesis and recognition technologies, together with customizable displays based on the latest vision research to accommodate a variety of visual impairments. These products will incorporate a 'Pick and Click' user interface, developed in Phase I, which does not require viewing the screen, yet presents visual displays useful to a low vision person, and is intuitive to fully sighted teachers experienced with graphical user interfaces (GUIs). Included in the products will be functions particular to the low vision market, such as reading text optimally, enlarging pictures, and using a video camera for magnification while handwriting and viewing 3D objects. In addition, 'Pick and Click' interfaces to the most common computer applications programs, such as word processing, e-mail, Internet browser, spreadsheet, and financial accounting will be included. Low vision users will benefit from a low cost interface that provides a clean and less cluttered presentation of information on the screen. JBliss Imaging's proffered new technology has potential to improve access to and capability of manipulating information for the low vision population.

The technology also has potential to serve individuals with other disabilities, such as dyslexia and other forms of challenges to learning and reading abilities. Commercial applications are in schools, libraries, businesses, and homes.

Title: SBIR Phase II: Design of a New and Improved Print Reading Machine for the Blind

Award Number: 0296066
Program Manager: Sara B. Nerlove

Start Date: March 1, 2001
Expires: July 31, 2000
Total Amount: $400,000
Investigator: Deane Blazie, deane@blazie.com
Company: C. A. Technology, Inc.
9500 S. Ocean Drive
Jensen Beach, FL 34957-2337

Abstract:

This Small Business Innovation Research Phase II project from Blazie Engineering, Inc. will conduct research leading to the development of three working prototypes of a new print reading machine for the blind. As of early 1996, the only existing device in the world that can produce a tactile image of print from a small hand held camera, the Optacon, is no longer being produced by its manufacturer. In Phase I, the researchers demonstrated the feasibility of incorporating new technology in a new print reading machine which make it easier to use, quicker to learn, less expensive, and attractive to a larger market. A new tactile screen was designed which should significantly reduce costs and provide a clearer tactile image. A new camera design coupled with built in synthetic speech would make the device easier to learn and use and, with the proper accessories, the device would appeal to a larger market. The Phase II effort includes the following: detailed design, construction and user testing of the new tactile array; research and design of a new camera to produce a better tactile image; built-in speech synthesis and capability for training programs; development of software to allow tactile imaging of a PC screen; and design of hardware that allows for future expansion (including multi-purpose interface for additional cameras/scanners, hardware features to allow built in training features, and communications ports and universal serial bus for future expansion to market).

The Optacon print reader enables blind individuals to have access to the study of mathematics and science. If this research is successful an improved, lower-cost commercial product incorporating new technology will result which make such access not only possible but also more attractive to a wider population. This new print reader for the blind will increase their employment opportunities and self-sufficiency to perform household management tasks as well as their ability to interface with print materials.

Title: SBIR Phase II: Folding Power Wheelchair with Modular Battery System

Award Number: 0548759
Program Manager: F.C. Thomas Allnutt

Start Date: February 16, 2006
Expires: February 29, 2008
Total Amount: 488,309
Investigator: Bart Kylstra, kylstra@gmail.com
Company: Daedalus
20 Scot Alley
San Francisco, CA 94107
Phone: (415)385-4508

Abstract:

This Small Business Innovative Research (SBIR) Phase II project aims to develop a lightweight modular wheelchair that can be easily lifted and handled by either the user or a companion. This wheelchair can be loaded into any vehicle, thus dramatically improving the mobility of the user. The research project focuses on designing the frame, drivetrain, motor and battery system to allow more of synergistic effect and lightweight to aid the user in his/her mobility.

The commercial and societal benefits from this project will result in not only greater mobility but also drastic increase in the quality of life for the user, improved family mobility.

Title: SBIR Phase II: Individualized Guidance for the Blind (IGB)

Award Number: 0620511
Program Manager: Ian Bennett

Start Date: September 13, 2006
Expires: August 31, 2008
Total Amount: $467,488

Investigator: Gary Livshin, glivshin@talking-lights.com
Company: Talking Lights Co
28 Constitution Rd
Boston, MA 02129
Phone: (617)242-0050

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an Individualized Guidance for the Blind system which is an accurate, affordable, easy-to-use indoor/outdoor assistive navigation system to aid people who are blind in wayfinding and traveling. In a separate effort, a wayfinding system for the blind using GPS for outdoor location is now being designed and built. For indoor use, however, this system requires a complex inertial guidance system for location and guidance. In this project, inexpensive optical locators will be used to improve indoor wayfinding and supply GPS-like location indoors.

Software developed will allow Individualized Guidance for the Blind locators to provide GPS-like locator information indoors and permit the input of location to the personal data assistants (PDA), updating of location and elimination of errors. As a commerical product, application areas will include hospitals, care facilities, museums, malls, schools, retail stores, trade shows, transportation facilities and otherplaces where blind and people with limited vision require navigation assistance.

Environmentally Benign Technology

Title: SBIR Phase II: Environmentally Benign, High-Pressure Plasma Cleaning Tool for Photoresists

Award Number: 0239331
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,999

Investigator: Steven E. Babayan, stevebabayan@hotmail.com
Company: Surfx Technologies LLC
10624 Rochester Avenue
Los Angeles, CA 90024
Phone: (310)592-3241

Abstract:

This SBIR Phase II project focuses on the development of a cleaning tool for the removal of tenacious organic residues from 200 mm wafers. These residues arise from ion bombardment of the photoresist films during processing. Organic residue removal encompasses approximately half of the cleaning operations in a semiconductor manufacturing plant. Surfx Technologies has developed a novel high-pressure plasma cleaning process that uses environmentally benign reagents and generates minimal waste. Results from Phase I indicate that ion-implanted resists may be stripped away in 5 min at 125 C, without any film popping and particle contamination as is normally observed during dry processing. The Phase II project will thoroughly research and optimize the process chemistry. In addition, a prototype cleaning system will be developed that meets all the technical criteria established by the semiconductor industry for organic cleaning operations.

This SBIR Phase II project has broad commercial and societal impact. Semiconductor equipment devoted to organic residue cleaning represents a multibillion-dollar market. If our environmentally benign, high-pressure plasma-cleaning tool can achieve all the technical objectives outlined in the proposal than it stands a good chance of garnering a significant share of this market. Moreover, it will replace current water-wasteful and hazardous wet cleans with an innovative process that uses non-toxic reagents and generates minimal waste. This will substantially benefit our society by mitigating the environmental, health and safety impacts of semiconductor manufacturing.

Title: SBIR Phase II: Neutralizing Utility Mercury Control Sorbents for Fly Ash Use in Concrete

Award Number: 0349752
Program Manager: Cheryl F. Albus

Start Date : January 1, 2004
Expires: December 31, 2005
Total Amount: $500,000

Investigator: Qunhui Zhou, QZhou@sorbenttechnologies.com
Company: Sorbent Technologies Corporation
1664 East Highland Road
Twinsburg, OH 44087
Phone: (330)425-2354

Abstract:

This Small Business Innovation Research Phase II project proposes to optimize and commercially apply a newly discovered carbon material that simultaneously exhibits high gas-phase adsorption of mercury and low wet-concrete adsorption of organic surfactants. Such a material is necessary if coal-fired power plants are to inexpensively retrofit sorbent-injection technology to comply with new limits on mercury emissions while continuing to sell their fly ash wastes as substitutes for cement in concrete construction applications. The material will be tested at both the pilot and full scales, paving the way for product commercialization.

The broader impact that could be achieved from this project will be a solution a serious pending economic and environment problem. The substitution of power-plant fly ash for manufactured Portland cement in construction applications is one of America's biggest recycling successes. Fly ash could lower the construction-industry concrete costs, increase the technical performance of the concretes, and preserve the environment by conserving energy and reducing both waste disposal and CO2 emissions.

Title: SBIR Phase II: Environmentally Compatible Recycling Method for Cadmium Telluride Devices

Award Number: 0078469
Program Manager: Winslow L. Sargeant

Start Date: September 15, 2000
Expires: August 31, 2002
Total Amount: $400,000
Investigator: Shalini Menezes, interphases@att.net
Company: Interphases Research Co
166 N. Moorpark Rd, Suite 204
Thousand Oaks, CA 91360
Phone: (805)497-2677

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an electrochemical method specific to recycling photovoltaic modules, which contain extremely low quantities of hazardous metals in large bulk-streams. It uses an innovative closed-loop approach to remove, separate, and regenerate semiconductor films in a single compact system, and do it with minimum waste. Phase I identified key process parameters, focusing on efficient removal and recovery of semiconductors from devices. Retrieval of sulfur-free cadmium telluride demonstrated method feasibility. Phase II will design a practical system to recycle the entire module for in-plant or centralized applications. It will identify the optimum parameters to delaminate modules, dissolve semiconductors, regenerate useful semiconductor precursor films, and re-utilize the electrolyte. The research will lead to a viable prototype recycling capability featuring low cost, high efficiency, low cycle-time, and production line amenability. Converting defective panels into efficient modules will lead to rapid turn-around and high production yields. Potential commercial applications are expected in the photovoltaic industry with a solution to managing hazardous waste disposal and improvement in module production yield. It has short-term applications for recycling other end-of-life products such as flat panel displays, infrared detectors, and mirror scrap.

Benefits are anticipated in increased productivity, large savings in disposal costs, recovery of scarce raw materials, and enhanced commercial success of the emerging cadmium telluride photovoltaic industry, which has grown 50-fold in production capacity within two years.

Title: SBIR Phase II: Green Solvent Mixtures as Alternatives to Environmentally Damaging and Toxic Solvents

Award Number: 0238674
Program Manager: Rosemarie D. Wesson

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $500,000
Investigator: John S. Flanagan, sflanagan@microcoating.com
Company: CCVD dba MicroCoating Tech
5315 Peachtree Industrial Blvd.
Atlanta, GA 30341-2107
Phone: (678)287-2400

Abstract:

This SBIR Phase II Project will develop software to aid formulation chemists in the replacement of environmentally damaging and toxic solvents such as those listed as hazardous air pollutants (HAP) in Section 112(b)(1) of the Clean Air Act. Phase I provided successful proof of concept for MCT's approach to use mixtures of "green" solvents that are tunable to obtain a wide range of solvent characteristics. This approach allows for the replacement of a broad spectrum of harmful solvents by using a small number of benign solvents. The system is flexible, allowing end users to control factors such as the organic functional groups present to fit their application. MCT will incorporate this method into software to guide non-specialists through the selection of solvents and optimization the mixture. MCT will collaborate with the research groups of Professors Charles Eckert and Charles Liotta at the Georgia Institute of Technology to develop a predictive model for the solubility of metal-organic compounds in organic solvents. We will perform quantitative solubility measurements on the systems initially studied in Phase I and use the resulting data to verify and improve the solubility model. The resulting solubility model will be incorporated in the solvent selection software.

The recent trend towards environmentally friendly products has caused an increase in the use of green solvents in product formulations and industrial processes. Regulations governing the use of solvents classified as Hazardous Air Pollutants (HAP) or as Volatile Organic Compounds (VOC) are forcing companies to look for alternatives to solvents presently in use. The Reference, there is an opportunity for the introduction of products that are designed to assist companies that need to Reference products or processes that use organic solvents. The niche market for Reference tools is estimated to fall into the $30 million range. MCT's goal is to release a software product that meets these needs within 3 years, and to gain the majority of the market share, producing revenues of $10 million over a period of 6 years. MCT will license software developed under Phase II to companies that manufacture chemicals and allied products. Solvent replacement tools can be applied to find alternative solvents almost anywhere solvents are in use, including coatings, pharmaceuticals, printing inks, toiletries, cosmetics, adhesives, household and car care, rubber and polymer manufacturing, industrial cleaning and degreasing, agrochemicals, oil seed and food extraction and dry cleaning.

Title: SBIR/STTR Phase II: Integration of Electromagnetic Actuation Using VOST Design

Award Number: 0215960
Program Manager: Cheryl F. Albus

Start Date: August 1, 2002
Expires: July 31, 2004
Total Amount: $499,994
Investigator: Ronn G. Smith, VOST@fiberpipe.net
Company: Big Horn Valve
248 W. Works
Sheridan, WY 82801-4213
Phone: (307)672-0968

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will produce an emission-free control valve to address an industry need for environmentally safe valves. The axially rotated Venturi Off-Set Technology valve will be equipped with a conical seat for internal sealing and a magnetic coupling for leak-proof actuation.

The commercial potential of this project will provide the Petroleum industry with valves that are emission-free which will result in a cleaner environment.

Title: SBIR Phase II: Innovative Blasting to Eliminate Nitrogen Dioxide Formation While Maximizing Energy Efficiency in Surface Mining

Award Number: 0216042
Program Manager: Rosemarie D. Wesson

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Eugene L. Watson, ewatson@wyoming.com
Company: Industrial Alchemy
6901 Valley View Place
Cheyenne, WY 82009
Phone: (307)637-2765

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the urgent need to improve control of the blast chemical reaction. These blasts are produced by drilling boreholes into the overburden and filling them with an ammonium nitrate/fuel oil (ANFO) mixture. These explosive charges are then ignited to push the overburden into a previously excavated trench. This Phase II project will complete the design, fabrication, and testing of a prototype detonation system to be deployed in surface mining boreholes to referentially initiate detonation of the powder column, thus insuring a high efficiency blast without the unwanted release of toxic air pollutants.

This project will lead to commercialization of a method of improving the efficiency and environmental quality of the cast blasting technique used by the surface mining. The market for this detonation system is any mining that involves cast blasting, primarily the surface coal mining industry. The United States is one of the two world leaders in coal production with nearly one billion tons of coal being produced in 2001.

Title: STTR Phase II: Formulation of Environmentaly Friendly Lubricants Based on Polymeric Materials for Cold Forging Process

Award Number: 0620290
Program Manager: Joseph Raksis

Start Date: July 5, 2006
Expires: June 30, 2008
Total Amount: $487,141
Investigator: David Stark, tdstark@mindspring.com
Company: Sisu
840 Main Campus Drive,Suite 3580
Raleigh, NC 27606
Phone: (919)831-2246

Abstract:

This Small Business Technology Transfer (STTR) Phase II project proposes to develop a polymeric lubricant that is environmentally friendly for cold forging of metals, by using proprietary emulsion polymerication technology to synthesize polymers containing both polar functional groups that adhere to the metal surface, and hydrophobic groups to provide lubricity, and by replacing zinc phosphate typically used as a corrosion inhibitor, with a more benign material.

This technology could lead to new lubricants for metal forging processes that are more environmentally benign, thereby reducing a potential health and environmental threat, and enhancing the competitive manufacturing position of the US.

Title: SBIR Phase II: Compacting Fly Ash to Make Bricks

Award Number: 0548719
Program Manager: George Vermont

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $497,506
Investigator: Henry Liu, fpc_liuh@yahoo.com
Company: FPC
2601 Maguire Blvd
Columbia, MO 62501
Phone: (573)442-0080

Abstract:

This Small Business Innovation Research (SBIR) Phase II project has the objective of conducting R&D needed for commercialization of new technology to make bricks using fly ash, which is a byproduct or waste material generated at coal-fired power plants. Research conducted under Phase I demonstrated that the known freeze/thaw problem of fly ash bricks can be solved using air entrainment. This process converts a high volume waste material into a useful product using a room temperature process, with cost, air pollution nd energy savings, compared to traditional processes.

The Phase II work will test key fly ash brick properties not tested in Phase I, investigate ways to vary the brick's color and shape, and study key steps in scaling up the process.

Title: SBIR Phase II: Novel Sensor for Control of Cleaning Processes During the Fabrication of Microstructures

Award Number: 0548743
Program Manager: Murali Nair

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $470,050
Investigator: Bert Vermeire, bert@env-metrology.com
Company: EMC
6595 N Oracle Rd Ste 153B
Tucson, AR 85704
Phone: (520)742-3300

Abstract:

This Small Business Innovation Research (SBIR) Phase II project provides a unique and robust in-situ sensor for detection and control of impurities in microstructures and porous layers associated with manufacturing of semiconductor, MEMS, and emerging nanodevices. Use of impedance as a measure of contamination in bulk fluids is well established. However, applying it in micro-scale features is novel and has many promising applications. The proposed Electro-Chemical Residue Sensor (ECSR) technology is not aimed at developing yet another sensor to measure contaminants in fluids. It is rather aimed at the in-situ, real-time, and low-cost measurement of residual contamination inside and on the sidewalls of micro- and nano- features (the bottlenecks of cleaning, rinsing, and drying). The Phase II proposed plan is to design, fabricate, and test a prototype sensor assembly and develop its interface with process tools for cleaning, rinsing, and drying of micro-features.

The first planned application, amounting to annual commercial market revenue of $9M to $30M, will be in rinsing and drying of patterned wafers and porous films in micro-electronics manufacturing. Currently, these operations are often run with no adequate real-time control. Insufficient cleaning and drying have significant negative impact on manufacturing yields and device performance. On the other hand, excessive cleaning and drying results in damage to the micro-structures, increase in cost, and wasting of chemicals, water, and energy. The application of the ECRS technology to wafer rinsing alone is expected to reduce water usage by 40-60%.

Title: SBIR Phase II: Improved Methods to Manufacture Brominated-Carbon Adsorbents for Power-Plant Mercury-Emission Control

Award Number: 0620518
Program Manager: Rosemarie Wesson

Start Date: July 26, 2006
Expires: July 31, 2008
Total Amount: $499,714

Investigator: Yinzhi Zhang, YZhang@SorbentTechnologies.com
Company: Sorbent Technologies Corp
1664 Highland
Twinsburg, OH 44087
Phone: (330)425-2354

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to further develop an advanced manufacturing method to both lower the cost and increase the performance of brominated carbon sorbents for power plant mercury emission control. Fine brominated carbon, a newly-commercial material, has been demonstrating a superior affinity in full-scale sorbent-injection trials for scavenging toxic mercury from power plant flue gases. In the Phase I project various production parameters were experimentally examined and the feasibility of an improved manufacturing process was preliminarily established. The Phase II project will concentrate on further developing and testing the innovative manufacturing technique.

Coal-fired power-plant mercury emissions are increasingly recognized as injurious to the environment and, ultimately, to human health. A leading retrofit technology for this application is the injection of a new material, brominated carbon, ahead of existing plant particulate controls. Consequently, successful efforts to lower the production cost and to increase the performance of these new materials will have high economic returns, potentially saving the nation tens or hundreds of millions of dollars each year.

Title: SBIR Phase II: Control and Optimization of Combustion Based on Multispectral Emission Tomography

Award Number: 0724385
Program Manager: Rathindra DasGupta

Start Date: August 15, 2007
Expires: July 31, 2009
Total Amount: $499,201

Investigator: Xuemin Jin, xjin@spectral.com
Company: Spectral Sciences Inc
4 Fourth Avenue
Burlington, MA 01803
Phone: (781)273-4770

Abstract:

The Small Business Innovation Research (SBIR) Phase II project investigates a novel approach for directly measuring critical combustion flow-field information required for active control to increase combustion efficiency and reduce harmful emissions. Combustion control systems can be based on non-intrusive in-situ measurement using passive optical probes that measure spectrally-resolved radiation from specific molecular products (H2O, CO, and CO2) in the hot flow field. Concentrations and temperatures can be directly determined from the observed spectral structure. The critical innovation in this proposal is the experimental determination of the functional relationship using spectral sensor technology and tomographic reconstruction techniques. Flow field characterization is achieved using a large number of measurements over multiple lines of sight through the flow.

The proposed Phase II research lays the scientific ground work for active control systems for a range of multi-burner combustors, including turbine engines, boilers, and process burners. These applications represent more than 50% of the global fossil energy usage; thus improvements in efficiency can have a major economic and societal impact. The proposed innovation is just one of the component technologies required for the development of active control systems, but it is an enabling component, with potential application in all industrial combustion markets.

Title: SBIR Phase II: One-Step Environmentally-Friendly Synthesis of Novel Organic/Inorganic Hybrid Pigments

Award Number: 0724210
Program Manager: Rathindra DasGupta

Start Date: August 1, 2007
Expires: July 31, 2009
Total Amount: $500,000

Investigator: Lori Polette-Niewold, lpolette@utep.edu
Company: Mayan Pigments
500 W. University Ave.
El Paso, TX 79968
Phone: (915)747-6122

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will support the commercialization of a novel line of high-performance Mayacrom pigments using a lower cost, solid-state, environmentally friendly one-step manufacturing process. The Mayacrom pigments exhibit superior properties compared with many commercially available pigments and may replace environmentally detrimental pigments such as cobalt and cadmium based colorants. The intellectual merit of the proposed work includes the advancement of knowledge of solid-state reactions in the fields of materials science and engineering. Environmentally, aspects of the proposal include creating a production process that is solvent free, consumes only a modest amount of energy, and releases only water during manufacturing, resulting in no negative ecological impacts.

Broader effects include the fundamental understanding of the solid-state thermodynamics and reaction kinetics that affect the physical and chemical properties of the pigments. Results of the influence of mixing intensity on reaction kinetics will also expand the knowledge for other industrial processes. Other broader impacts include continued collaborative research activities at the minority-based University of Texas at El Paso (UTEP) to expand the scientific understanding of these hybrid pigments and publish significant findings. If successfully commercialized, the one-step manufacturing process will create jobs in the United States and in the under-utilized El Paso, Texas border region.

Polymer, Powder, & Composite Systems

Title: SBIR Phase II: Carbon Fiber/Boron Nitride Matrix Composites: A Unique Low Wear Friction Material

Award Number: 0321629
Program Manager: Cheryl F. Albus

Start Date: August 1, 2003
Expires: July 31, 2005
Total Amount: $492,069
Investigator: Christian L. Mangun, cmangun@ekos-corp.com
Company: EKOS
101 Tomaras Avenue
Savoy, IL 61874-9547
Phone: (217)356-7162

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a testing application for intermediate and full-scale boron nitride (BN) composites for a wide variety of wear applications with a focus on aircraft brakes. Viability of this material was demonstrated in Phase I where 3-dimensional needled carbon fiber/C-BN hybrid matrix composites displayed an order of magnitude decrease in wear as compared to current carbon fiber/carbon matrix composites (C/C). The plan is to fabricate stable boron nitride composites from a unique pre-ceramic polymer (borazine) through a commercially viable technique, namely resin transfer-molding process.

The commercial and broader impacts of this technology of a composite using BN as a matrix appears to provide the best opportunity of addressing the desired cost-performance characteristics (both a decrease in raw material components and in maintenance due to fewer brake overhauls). In addition, the improved properties of these materials over current aircraft brakes have the potential to increase passenger safety in emergency braking situations.

Title: SBIR Phase II: Development of Smart Material Using Natural Fiber Reinforced Composite

Award Number: 0521905
Program Manager: Joseph E. Hennessey

Start Date: August 1, 2005
Expires: July 31, 2007
Total Amount: $439,726
Investigator: Christopher Whitmer, cwhitmer@vibroacoustics-solutions.com
Company: Vibroacoustics Solutions Inc
2205 229th Place
Boone IA, 50036
Phone: (515)450-8997

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a suitable prototype based on the Active-Passive Natural Fiber Composite (APNFC0), the technical feasibility of which was demonstrated in the Phase I program. This innovative composite material concept is bio-based and hence environmentally friendly. The APNFC has excellent vibration and noise mitigation properties and can be used to control acoustic noise and structural vibrations in a wide variety of noisy environments. The unique design of this composite material will reduce noise transmission over a broad band of frequencies through a combination of absorption and dissipation phenomena. The prototype to be built during Phase II will consist of a thermoformed sandwiched material configuration where a polymer-based piezoelectric layer (PVdF) is formed between two passive layers composed of variable density natural fiber composite (VDNFC). This material will have an embedded control system with amplifiers and power supplies.

The commercial applications of the new technology include: home appliances, soundproof architectural doors, office furniture, operator cabins for agricultural and construction machinery, building materials, automobiles, and aircraft cabins. Collectively, these represent a multi-billion dollar market for parts and products to which the present core technology can be applied. The company has a focus commercialization plan with strategic partner support in the appliance application and the office and construction applications

Title: SBIR Phase II: Commercialization of Perfluorocyclobutyl Polymers for Integrated Optics and Other High Performance Applications

Award Number: 0349519
Program Manager: Rosemarie D. Wesson

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $499,983

Investigator: Earl Wagener, ewagener@bellsouth.net
Company: Tetramer Technologies, L.L.c
501-8 Old Greenville Hwy, #325
Clemson, SC 29631
Phone: (864)653-4339

Abstract:

This SBIR Phase II project proposes to pursue commercialization of perfluorocyclobutyl (PFCB) polymer products successfully developed during Phase I. High performance fluoropolymers, whose structure can be readily adjusted to achieve performance targets and which can be easily processed are in demand for next generation technologies including integrated optics, fuel cell membranes, gas separation membranes, and deep UV lithography. Tetramer's patented PFCB polymers exhibit superior processing and performance advantages including excellent molding and extrusion capability, unmatched thermal stability, zero by-products during polymerization and fabrication, and the ability to tune properties for these large market applications that promise significant growth from to their global economic attractiveness and strategic military importance to the United States.

This distinctive activity will enhance scientific and technological knowledge in both academia and industry for such diverse technically driven fields as lower cost higher data rate integrated optics, fuel cell membranes, white light LEDs, and gas separation membranes and particularly the discipline of polymer chemistry due to its structural versatility. After protecting intellectual property, Tetramer plans to share the results through published papers, and university and industrial seminars. This project will also contribute to US global leadership in the above fields of strategic commercial and military interest.

Title: SBIR Phase II: High Performance Transparent AlON via Novel Powder Synthesis

Award Number: 0349022
Program Manager: Rosemarie D. Wesson

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $500,000
Investigator: George Hida, Ghida@mercorp.com
Company: Materials and Electrochemical Research Corporation (MER)
7960 South Kolb Road
Tucson, AZ 85706
Phone: (520)574-1980

Abstract:

This Small Business Innovative Research Phase II project proposes to develop a high performance transparent aluminum oxynitride (AlON) material, with improved mechanical properties and low cost, via an innovative powder synthesis method. Using nanoparticle sintering, an IR transmission of 80% can be achieved. The smaller grain size leads to a MOR of 400 MPa.

The Phase II program proposes to extend the applications of AlON for wide spread commercial applications. Several major forming methods will be developed in this Phase II program so that the forming capability can be established to fulfill all of the different parts for different markets. These products include high intensity discharge lamps, security windows, semiconductor substrates, laser windows, consumer optic windows, orthodontic brackets, etc.

Title: SBIR Phase II: Thin Film Deposition & Dynamic Characterizations Using Sub-Psec Eximer Laser Sources

Award Number: 9983366
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2003
Total Amount: $399,586

Investigator: Kenneth Church, khc@cmst.com
Company: Sciperio, Inc.
5202-2 N Richmond Hill Road
Stillwater, OK 74075
Phone: (405)624-5751

Abstract:

This Small Business Innovation Research (SBIR) project continues the Pulsed Laser Deposition project using a femto-second or sub pico-second pulsed laser. The sub pico-second regime is a recent (just a few years old)development in the laser industry. As technology progresses these lasers are becoming more common to both the end user and the commercial manufacturer. There are now solid state femto-second lasers available in the product line of some well known laser companies. The recent advances made in the production and sales of the new sub pico-second laser and the results achievable by these lasers have opened up new opportunities in tribological coatings. The Phase I results demonstrated superior hardness using the sub pico-second laser as compared to the traditional nano-second lasers. The coatings were also much smoother when observed under a scanning electron microscope. These initial findings suggest a need to continue the study for applications in the tool and space industries as well as the military. Coatings with such improved performance would be considered a significant contribution to both the scientific and industrial communities. Current coatings are short lived and therefore expensive to maintain.

A longer life coating, even if it was more expensive, would provide significant savings do to the life of the tool, device or machine. Some devices are not even practical to make do to poor performing coatings. Coatings produced using a sub pico-second laser source will change that.

Title: SBIR Phase II: Novel Microphase Separated Solid Polymer Electrolytes

Award Number: 0091492
Program Manager: T. James Rudd

Start Date: February 15, 2001
Expires: January 31, 2003
Total Amount: $500,000
Investigator: Dharmasena Peramunage, pera@eiclabs.com
Company: EIC Laboratories Inc
111 Downey Street
Norwood, MA 02062-2664
Phone: (617)769-9450

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop novel nano-structured solvent free polymer electrolytes for solid-state Li-ion batteries. The important characteristics of these electrolytes are that they are of high ionic conductivity and have excellent mechanical strength. The combination of these properties results from an ordered structure on the nanometer scale, consisting of a co-continuous network of an epoxy scaffold and a polymer electrolyte. This unique structure is obtained by self-assembly during curing of the epoxy in the presence of a partially emersiable block copolymer containing the ion-conducting phase. Polymer electrolyte batteries based on the new electrolytes promise great configuration flexibility in design and substantially increased energy density.

The new polymer electrolytes will permit fabrication of high performance Li- ion batteries for use in portable consumer products such as cellular telephones, portable power tools, video cameras and laptop computers. Other applications include "dye sensitized solar cells", and electrochromic devices.

Title: SBIR Phase II: Protective Metal Foam Hybrid Composites

Award Number: 0238610
Program Manager: T. James Rudd

Start Date: February 15, 2003
Expires: January 31, 2005
Total Amount: $500,000
Investigator: Dana T. Grow, siouxman@siouxmanufacturing.com
Company: SMC
Main Street
Fort Totten, ND 58335-0400
Phone: (701)766-4211

Abstract:

This Small Business Innovation Research Phase II project will develop a low-cost manufacturing process for multifunctional composite materials that have specific air and ground transportation applications. Existing materials designed to protect against explosions or impacts tend to be heavy and to be appendages on structural systems. The new materials, which consist of an aluminum foam surrounded by facing plies of resin-infused glass, carbon, or aramid, will be lightweight and designed to integrate affordability and functionality. Innovative manufacturing methods, using out-of-autoclave processes that are derivatives of liquid molding approaches, will be developed to incorporate automation to improve quality and decrease processing time. A number of fiber-ply/foam combinations will be fabricated with a focus on manufacturing a container for explosives transport and on a hardened aircraft door. Prototypes will be fabricated for customer testing. The improved processing and unique properties are expected to lead to a variety of other applications.

These applications of aluminum foam core composites for making protective structures will meet the national need for materials that provide increased protection and security. The market for protective materials is expected to grow, and is already a sizeable $150 - $200 million per year.

Title: SBIR Phase II: Low-Cost Glass Fiber Composites Tailored Towards Concrete Reinforcement

Award Number: 0215179
Program Manager: T. James Rudd

Start Date: August 1, 2002
Expires: July 31, 2004
Total Amount: $499,995

Investigator: Fadhel Aouadi, dpdinc@aol.com
Company: DPD Inc
2000 Turner Street
Lansing, MI 48906-4053
Phone: (517)347-5648

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will refine the polymer matrix of glass fiber composites with ion exchangers in order to enhance their longevity in the alkaline environment of concrete. Glass fiber composites offer a desirable balance of performance and cost for replacement of corrosion-prone steel reinforcement in concrete; their rapid deterioration in the alkaline environment of concrete is, however, a major setback. Ion exchangers are insoluble solids carrying cations (or anions), which can be exchanged with ions of the same sign. Cation exchangers of hydrogen form replace alkali metal cations (e.g., K + in alkaline solutions diffusing into the polymer matrix) with H +. This exchange of cations neutralizes aggressive alkaline solutions by converting K + OH - (and Na + OH -, etc.) into H2O. Through laboratory investigations and industrial-scale pultrusion efforts, the Phase I research demonstrated that introduction of selected ion exchangers into the polymer matrix (or a surface layer of matrix) does not interfere with the pultrusion process, and yields significant gains in alkali resistance of glass fiber composites. The Phase I effort also established a theoretical context for selection of the dosage of cation exchanger in the polymer matrix of glass fiber composites, and verified the economic viability of our approach. The proposed Phase II project will: (1) develop Refined theoretical principles and design procedures for formulation of polymer matrices with ion exchangers; (2) develop and experimentally verify optimum polymer matrix formulations incorporating ion exchangers; (3) optimize the pultrusion process of glass fiber composites with the Refined polymer system, and fully characterize the end products; and (4) evaluate the structural performance and durability of concrete systems reinforced with Refined glass fiber composite bars through comprehensive laboratory studies complemented with a field investigation involving design, construction and monitoring of a reinforced concrete bridge deck. The Phase II effort will receive critical support from major manufacturers of composite rebars (including Hughes Brothers, the world leader in this field), the leading supplier of ion exchangers (Dow Chemical), Michigan Department of Transportation, and Michigan Economic Development Corporation. Michigan State University (Composite Materials & Structures Center) will also take part in the proposed research effort.

Close to one-third of reinforced concrete structures, including bridges, parking structures, buildings in coastal areas and offshore structures, are exposed to corrosive environments (deicer salt, seawater spray, etc.); domestic sales of steel for reinforcement of these concrete structures is about $2 billion/yr. Glass fiber composites embodying our technology are resistant to both corrosive effects and the alkaline environment of concrete; they offer a desirable balance of performance and cost to replace steel reinforcement in corrosive environments. Major savings in life-cycle cost can be realized at competitive initial cost through replacement of steel reinforcement with alkali-resistant glass fiber composites in concrete structures exposed to corrosive environments. Glass fiber composite jackets and sheets applied onto concrete surfaces for repair/rehabilitation purposes are also prone to attack by the alkaline pore solution of concrete, representing another market opportunity for our technology. We have filed a patent application, and have reached agreements with Dow Chemical (leading supplier of ion exchangers) and Hughes Brothers (world's leading manufacturer of composite bars for concrete reinforcement) towards transfer of the technology to marketplace.

Title: STTR Phase II: Enhanced High Volume Reinforced Al/SiC Metal Matrix Composites

Award Number: 0132166
Program Manager: T. James Rudd

Start Date: January 15, 2002
Expires: December 31, 2003
Total Amount: $499,998

Investigator: Dean Baker, powdermet@earthlink.net
Company: Powdermet, Inc.
9960 Glenoaks Boulevard, Unit A
Sun Valley, CA 91352-1047
Phone: (818)768-6420

Abstract:

This Small Business Technology Transfer (STTR) project will develop advanced, nano-engineered thermal spray powders for producing composite coatings with revolutionary enhancements in performance. The Phase I project demonstrated the production of high volume reinforced (25-65 wt % SiC) aluminum and nickel matrix composite materials using CVD fluid bed coated powders and low cost consolidation techniques. Dramatic increases in flexure strength and modulus were achieved; with results showing greater than 5% (80% increase) ductility and a 600% increase in flexural strength compared to current metal matrix composite state of the art. A greater understanding of the nano-engineered particles being produced, and the relationship between nano-structural features and the resulting mechanical property improvements will be developed leading to repeatable, predictable performance and application to additional composite and coatings systems.

The commercial potential will be for producing low cost; high volume fraction consolidated spray-deposited composite systems with significant improvements in mechanical properties and desired physical properties for structural and corrosion applications for the electronic industry.

Title: STTR Phase II: Alignment of Low Cost, High Modulus, High Strength Carbon Nanofibers in Composites

Award Number: 0110456
Program Manager: Cheryl F. Albus

Start Date: August 15, 2001
Expires: July 31, 2003
Total Amount: $499,980

Investigator: Ronald L. Jacobsen, rljacobsen@ApSci.com
Company: Applied Sciences, Inc
Cedarville, OH 45314-0579
Phone: (513)766-2020

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will develop low-cost, composites reinforced with carbon nanofibers. Methods demonstrated in Phase I will be further developed to generate alignment and promote adhesion of nanofibers polymer systems. These efforts help to capture the extraordinary intrinsic mechanical, electrical, and thermal properties of carbon nanofibers in practical, affordable composites. One thrust of the program seeks to align nanofiber in extruded and spun flows, in materials that include polypropylene, polyester, and nylon. The composite filaments produced by these means will then be formed into net-shape composite components for a variety of applications. A second thrust focuses on fabrication of nanofiber papers for applications that include fuel cell electrodes. Potential end users of the technology and leaders in their respective markets will evaluate materials and prototypes produced during Phase II.

Specific commercial applications targeted by the Phase II work include nanofiber reinforced polyester and nylon tire cord, thermally conductive plastics for electronics packaging, nanofiber paper for fuel cell components, and conductive, high service temperature plastics for electrostatic precipitators needed to clean exhaust streams from power and chemical production. Each of these applications has an associated Phase II partner participating in the program.

Title: SBIR Phase II: Spinning Performance of Melt-Spun Fibers Containing Microencapsulated Phase Change Material

Award Number: 0110499
Program Manager: T. James Rudd

Start Date: October 1, 2001
Expires: September 30, 2003
Total Amount: $499,991

Investigator: Yvonne G. Bryant, ygbryant@TRDCorp.com
Company: Triangle Res & Devel Corp
P O Box 12696
Research Triangle Park, NC 27709-2696
Phone: (919)832-5959

Abstract:

This Small Business Innovation Research (SBIR) Phase II project continues the development of the spinning performance of melt-spun fibers containing microencapsulated phase change materials (microPCMs). In Phase I, polypropylene fibers less then 3 denier per filament were demonstrated with a good balance of physical properties (tenacity, percent breaking elongation, modulus, etc.) and thermal energy storage capability (latent heat content). Phase II will focus on process and materials variables that affect, in particular, the structure and properties of the as-spun fiber, and in general, the overall spinning process. A key objective is to convert the microcapsule wet cake into a well-dispersed microPCM/polymer concentrate devoid of volatilizing components for adding to virgin polymer and extruding into fiber. Innovative spinning concepts will be employed to improve the capture of microPCMs to maximize thermal energy storage properties.

The commercial availability of melt spun fibers and resulting fabrics with enhanced thermal energy storage capabilities will enable products with superior performance for use in situations where comfort, endurance, or survivability in cold or hot environments is demanded. Thus, the perfection of this technology for the production of good quality fabric could be a major breakthrough in the textile industry.

Title: STTR Phase II: Formulation of Environmentaly Friendly Lubricants Based on Polymeric Materials for Cold Forging Process

Award Number: 0620290
Program Manager: Joseph Raksis

Start Date: July 5, 2006
Expires: June 30, 2008
Total Amount: $487,141
Investigator: David Stark, tdstark@mindspring.com
Company: Sisu
840 Main Campus Drive,Suite 3580
Raleigh, NC 27606
Phone: (919)831-2246

Abstract:

This Small Business Technology Transfer (STTR) Phase II project proposes to develop a polymeric lubricant that is environmentally friendly for cold forging of metals, by using proprietary emulsion polymerication technology to synthesize polymers containing both polar functional groups that adhere to the metal surface, and hydrophobic groups to provide lubricity, and by replacing zinc phosphate typically used as a corrosion inhibitor, with a more benign material.

This technology could lead to new lubricants for metal forging processes that are more environmentally benign, thereby reducing a potential health and environmental threat, and enhancing the competitive manufacturing position of the US.

Title: SBIR Phase II: Highly Efficient Exhaust Cleanup Technology for Environmentally Benign Processing

Award Number: 0548440
Program Manager: George Vermont

Start Date: January 10, 2006
Expires: December 31, 2007
Total Amount: $500,000
Investigator: Ofer Sneh, ofer@sundewtech.com
Company: Sundew Technologies
1619 Garnet St
Broomfield, CO 80020
Phone: (720)887-8166

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a novel, integrated reactive abatement model (IRAM) that effectively removes solidifying chemicals from the exhaust effluent of atomic layer deposition (ALD) manufacturing processes. ALD and related manufacturing technologies are widely used in the electronics industry and will be critical for emerging nanotechnology applications. However, a key issue is the emission of reactive, toxic and solidfying chemicals that clog and destroy equipment, requiring frequent cleanup and replacement, and create worker safety and environmental concerns.

Objectives of this project include developing suitable abatement chemistries and systems for several important generic ALD processes and deriving generalized IRAM methodology that can be used to produce a module that can be integrated into ALD equipment.

Title: SBIR Phase II: Anti-Microbial Vinyl Nanocomposites

Award Number: 0646481
Program Manager: William Haines

Start Date: April 15, 2007
Expires: March 31, 2009
Total Amount: $500,000
Investigator: Andrew Myers, amyers@tda.com
Company: TDA Research, Inc
12345 W 52nd Ave
Wheat Ridge, CO 80033
Phone: (303)940-2301

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop biocidal nanocomposites to protect plastics such as polyvinyl chloride (PVC). Biocides can now be added as a component during the plastic manufacturing process to make it inherently resistant to microbial attack. PVC is a widely used plastic that requires antimicrobial protection in many applications, as it is often used near water (swimming pool liners and shower curtains) or in areas where sterile or clean surfaces are critical (flooring for hospitals or kitchens and bathrooms). PVC is currently protected from microbial attack by arsenic compounds or organic biocides that migrate slowly out of the protected material. Arsenic-based biocides are under increasing regulatory pressure, and an alternative would be welcomed by the industry. Unfortunately, current non-arsenic (organic) biocides leach out of PVC, contaminating the environment and allowing fungi to attack the PVC. TDA Research, (TDA) proposes to increase the permanence of biocides designed to disperse in PVC. Nanoparticle-based biocides would not migrate out of the thermoplastics, prolonging product lifetimes. The project will start by examining several active organic biocides that have been approved and regulated as biocides for thermoplastics. Following this will be tasks related to nanoparticle synthesis; formulation and testing of the nanocomposite; nanoparticle manufacturing scale-up; and performance and economic evaluation. The plan is to develop nonarsenic, non-migratory biocides for PVC.

Commercially, the proposed project will improve help eliminate the use of arsenic containing biocides; biocides which are particularly harmful because they persist in the environment. Despite their known dangers and the desire of manufacturers to discontinue their use, arsenic containing formulations continue to be used in several applications where the alternative organic biocides do not provide the needed long term protection. Further, the use of our technology will decrease the release of the organic biocides into the environment as well, keeping them in the polymer where they are needed.

Surface Treatments/Coatings

Title: SBIR Phase II: Smart Fiber Composite System Capable of Early Detection of Material Failure

Award Number: 0091576
Program Manager: T. James Rudd

Start Date: May 1, 2001
Expires: April 30, 2003
Total Amount: $499,302
Investigator: Kirk Newton, knewton@tritonsys.com
Company: Triton Systems Inc
200 Turnpike Road
Chelmsford, MA 01824
Phone: (978)250-4200

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will build on results of Phase I research to fully demonstrate an early warning system for potential failure of ceramic matrix composite (CMC) materials. In Phase I, a novel detection technique called Composite Failure Onset Response Test (ComFORT (TM)) was demonstrated for use with high temperature CMCs. ComFORT (TM) is a composite failure detection technique whereby proprietary thermally stable electrically conductive ceramic fibers are selectively placed, together with regular reinforcing fibers, and are then processed into a dense ceramic composite. Once in place, existing hardware is used to monitor the condition and the health of the electrical signal, while an especially designed algorithm minimizes false negatives during use. As the ceramic composite begins to fail, the failure of the fiber reinforcement is preceded by the failure of the conductive coating, which is recognized through a weakening or loss of electrical conductivity. This novel technique lends itself to a powerful early warning system, whereby the conductive fiber can be designed to fail before catastrophic failure of the composite itself. Proper placement of these conductive fibers enables tracking of even minute levels of breach within the composite. Moreover, through a novel design, it may be possible to extend the performance to detect matrix cracking. The lack of reliability and little to no warning before catastrophic failure has prevented a more widespread use of CMC's. The smart fiber system to be developed in this project will allow the use of CMC's in more demanding applications with greater certainty of success.

The successful commercialization of the proposed technology will lead to the insertion of continuous fiber reinforced composites into power generation, energy, air, space and missile applications, where high temperature, lightweight, and mechanically reliable materials are needed, and the cost of part failures is high. Ceramic composites can be used in a larger number of these applications, if part reliability can be assured. Substantial benefits in operating efficiency of gas turbine, automotive and rocket systems can be realized with increased operating temperatures.

Title: SBIR Phase II: Environmentally Benign Antifouling Coatings From Dendritic Nanotechnology

Award Number: 0522183
Program Manager: Joseph E. Hennessey

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $498,473

Investigator: Petar Dvornic, dvornic@dendritech.com
Company: Dendritech, Inc
3110 Schuette Rd
Midland MI, 48642
Phone: (989)496-2016

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to further the development of the technology to manufacture the first environmentally safe polymer coating that can successfully prevent aquatic biofouling on submerged man-made surfaces. The Phase I study clearly showed that the unique honeycomb-like structure of these novel nano-structured dendritic polymer coatings not only delivers very efficient anti-fouling protection, but also prevents environmental pollution.

The broader impact (commercial significance) of the program is the immediate application of this technology to coatings for ship/boat hulls used in marine and fresh water environments. These unique nano-structured antifouling coatings are also expected to have a very broad impact and large commercial effect in a variety of other water-based industries, ranging from shipping, fishing, tourism and defense, to production of energy in hydroelectric plants, protection of shorelines, production of potable water by desalination of sea water or from biofoulant-infested fresh-water sources.

Title: SBIR Phase II: Ultrananocrystalline Diamond as Wear Resistant and Protective Coating for Mechanical Shaft Seal Applications

Award Number: 0521596
Program Manager: Joseph E. Hennessey

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $511,530
Investigator: James Netzel, netzel@thindiamond.com
Company: Advanced Diamond Technologies
2001 S. First Street
Champaign IL, 61820
Phone: (217)239-1963

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new class of mechanical shaft seals based on the benefits of a novel material called Ultrananocrystalline (tm) diamond (UNCDtm) that will result in seals that last longer, save energy and reduce environmental emissions associated with industrial pumping and turbo-machinery applications. Mechanical shaft seals are used in almost every industry. The main functions of these seals are to ensure that the pumping fluid does not escape the system and to protect the fluids from contaminants. This program will build upon earlier results that showed that UNCD could reduce seal wear by orders of magnitude over SiC seals.

The project will include customer trials, securing industry standard qualification and developing manufacturing capabilities. New UNCD seal products will be developed for chemical, refinery, pharmaceutical, mining, and other demanding industrial applications. Several features of UNCD, including its fine grain size, high quality surface and its ability to be processed at reasonable temperatures, make it an ideal material to be leveraged other friction and wear materials.

Title: SBIR Phase II: Temperature-Adaptive Nano-Crystalline Combinatorial Self-Lubricating Coating

Award Number: 0422080
Program Manager: Errol B. Arkilic

Start Date: September 15, 2004
Expires: August 31, 2006
Total Amount: $471,482
Investigator: Wenping Jiang, wjiang@virtual-incubation.com
Company: NanoMech Corporation
21 West Mountain
Fayetteville, AR 72701
Phone: (479)571-2592

Abstract:

This Small Business Innovation Research (SBIR) Phase II research project develops a temperature-adaptive nanoparticles-based solid lubricant coating (ZnO and MoS2 and their metastable forms) on textured cBN/TiN for hard turning and dry machining applications. The uniquely coated tool inserts are able to constantly release the lubricants out of reservoirs on the textured cBN/TiN surface. Currently available solid lubricant coatings do not offer temperature-adaptive properties and are NOT suitable for hard turning applications. Hard turning can offer manufacturers large cost savings compared to grinding. However, the achievable surface finish is critical. The preliminary results indicate that the proposed solid lubricant coating will enhance hard turning surface finish and provide greater consistency. In addition, both environmental and competitive cost issues are causing manufacturers to migrate toward dry machining. Solid lubricant coatings can both improve surface finish and extend the tool life in dry machining applications by lowering the friction at the interface between the tool and the workpiece. Commercially available solid lubricants are primarily configured in layered structures. As wear progresses, the lubrication layer wears away and leaves the hard layer behind. Thus, the proposed novel configuration that provides temperature adaptability while also offering continuous long lasting lubrication has great potential. The proposed research is an excellent example of adding value to industrial products from the investment in nano science and engineering. The project will provide improved understanding of how the tribo-chemistry of nanoparticle coatings can offer temperature adaptive properties and affect machining performance. Also, it will provide insights regarding the micro tribology along the boundary of the particles and binder(s).

The primary application of the coating will be for cutting tools in hard turning and dry machining. These are very important and growing commercial markets. Additional markets could be for rotating machinery, dies and molds, and other wear parts. The successful development of the proposed coating will help reduce environmental waste and contaminants from the usage of coolants. The disposal of both the used cutting fluid and the contaminated metal chips that were removed during the cutting process is becoming harder and more costly. The cost of the coolant has been widely estimated as contributing over 15% of a typical part.s machining costs. The project will help facilitate the adoption of high speed machining techniques, which is considered a key factor for the United States maintaining its manufacturing base in the face of strong competition from low labor rate countries.

Title: SBIR Phase II: ACIM deBonder: Thin Film Integrity Testing Using Controlled Microcavitation

Award Number: 0422191
Program Manager: Cheryl F. Albus

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $500,000

Investigator: Sameer Madanshetty, sameer@ksu.edu
Company: Uncopiers, Inc.
6923 Redbud Drive
Manhattan, KS 66503
Phone: (785)293-4917

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new method of determining how strong a thin film anchors to a substrate. The ACIM deBonder(trade mark)uses controlled microcavitation to directly reveal a thin film's adhesion strength by subjecting it to controlled erosion. ACIM is a means of constructively controlling acoustic microcavitation. Substrates are not harmed. The ACIM deBonder(trade mark) will be applicable to any type of film or coating that can be eroded in a controlled manner by cavitation. It is essentially a nondestructive method that only uses small areas of films. No special sample preparation is needed and the method is capable of in situ inspection. The ACIM deBonder tool will be developed for use in microelectronic manufacture. Semiconductor chips rely on the various film layers of their constitution to bond reliably. Beyond semiconductors the deBonder could be useful in optical coatings, and all contexts involving surface modification involving films.

The broader impacts of this project will be a new method of determining the adhesion strength of thin films; it is expected to advance the science of thin film engineering. The controlled erosion of ACIM can itself be used to create nascent surfaces in preparation for thin film deposition. Ultimately, the principle of ACIM deBonder (trade mark) relies controlled caviational erosion, in fact it relies on controlling the very fundamental process of phase change, the control of nucleation--the ability to convert a liquid into a gas in the vicinity of a solid phase. This should have much wider applications in a variety of chemical processing, e.g. in the control of the boiling processes in chemical and nuclear reactors. The study of this acoustically mediated nucleation control could form an active field/area of research and education

Title: SBIR Phase II: Cubic Phase-Stabilized Zirconia Thermal Barrier Coatings Applied via a Novel Chemical Vapor Deposition Route

Award Number: 0422242
Program Manager: Rosemarie D. Wesson

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $427,752

Investigator: Jason Babcock, jason.babcock@ultramet.com
Company: Ultramet
12173 Montague Street
Pacoima, CA 91331
Phone: (818)899-0236

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will seek to develop a novel technique for applying thermal barrier coatings (TBCs) to turbine (jet) engine components. The use of low thermal conductivity TBCs has enabled higher temperatures and longer component life to be achieved, along with more efficient engine operation. Application of the state-of-the-art coating compositions via chemical vapor deposition (CVD) has the potential for an order-of-magnitude reduction in processing cost over the conventional technique employed. In addition, CVD is a non-line-of-sight technique capable of coating components and/or regions of components not possible by any other means

The next-generation TBC system to be developed in this project will provide superior reduction in actual part temperature and oxidation resistance compared with state-of-the-art coatings. In addition to the increased engine efficiency realized from the higher temperature operation these coatings will allow, this application method has the potential for an 80-90% reduction in cost. Improved TBCs will have wide application to commercial and military propulsion and power generation systems, including turbine and reciprocating engines.

Title: SBIR Phase II: Nanocrystalline Diamond Coated Cutting Tools

Award Number: 0349769
Program Manager: T. James Rudd

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount $509,999
Investigator: Raymond Thompson, rthompson@VistaEng.com
Company: Vista Engineering Inc.
2800 Milan Ct
Birmingham, AL 35211
Phone: (205)943-6720

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop nanocrystalline diamond coatings on tungsten-carbide cutting tools with technical attributes that surpass the current generation of chemical vapor deposited (CVD) diamond coatings as well as tools made from polycrystalline diamond (PCD) wafers. The problem with CVD diamond coatings for cutting tools is poor surface finish and weak adhesion. Nanocrystalline CVD diamond deposited using microwave plasma (MP) techniques overcomes these problems with a smooth finish that is well adhered. This makes the nanocrystalline diamond a potential competitor to PCD diamond by lowering the price and increasing productivity. The research proposed for Phase II will use a 30kW MP-CVD reactor to investigate the relationships between nanocrystalline structure and technical performance. The structure will be controlled by process variables. Technical performance will be measured by mechanical testing and field testing on the proposed target application of machining cast aluminum-silicon alloy. The anticipated technical result will be direct correlations between structure, properties and performance that can be used to optimize nanocrystalline diamond coatings for machining automotive drive-train components.

Commercial applications of nanocrystalline diamond coatings are far reaching due to applications in the cutting tool industry that promote the use of hard-to-finish advanced materials; applications in pulp and paper for cutting and guides, applications in textiles for guides and applications in various bearing surface applications such as deep-well oil drill-head bearings. The National Institute of Health is also sponsoring research on nanocrystalline diamond applications in biomedical hardware surfaces subject to wear. Additionally, environmental impact of cutting fluid and related waste from machining processes are driving manufacturers to implement dry machining processes. MP-CVD nanocrystalline diamond tooling is the ideal tool for dry machining nonferrous materials.

Title: SBIR Phase II: Interface Functionalization of Commercial Substrates to Promote Adhesion of Solventless Inks

Award Number: 9982958
Program Manager: Rosemarie D. Wesson

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $400,000

Investigator: Richard Ellwanger, ree@sigmalabs.com
Company Sigma Labs Incorporated
10960 N Stallard Place
Tucson, AZ 85737
Phone: (520)575-8013

Abstract:

This Small Business Innovation Research Phase II project will address in-line treatment for functionalization of commercial substrate surfaces. The proposed treatment will consist of an appropriate combination of vacuum plasma treatment, atmospheric plasma treatment, and/or acrylate coating. It is expected to functionalize the surface of commercial substrates such as packaging films, labeling sheet, paper webs, and Teflon(tm) sheet to readily accept and bond with solventless printing inks, thus reducing the need for solvent-based inks. The EPA Toxic Release Inventory (TRI) for 1995 shows that 1.224 billion pounds of organic solvents were released into the atmosphere over this country in 1995. The number 3 chemical (146 million pounds) contributing to TRI air emissions for 1995 was toluene, a major constituent of printing ink formulations. Regulatory and community pressure to reduce the use of solvent-based inks as a pollution prevention measure is already a significant driving force and will only intensify in the future. Proof-of-concept has been achieved in Phase I. Sigma Technologies has indeed been able to alter the surface functionality of a variety of commercial substrates to the extent that water-based ink formulations will adhere well to the functionalized surfaces without sacrifice of ink deposit quality.

Several major players in the packaging film and related industries are very interested in our progress in the area of interface functionalization. They are under pressure from the USEPA to reduce their use of solvent-based inks and are operating in a highly competitive, often narrow margin, business venue. They are watching us closely and at least two of these clients will participate in the proposed Phase II effort by providing in-kind matching funds expenditures to provide inking runs on treated substrates and to help us evaluate ink deposit quality. If we are able to maintain this high level of interest through the Phase II effort we are confident that firm orders for equipment and process development for Sigma Technologies will result.

Title: SBIR Phase II: The Study of Superior Quality Thin Films Derived from Liquid Combustion in a Thermal Plasma

Award Number: 9983420
Program Manager: Rosemarie D. Wesson

Start Date: June 1, 2000
Expires: May 31, 2003
Total Amount: $739,723

Investigator: Miodrag Oljaca, moljaca@microcoating.com
Company: CCVD, Inc dba MicroCoating Technologies (MCT)
5315 Peachtree Industrial Blvd.
Atlanta, GA 30341
Phone: (678)287-2400

Abstract:

This Small Business Innovation Research Phase II project for clean and efficient combustion of liquid fuels is of importance in many technologies including internal combustion engines, gas turbines, waste-incineration and, more recently, advanced materials processing. The efficiency of the thermal combustion of a fuel controls the efficiency and emissions of a process. Two governing factors in the combustion of a liquid fuel are atomization and vaporization of the liquid prior to its ignition. Two advanced thin film coating deposition techniques utilize the combustion of a liquid fuel containing a dissolved metal complex to deposit films of desired materials on to substrates. The first, flame spray pyrolysis, is a rapid deposition process yielding thick films, however, the films are generally of poor quality due to inefficient atomization. This leads to rough films of low density and purity. In contrast, combustion chemical vapor deposition (CCVD) utilizes an efficient atomization and vaporization process that makes it a true vapor deposition method. The CCVD process incorporates a patented atomization method for liquid fuels, trademarked as the Nanomiser. The Phase I effort studied the flame physics and chemistry of the deposition of high quality barium strontium titanate (BSTO) thin films by CCVD. BSTO is a high performance ferroelectric. This Phase II project will build upon the results of Phase I by expanding the levels of analysis and modeling of the CCVD process to develop a thorough, predictive model and thereby improve the CCVD process. The data and models developed in Phase II will be of extreme importance to spray combustion processes in general. MCT is targeting development of high quality thin film materials for use in electronics, corrosion protection, optical coatings, nanopowders, superconductors, fuel cells as well as other applications yielding a potential multibillion dollar market.

Results from this research will be used to increase combustion efficiency and satisfy key requirements for performance of thin film ferroelectrics. This will enable commercialization of the CCVD process applications through a combination of R&D services, advanced license agreements and pilot production services.

Title: SBIR Phase II: New Oxide Coatings for Protection of Alloys in a High-Temperature Oxidizing Environment

Award Number: 0078347
Program Manager: T. James Rudd

Start Date: September 1, 2000
Expires: August 31, 2002
Total Amount: $380,669
Investigator: Donald Alger, alger@mail.ohio.net
Company: Alger Stirling Company
4050 Paradise Road
Seville, OH 44273
Phone: (330)722-6181

Abstract:

This Small Business Innovation Research (SBIR) Phase II project's objective is to provide oxide coatings that resist deterioration in a high-temperature oxidizing environment. A new, innovative process is will be developed that should form strongly-adherent, high-temperature, oxidation resistant coatings on steel alloys, iron and nickel superalloys, aluminides, and superalloy matrix composites. Using this process in Phase I, Alger Stirling Company (ASC) alpha-Al_2O_3 as well as ASC alpha-Al_2O_3/Ti_2O_3 protective coatings, whose coating-to-substrate bond strength was measured to be in excess of 10,000 psi, were formed on six different aluminum-containing and aluminum-and-titanium-containing alloy substrates. Phase II testing (1) will optimize oxide thickness to provide maximum oxide/substrate bond strength, and (2) perform lifetime testing of the oxidized specimens in a high-temperature oxidizing environment.

These coatings have broad application in industry throughout the nation. Products that utilize the ASC coatings can achieve longer lifetimes because of the surface protection provided by the coatings. Such longer lifetime translate directly to user dollar savings that are, first of all, a benefit to the entire nation and, second, make the products more competitive in foreign markets.

Title: SBIR Phase II: Ultra-Hard Boron Coatings through Vacuum Arc Deposition

Award Number 0078385
Program Manager: Rosemarie D. Wesson

Start Date: August 15, 2000
Expires: July 31, 2002
Total Amount: $399,996
Investigator: C. Christopher Klepper, cck.brontek@nrvdc.org
Company: HY-Tech Research Corporation
104 Centre Court
Radford, VA 24141
Phone: (540)639-4019

Abstract:

The Small Business Innovation Research (SBIR) Phase II project aims to demonstrate the operation of a commercially viable boron deposition source based on vacuum arc technology. The source is for the deposition of boron-based, self-lubricious coatings of hardness comparable to diamond, which are also compatible with high-temperature applications. A special sintering method, developed in the Phase I, produced boron cathodes that survive the severe vacuum arc environment, when properly supported and heated. This patentable Phase I technology will be applied in the Phase II to demonstrate the production of the desired films. The emphasis will be in ultra-hard forms of nearly-pure boron, although some compounds are also of interest. Water cooling of the anode and surrounding structures will be used to avoid damage in continuous operation of the source. Well established wall conditioning techniques will be used to reduce contamination of the films from the inner surfaces of the vacuum chamber.

Partnering with both a major coatings company and with a major manufacturer of heavy machinery, that require low-friction, hard-coatings for components, will enhance this Phase II project with valuable in-kind support, as well as a clear path to the Phase III commercialization. Boron coatings have excellent hardness, tribological (low friction) and corrosion resistance properties. Their high temperature and combustion environment compatibility would make them ideal for advanced automotive applications. For example, such coatings could potentially eliminate the need for added lubricants in high temperature, low heat loss diesel engines, leading to substantial reduction in particulate emissions.

Title: SBIR Phase II: Surface Engineering of Metals with Plasma Polymers

Award Number: 0216100
Program Manager: T. James Rudd

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $499,219
Investigator: Giles Dillingham, gdillingham@btgnow.com
Company: Brighton Technologies Group, Inc.
4125 Dane Avenue
Cincinnati, OH 45223
Phone: (513)591-3100

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will replace current environmentally damaging metal pretreatment processes with an environmentally benign process whereby the metal surface is etched then coated with a sub-micron film of plasma polymerized SiO2. Current metal pretreatment processes for painting and adhesive bonding perform well, but generate tremendous volumes of wastes, including hexavalent chromium and various inorganic acids. To obtain performance superior to the current state-of-the-art wet chemical surface treatments, the surface chemistry and morphology of the plasma polymerized films need to be tailored for specific interactions with the adhesive. Effects of variables including substrate chemistry, monomer chemistry, and ion kinetic energy on surface chemistry and morphology of plasma polymers will be determined. Then, the effect of the resulting structure on the strength and durability of adhesive joints will be determined.

By combining in-situ analytical techniques with accelerated aging and mechanical testing of adhesive specimens, a superior, environmentally benign process based on plasma polymerization will be developed and commercialized. These primers will have well understood morphologies and surface compositions tailored to the adhesive chemistry through control of the deposition conditions and/or chemical derivitization of the plasma polymer surface.

Title: SBIR Phase II: Development of NZP-Based Advanced Thermal Barrier Coatings

Award Number: 0111605
Program Manager: T. James Rudd

Start Date: October 15, 2001
Expires: September 30, 2003
Total Amount: $499,747
Investigator: Ramachandran Nageswaran, rnageswaran@coiceramics.com
Company: COI Ceramics, Inc.
181 West 1700 South
Salt Lake City, UT 84115
Phone: (801)364-6446

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop and optimize the NZP (sodium zirconium phosphate type) ceramic-based thermal barrier coating (TBC) technology for use in advanced turbine and power generation systems. These advanced systems drive the need for higher operating temperatures to achieve better efficiencies without compromising durability. Such requirements heighten the threat of: (i) microstructural changes, which reduce thermal barrier effectiveness; (ii) premature oxidative spalling; and (iii) susceptibility to mechanical stresses in conventional yttria-stabilized zirconia (YSZ)-based TBCs. Some NZP ceramics have very low thermal and oxygen conductivity, excellent thermal cycling resistance and high temperature stability but also have low thermal expansion. Phase I demonstrated the feasibility of thermal spraying simple and functionally graded (to minimize thermal expansion mismatches) TBCs of NZP with YSZ that are better thermal barriers and also have very good thermal cycling resistance to 1200 degrees C. The primary goal for Phase II is to complete the scientific and engineering development in order to commercialize the NZP-based TBC technology. A team of academic and industrial collaborators will work under the guidance of committed end-users to achieve this goal.

Potential successful development of the NZP-based TBC concept will enable applications in high efficiency power generating systems and gas turbine engines; specifically, for turbine vanes and blades, and combustors and afterburners. Coatings based on NZP can also double up as environmental barrier coatings (EBCs), and find use in diesel engines and as abradable seals. The financial benefits of the NZP-based coatings could be over $100M arising from reduced component maintenance and fuel and operational costs.

Title: STTR Phase II: Light Transparent, Electrically Conductive Coatings by Filtered Cathodic Arc Plasma Deposition

Award Number: 0216628
Program Manager: T. James Rudd

Start Date: July 15, 2002
Expires: June 30, 2004
Total Amount: $499,993
Investigator: Michael McFarland, mcfarland@aasc.net
Company: Alameda Applied Sciences Corporation
2235 Polvorosa Avenue, Suite 230
San Leandro, CA 94577-2249
Phone: (510)483-4156

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will build upon and extend the encouraging results obtained in the Phase I program, which investigated the properties of thin, electrically conductive, UV transparent films and tri-layer metal coatings as possible diamond switch electrode structures for power electronics. Phase I benchmarked UV transmission, electrical conductivity and substrate adhesion for 14 to 44 nm Mo films, deposited using an energetic filtered cathodic arc deposition process. A companion program demonstrated a significant reduction in the diamond switch on-state resistance, and hence, improvement in switch efficiency, using these films as contact electrodes. The Phase II program will apply these results to a commercially relevant specification by demonstrating that the thin film deposition process can be scaled and the complex thin film mesa-shaped electrode topology can be realized. The anticipated mesa-shaped design will consist of a series of narrow tri-layer conduits, with the relatively large spaces in between coated with the thin UV transparent, electrically conductive film. This design maximizes the UV input into the diamond, which is used to activate the switch, while minimizing the electrical resistance. The properties of the electrode will be benchmarked against commercially relevant operating requirements.

The project's commercial potential is considered significant since it both supports the entry of diamond switch technology into the $21 billion per year power electronic device market as well as advancing the energetic deposition process thin film knowledge base, which in turn provides an improved platform for launching additional commercial ventures.

Title: SBIR Phase II: Noncorroding Steel Reinforced Concrete

Award Number: 0091686
Program Manager: Joseph E. Hennessey

Start Date: June 1, 2001
Expires: May 31, 2004
Total Amount: $499,204
Investigator: Dominic J. Varacalle, Jr., djv@iictr.com
Company: Concrete Sciences Corporation
748 Greenwood Avenue
Glencoe, IL 60022
Phone: (847)776-7200

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new class of cement-steel interfaces for high performance steel reinforcing bars for concrete. In Phase I the project demonstrated a bar coating system that can protect against corrosion of steel in concrete structures and has improved adhesion characteristics between steel reinforcement and the cement matrix. Phase II continues to refine the properties and techniques for producing this new class of High Performance Non-corroding Steel-Reinforced Concrete.

Improved corrosion resistance of steel reinforcement in concrete structures could address a major infrastructure problem that has been estimated to require up to $3 trillion for repair. The potentially cost effective coatings to be developed and commercially applied during production runs in steel mills would result in a value added product of major importance for managing the infrastructure. Improvements in adherence and corrosion resistance would be highly beneficial, for example, in corrosive highway deicing environments and marine structures.

Title: STTR Phase II: Nano-Layered Composites as High-Temperature Hard Coatings

Award Number: 0226328
Program Manager: Cheryl F. Albus

Start Date: January 1, 2002
Expires: November 30, 2003
Total Amount: $375,000
Investigator: Ilwon Kim, ikim@fctnet.com
Company: Functional Coating Technology, LLC
1801 Maple Ave. suite 5320
Evanston, IL 60201-3135
Phone: (847)467-5377

Abstract:

This Small Business Technology Transfer (STTR) Phase II Project aims to develop novel nano-layered coatings for high-temperature tribological applications, specifically cutting-tool coatings that perform well at elevated temperatures (up to 1000 degrees C). There is a high level of interest in these coatings because of the desire to cut at higher rates and due to increasing environmental concerns over the use of coolants during machining. Traditional coating materials do not perform well under these conditions, primarily because their hardnesses decrease rapidly as temperature rises. Research in Phase I developed a new class of coatings, combining many alternating nanometer-thick layers of metals and nitrides, which show substantial hardness enhancements. Hardnesses up to 44 gigapascals (GPa) were maintained after high temperature annealing, demonstrating the feasibility of these new materials as high-temperature stable coatings. Strong dislocation confinement in nano-layers is likely to yield higher high-temperature hardness than in monolithic coatings, providing improved wear resistance. In Phase II, nano-layered coatings will be developed that optimize key properties including hardness, thermal expansion match with the substrate, stability against dissolution into different workpieces, and oxidation resistance.

Nano-layered coated cutting tools have the potential to make dry-cutting a practical alternative, and to improve wet-machining performance.

Title: SBIR Phase II: Latent-Reactive Surface Modification Reagents for Biofilm Control

Award Number: 0216532
Program Manager: T. James Rudd

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $496,893
Investigator: Patrick E. Guire, pguire@surmodics.com
Company: SurModics, Inc.
9924 West Seventy Fourth Street
Eden Prairie, MN 55344
Phone: (612)829-2707

Abstract:

This Small Business Innovation Research Phase II project continues the development of new thermally activable reagents for bonding microbicidal polymers to inner surfaces of a variety of opaque tubing materials, initiated in Phase I under the Advanced Materials and Manufacturing (AM) topic, Surface Engineering subtopic (F). Materials have been developed with bulk physical properties needed for transport of aqueous mixtures; however, the development of biofilm on the wet surfaces is a continuing serious problem in the dental, pharmaceutical, food processing, and marine transport industries. Surface modification of waterlines could decrease the formation of biofilm while retaining the desired bulk properties of the tubing. Photochemistry has been proven commercially successful in enhancing the surface properties of medical devices with radical-based surface modification initiated by RF plasma or ultraviolet light. However, these energy sources are not effective for modifying the inner surfaces of opaque tubes such as waterlines used with dental units and plumbing in pharmaceutical plants. This project is designed to develop latent-reactive radical generators activatible with thermal energy, which penetrates these opaque devices. This innovative approach to scheduled activation of radical generators will provide a method to modify inert surfaces, which cannot be activated with external light or plasma sources.

Microbial colonization and biofilm formation remain a major cost and threat to human health and product quality for dental and pharmaceutical industries, health care and public lodging, and marine vessel utilization. Successful development of microbicidal and antifouling coating technology for the luminal surface of opaque transport and storage vessels for aqueous liquid ingestible products, constitute an incremental market size of tens of millions of dollars, not subject to current commercial coating technology.

Title: SBIR Phase II: Eddy Current Condition Monitoring of Metallic Flaws Under Surface Coatings Using Giant Magnetoresistance (GMR) Sensors

Award Number: 0216200
Program Manager: T. James Rudd

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $499,995
Investigator: Carl H. Smith, chsmith@nve.com
Company: NVE Corporation
11409 Valley View Road
Eden Prairie, MN
Phone: (973)635-7576

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop prototypes of fieldable eddy-current systems with GMR and SDT sensors that can detect defects in metals even with significant lift off from the material under inspection due to such things as thermal barrier coatings. Techniques for maintaining the a constant distance between the eddy-current probe and the conductive surface despite intervening coatings will also be developed in this project. Such a system can be used to lengthen the lifetime of mission critical components such as aircraft bearings, which at present have to be replaced on schedule using rather conservative lifetime estimates.

The main commercial application of these systems would be military and commercial aircraft. A simple system capable of rapidly scanning an area would require eddy-current probes that can inspect a large surface in a single pass. Compact and low-power arrays of GMR and Spin Dependent Tunneling (SDT) sensors developed for this program can be used in this application as well as other applications such as nanotechnolgy read heads to read implanted magnetic noise that is extremely difficult to compromise. The implications for more secure forms of identification are clear for the post 9/11world.

Title: SBIR Phase II: Surface Modification of Textiles for Protective Clothing
Award Number: 0239038
Program Manager: T. James Rudd

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,998
Investigator: Don B. Elrod, don.elrod@lynntech.com
Company: Lynntech, Inc
7610 Eastmark Drive, Suite 202
College Station, TX 77840-4024
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research Phase II project involves the modification of the surface of textiles through graft polymerization of an oxidizing polymer resulting in a fabric, which has the ability to eradicate/neutralize pathogenic microorganisms, pesticides, and chemical/biological weapons. The fabric could be used to produce medical textiles in order to reduce the transmission of infectious pathogens in hospitals, protect agricultural workers from contact with pesticides, and protect military personnel and first responders from contact with chemical/biological weapons in the event of terrorism or war. The Phase I research showed that the grafted fabric was highly effective against both microbial and chemical agents. The modified fabric was also found to be non-irritating to both intact and abraded (compromised) skin. In this Phase II project the research will consist of optimizing the graft polymerization process, extensive testing of the optimized fabric against microbial and chemical challenges, durability testing through repeated laundering, mechanical property evaluation, extensive cytotoxicity and irritation testing, capacity and regenerability assessment, stability assessment in storage, pilot plant production runs, and custom production/testing of fabric for a strategic partner.

The fabric technology to be developed in this project has a vast amount of potential in a variety of niche applications in the medical, agricultural, and military arenas. In addition to the huge markets that exist for these products, there are obvious societal benefits that are inherent with the technology. Infection control is a huge problem in medical facilities resulting in prolonged hospital stays and leads to higher medical costs. The modified fabric could be constructed into medical textiles for use as surgical drapes, scrubs, lab coats, bed sheets, privacy drapes, gowns, etc. Farm workers could protect themselves from exposure to the pesticides they use in the field. The fabric could be employed in the production of protective clothing for first responders and military personnel who find themselves in an environment where there is a potential risk of exposure to chemical/biological weapons.

Title: SBIR Phase II: A New Pseudo Amorphous High Temperature Oxide Material

Award Number: 0132146
Program Manager: T. James Rudd

Start Date: March 15, 2002
Expires: February 29, 2004
Total Amount: $499,999
Investigator: Kimberly Steiner, ksteiner@atfinet.com
Company: Applied Thin Films
Evanston Business & Tech Center
Evanston, IL 60201-3135
Phone: (847)491-2447

Abstract:

This Small Business Innovation Research (SBIR) project will investigate the use of a new high temperature amorphous oxide material, CerablakTM, as a protective coating on components used in the molten aluminum industry. CerablakTM is a newly discovered sol-gel derived material that is thermally stable up to 1400 degrees Celsius over many hours. A patented precursor is used to form a continuous, dense, and smooth thin film using a simple dip coating process. The key property of CerablakTM is its relatively low oxygen diffusivity, which enables its use for oxidation protection of metal and alloy surfaces exposed to elevated temperatures. The Phase I project showed that the material is non-wetting and compatible with molten aluminum. CerablakTM coatings developed on full-size thermocouple protection tubes showed excellent durability and non-wetting behavior. The Phase II project will optimize the coating quality for use in protection of thermocouple protection tubes, riser stalk tubes, molds, and dies.

The commercial applications include protective coatings for metals and alloys used in turbine components and petrochemical refining, molten metal processing, thermal protection systems for space propulsion, cookware, and glass.

Title: SBIR Phase II: ECR (Electron Cyclotron Resonance) Plasma Treatment of Polymer Tubing Such As Catheters

Award Number: 0238947
Program Manager: Rosemarie D. Wesson

Start Date: March 15, 2003
Expires: February 28, 2005
Total Amount: $445,576
Investigator: James G. Moe, jmoe@spirecorp.com
Company: Spire Corporation
One Patriots Park
Bedford, MA 01730-2396
Phone: (781)275-6000

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop new techniques to treat both internal and external surfaces of polymer tubing such as catheters. The treatments will modify the surfaces to facilitate attachment of bioactive coatings, clean, sterilize, or reduce friction; similar processes can also deposit organic or inorganic coatings. Plasmas driven by electron cyclotron resonance (ECR) will treat the lumen and external surfaces more uniformly, and over a greater range of parameters, than conventional plasmas and can be spatially localized to provide different effects on each.

The ECR plasma process should be expandable to large-scale, low-cost commercial production coating and surface modification of catheters. Surface treatments to facilitate attachment of bioactive coatings to hemodialysis and other catheter types would have societal benefits by extending the period between catheter replacements clear therapeutic and economic.

Title: SBIR Phase II: Nanocomposite Coating on Coronary Stents

Award Number: 0620563
Program Manager: James Rudd

Start Date: August 23, 2006
Expires: August 31, 2008
Total Amount: $490,533
Investigator: Robert Hoerr, bobhoerr@comcast.net
Company: Nanocopoeia
1479 Gortner Avenue, Suite 240
St. Paul, MN 55108
Phone: (651)624-3060

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is focused on designing, prototyping, and fully qualifying a proprietary manufacturing apparatus capable of applying a range of next-generation coronary stent coatings. First generation drug-eluting coronary stents have significantly improved clinical outcomes for heart patients, while concurrently highlighting the potential for substantial improvements. Next-generation methods are needed for improving the way drugs and other biologics are applied to the stent, as well as for active-agent release from the stent. The company successfully demonstrated in Phase I that its proprietary ElectroNanospray process could reproducibly apply nanocomposite drug/polymer coatings onto the intricate architecture of a coronary stent and could consistently meet preliminary specifications provided by a potential commercial partner. This Phase II project will extend that R&D by producing a manufacturing. Apparatus designed to significantly improve process control features and throughput. Rigorous step-wise hardware-qualification experiments will generate test lots of coated stents for further characterization and validation by the same partner. Feedback will guide design iterations needed to optimize this unique manufacturing capability, with the goal of producing an apparatus that coats stents with a broad range of novel nanocomposite coatings and drug-release properties for preclinical testing and meets the stringent performance requirements for commercial manufacturing in a regulated environment.

Commercially, sales of drug-eluting coronary stents will exceed $6 billion in 2006. With the first products entering the market in 2003, this represents the fastest market introduction in medical device history. The drug-eluting stent showed that the body's inflammatory and scarring response to the implanted bare metal stent, which resulted in re-blockage of the artery, could be overcome by applying thin layers of drug-releasing polymers to the stent surface. The broader implications are that coatings that enable site-specific delivery of biologically active compounds could improve the clinical performance of a wide variety of medical device implants, not only for cardiovascular indications, but also for use in orthopedic, neurology and tissue engineering applications. In addition, using the drug-eluting stent as an example, they offer the possibility of bringing about the same or improved clinical outcomes as existing therapies, while reducing cost, hospital length of stay, and loss of productivity by the patient. The novel manufacturing apparatus proposed in this research will have the ability to create and apply engineered nanocomposite coatings to device implants that incorporate novel active agents and controlled-release properties not possible with today's conventional coating processes, thereby offering the possibility of improved clinical outcomes for a wide variety of diseases.

Title: SBIR Phase II: Nanoparticulate Based Coating Approach for Making Thin Film Batteries

Award Number: 0620596
Program Manager: Rosemarie Wesson

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $500,000

Investigator: Suvankar Sengupta, ssengupta@aol.com
Company: MetaMateria
1275 Kinnear Rd
Columbus, OH 43212
Phone: (614)340-1690

Abstract:

This Small Business Innovation Research Phase II project will further develop unique materials demonstrated with potential to provide higher performance nanostructured cathodes for a solid state lithium ion thin film battery using a lower cost, nanoparticulate based deposition approach. A unique nanocomposite anode consisting Sn nanoparticles deposited onto CNT has been developed, with capacities higher than typically found in conventional Li ion batteries The cathode work will be directed toward development of improved cathode coatings.

The potential to cost-effectively eliminate the primary limitation to portable electronic advances will have a significant impact on industry and society. Lighter weight, more powerful and permanently rechargeable solid state devices that enable a new portable power "platform" will be an outcome of this endeavor. In addition, the nature of the solid-state design and materials is inherently disposable and environmentally friendly.

Title: SBIR Phase II: Nanostructured WC/Co Coatings for Enhanced Wear Resistance Applications

Award Number: 0646485
Program Manager: Deepak Bhat

Start Date: April 1, 2007
Expires: March 31, 2009
Total Amount: $499,972
Investigator: Ralph Tapphorn, rtapphorn@inovati.com
Company: Innovative Technology Inc
Cabrillo Business Park
Goleta, CA 93117
Phone: (805)571-8384

Abstract:

This Small Business Innovation Research (SBIR) Phase II project continued development of nano-crystalline tungsten carbide-cobalt coatings by integrating two novel processes: i) a low temperature spray deposition process (kinetic metallization), and ii) a nano-crystalline powder deposition process. The results of Phase I research demonstrated that the two proposed methods can be synergistically combined to synthesize unique new compositions of powders for thermal spray coating process. The Phase II work is focused on the scaling and optimization of the powder manufacture and deposition techniques.

If successful, the process and material system can provide an environmentally acceptable replacement for chromium-based coatings. A nc-WC-Co coating system with good fatigue properties will certainly provide an alternative to hard Chrome coatings, if it can be fabricated cost effectively. The environmental benefit resulting from this will be significant. The proposed technique is also claimed to result in a deposition equipment at a lower cost of ownership as compared to curently available equipment. The technique has significant broad applications in a number of key industries, including aerospace, power generation, oil and gas drilling, defense and medical industries.

Title: SBIR Phase II: Incorporation of Carbon Nanotubes into Nylon Filaments

Award Number: 0321695
Program Manager: T. James Rudd

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $499,995
Investigator: Richard A. Bley, eltron@eltronresearch.com
Company: Eltron Research, Inc.
4600 Nautilus Court South
Boulder, CO 80301-3241
Phone: (303)530-0263

Abstract:

This Small Business Innovation Research Phase II project will continue developing a method for incorporating Single Walled Carbon Nanotubes (SWNT) into nylon to act as reinforcement. Their incorporation will be achieved by wrapping the SWNTs with a functionalized polymer that interacts with the SWNTs mechanically, but is not chemically bound to them. The polymer will be chemically bound to the nylon and in this way will act as a load-transferring conduit between the nylon matrix and nanotubes in the final composite. How well the polymer transfers the extraordinary strength and durability of the carbon nanotubes to the nylon composite will depend on how well this new interface, between the SWNT and the nylon matrix, functions. For nylon fibers, the degree to which it is possible to align the SWNTs along the major axis of the fiber filaments will play a role in the fiber's thermal and electrical conductivity as well as strength. The primary focus of this work is to optimize the SWNT/nylon matrix interaction in order to obtain the best load transfer properties. Methods to align the SWNTs along the long axis of the nylon filaments in order to maximize fiber strength will also be investigated.

Commercially, this high strength nylon composite will have significant applications in the aerospace industry for use in fabricating lightweight, retrievable, satellite launch vehicles, reusable space craft etc. The military will also be interested in this technology because of the combination of exceptionally high strength, lightweight and stealth capability. The successful development of this technology will result in new lightweight thermoplastic composites that have extraordinarily high flexural, tensile and impact strengths and can be easily molded into any shape desired. This new technology will eventually be applicable to many other materials. Additionally, since these composites are thermoplastics and not a thermosets, they will be more easily recycled.

Title: SBIR Phase II: Reactive Multilayer Joining of Metals and Ceramics

Award Number: 0349727
Program Manager: Cheryl F. Albus

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $500,000
Investigator: David Van Heerden, dvh@reactivenanotech.com
Company: Reactive NanoTechnologies
111 Lake Front
Hunt Valley, MD 21030
Phone: (410)771-9801

Abstract:

This Small Business Innovation Research Phase II project proposes to develop technology for joining metallic and ceramic components; this is a reactive joining process that uses reactive multilayer foils as local heat sources for melting solders. These foils are a new class of nano-engineered materials, in which self-propagating exothermic reactions can be initiated at room temperature using a hot filament or laser. By inserting a multilayer foil between two solder layers and two components, heat generated by the reaction in the foil melts the solder and consequently bonds the components. This new method of soldering eliminates the need for a furnace or protective atmospheres and, with very localized heating, avoids thermal damage to the components. The reactive bonding process is far more rapid than most competing technologies, and results in strong and cost-effective joints. The last and potentially most important benefit is the fact that joining with multilayer foils enables the use of lead free solders and therefore offers tremendous environmental benefits.

The broader impacts that could result from this project could be to microelectronic packaging facilities.

Title: SBIR Phase II: Reliable, Low Cost Support System for Flywheel Energy Storage

Award Number: 0078459
Program Manager: Rosemarie D. Wesson

Start Date: December 15, 2000
Expires: June 30, 2004
Total Amount: $483,061
Investigator: Joseph Imlach, jiice@alaska.net
Company: Imlach Consulting Engineering
460 Falke Court
Anchorage, AK 99504
Phone: (907)337-8954

Abstract:

This Small Business Innovation Research Phase II project will result in the development of a prototype flywheel energy storage system (FESS) utilizing the innovative passive, non-contacting bearing developed in the Phase I project. This new type of passive magnetic support and damping (PMSD) system consists of integrated stiffness and damping elements in a configuration that overcomes the most significant problems of previous systems. The new bearing technology will result in a more efficient, more reliable, and less expensive FESS than is currently available. The resulting FESS will facilitate the use of alternative energy systems in remote and/or hostile environments. Phase II efforts will focus on 2 objectives: (1) The refinement and experimental validation of design equations predictive of PMSD performance; and (2) The development, installation, and testing of PMSD systems in a prototype FESS. The FESS system for the prototype will be a commercial unit provided by the commercialization partner, and modified to accommodate the new technology. The partner currently manufactures FESS for commercial power quality and uninterruptible power supplies applications. Follow-on funding commitments and other agreements have been secured from the Alaska Science and Technology Foundation and from the commercialization partner to pursue additional technical work and for Phase III commercialization. In addition to providing storage for alternative energy systems, there are numerous commercial applications for FESS incorporating the PMSD technology including utility load leveling and uninterruptible power supplies (UPS).

The commercialization partner expects that the combination of technical and cost advantages demonstrated in Phase I would enable rapid market acceptance and encourage application of FESS in new markets. The PMSD technology is also applicable to turbo-molecular pumps (TMPs). These are used in the manufacture of silicon chips and in scientific instrumentation requiring high vacuums. Predicted market penetration into these areas is in excess of 18,000 units per year by 2005 and in excess of 30,000 units per year by 2009.

Title: SBIR Phase II: Continuous SiC Matrix Composite Fabrication Using UV Curable Precursors

Award Number: 9983317
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: April 30, 2003
Total Amount: $399,999

Investigator: Kenneth Kratsch, matech@thegrid.net
Company: MATECH Advanced Materials
31304 Via Colinas Ste 102
Westlake Village, CA 91362
Phone: (818)991-8500

Abstract:

This Small Business Innovative Research Program (SBIR) Phase II project utilizes a unique photo-curable, high weight-yield preceramic polymer in a continuous fabrication process to produce a low-cost beta-silicon carbide (SiC) ceramic composite. Phase I succeeded in both photo curing and cold-initiation rapid curing (5 minutes) of a new polymer with higher ceramic yield, easier processability, and greater scalability than anticipated. Phase II will optimize the new polymer for both 'cure on demand' and viscoelastic volumetric compression in order to increase ceramic matrix density and to eliminate polymer springback between fabric layers. Use of pre-preg technology will enable large sheets and rolls of fabric to be impregnated and cured into a rubbery, coated fabric-polymer body that can be easily stored, cut to pattern, and applied in a ply-by-ply process. Process machinery will be scaled up to produce component sizes of commercial interest with fast curing and automated part fabrication.

Potential commercial application are anticipated in gas recirculating fans, heat exchangers, radiant burner screens and tubes, gas turbine engine combustion liners and tip shrouds, hot liquid filtration, containment shells, gas-fired melting immersion burner tubes, and furnace pipe hangers. Ultimately, large composite structures may be constructed for vehicles such as hypersonic aircraft.

Title: SBIR Phase II: Innovative Snap Joining of Composite Structures

Award Number: 9983318
Program Manager: Joe Hennessey

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $374,173
Investigator: W. Brandt Goldsworthy, wbg@wbgoldsworthy.com
Company: W. Brandt Goldsworthy & Associates Inc
23930-40 Madison Street
Torrance, CA 90505
Phone: (310)375-4565

Abstract

This Small Business Innovation Research (SBIR) Phase II project will develop snaplock design concepts for composite materials, which is a novel and patentable joining and assembly technology. Two snaplock connections were built in Phase I for testing, whereby application to a snaplocked and lightweight, tapered transmission pole was found feasible in both technical and economic terms. Phase II will design, build, and test a prototype 75-foot transmission pole, using pultrusion of two building-block profiles. A tapered beam (or tube) of any desired length is obtained by performing secondary cutting, machining, and assembly, which are operations that can be automated.

Potential commercial applications are seen chiefly in the $5 billion international market for electric power transmission poles. Additional applications are expected in highway sign bridges, intermodal shipping containers, housing, and tiltrotor aircraft.

Title: SBIR Phase II: Nanolaminate Structural Composites

Award Number: 0078403
Program Manager: T. James Rudd

Start Date: June 1, 2000
Expires: November 30, 2002
Total Amount: $399,996

Investigator: Angelo Yializis, ayializis@sigmalabs.com
Company: Sigma Labs Incorporated
10960 N Stallard Place
Tucson, AZ 85737
Phone: (520)575-8013

Abstract:

This Small Business Innovation Research (SBIR) Phase II project deals with the fabrication of ultra high strength Polymer/Metal Multi-layers (PML) nanolaminates. In Phase I, Sigma Technologies has demonstrated that the Aluminum/Polymer nanolaminates have distinctive advantages over Aluminum, (a) a superior tensile strength (over 3 fold in some cases), (b) and a lower density. Furthermore, Sigma has developed, based on experimental results, a numerical model to predict the tensile strength of multilayer composites. The attractive features of the PML composites have generated a significant interest in this product by a major aerospace and avionics OEM (Original Equipment Manufacturer. Additional functionality of this composite includes ultra-high gas and vapor barrier, high electrical conductivity, electromagnetic shielding, preferential heat conductivity that is useful for low observable applications, and structural self-monitoring characteristics.

In Phase II, Sigma will further optimize the properties of the PML composites and upgrade equipment that is already in place to produce 7ft x 4ft PML panels. Parts will be tested independently by Sigma and its industrial and university partners. Market research has shown that several applications may be served by the multifunctional structural PML composites. Sigma will follow a systematic plan to identify niche markets and supply samples for evaluation.

Title: SBIR Phase II: Engineered Lumber from Sawmill Residue

Award Number: 0078473
Program Manager: T. James Rudd

Start Date: September 15, 2000
Expires: February 28, 2005
Total Amount: $749,999
Investigator: Ernest Schmidt, eschmidt_wsiwood@vcn.com
Company: Wyoming Sawmills Incorporated
PO Box 6088
Sheridan, WY 82801
Phone: (307)674-7484

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enable conversion of low value residual edgings from sawmill operations into a structural quality engineered wood composite called Structural Strand Lumber (SSL). Edgings are created at sawmills when round logs are sawn into rectangular pieces of lumber. The SSL concept is to cut these edgings into strands, align them directionally, and then glue and compress them into a high value product. Edging material currently is used for low value wood chips for use in paper production. The SSL process will enable sawmills to convert up to 14% more of forest raw materials into structural quality lumber compared to conventional practices. SSL manufacturing will yield a high value added wood product, dramatically reduce waste, reduce demand on natural resources, and increase sawmill operating efficiency. These benefits will reduce dramatically the environmental impacts of sawmill operations. Phase I research provided a fundamental understanding of key processes, and clearly demonstrated the feasibility of the SSL concept. Phase II will demonstrate the operation of critical SSL components, and enable a manufacturing facility prototype demonstration early in the Commercialization Phase.

If the research is successful, dramatic increases in the fraction of a log that can be used for quality structural materials will result. The cost of the engineered material will be competitive with solid high-grade structural material. The method is applicable to virtually all sawmills operating in the United States and around the world. More efficient utilization of existing wood supply will be enabled by this innovation.

Title: SBIR Phase II: Net Shape, SiC-Toughened Molybdenum Disilicide Composites

Award Number: 0079262
Program Manager: T. James Rudd

Start Date: October 1, 2000
Expires: December 31, 2002
Total Amount: $394,814
Investigator: Ramachandran Nageswaran, rama@smahtcer.com
Company: COI Ceramics, Inc.
181 West 1700 South
Salt Lake City, UT 84115
Phone: (801)364-6446

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims at further developing and optimizing the innovative technology for the cost-effective fabrication of dense silicon carbide (SiC) fiber-reinforced molybdenum disilicide ($MoSi_2$) composites with enhanced strength and toughness up to very high temperatures (1400 degrees C). Molybdenum disilicide has very attractive thermal, oxidative, and corrosion resistance properties for applications in turbine engines, burner rigs, hot gas filters, molten metal lances, and heating elements, but is structurally weak. Reinforcement with a mechanically superior second phase material makes $MoSi_2$-based composites serious candidates for such applications if the composites can be processed to net shape cost effectively. The Phase I project demonstrated the feasibility of reaction forming the $MoSi_2$ matrix with controlled amounts of SiC whiskers or particles, which themselves are formed in-situ. Further, several SiC(f)/$MoSi_2$ compositions were developed that are strong, dense, and resistant to pesting. These compositions were developed using a single step process that combines Self-Propagating High-Temperature Synthesis (SHS) of elemental mixtures of Mo, Si, and C with psuedo-Hot Isostatic Pressing (HIP) -- electroconsolidation. Phase II research will demonstrate the near-net shape capability of the process along with the ability to produce robust $MoSi_2$-based composites.

Based on design specifications from turbine engine manufacturers, the project will also fabricate prototypes for testing at the end of Phase II. Immediate commercial use of the SiC(f)-toughened $MoSi_2$ composites can be realized as heating elements, combustion and burner rigs, and molten metal filters. Future applications include uses for aviation and gas turbine engine components, heat exchangers, hot gas filters, and waste incinerators. Other advanced applications include energy storage devices such as ultracapacitors.

Title: STTR Phase II: Magneto-Rheological Fluids for Sensor Actuator Systems

Award Number: 0110447
Program Manager: T. James Rudd

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $500,000
Investigator: R Radhakrishnan, radha@matmod.com
Company: Materials Modification Inc
2721-D Merrilee Drive
Fairfax, VA 22031-0113
Phone: (703)560-1371

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop advanced magnetorheological fluids for various damping applications. The Phase I project focused on a microwave plasma synthesis technique (NANOGENTM) and chemical precipitation technique; both techniques were successfully used to synthesize nanoparticles of iron, cobalt and iron oxide. NANOGENTM was selected as one of the 100 most innovative technologies in 1998 when it won the prestigious R&D 100 Award. MR fluids were prepared from these fluids and preliminary results on their damping behavior was found to be comparable with commercially available fluids. The Phase II project will scale-up the production of nanopowders and will conduct testing of their damping characteristics to help foster the development and application of MR fluids in key technology driven areas.

The possible commercial applications will be in automobile suspensions, hybrid actuator valves, semi-active vibration control in turbines and bridges as well as for seismic damping.

Title: SBIR Phase II: Subgrade Repair and Stabilization
Award Number: 0111712
Program Manager: T. James Rudd

Start Date: August 1, 2001
Expires: July 31, 2004
Total Amount: $500,000
Investigator: Lawrence Farrar, lcfarrar@montecresearch.com
Company: Resodyn Corporation
1901 South Franklin
Butte, MT 59701
Phone: (406)723-2222

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and demonstrate a novel vitrification process for subgrade soil stabilization. The process includes a method to inject readily available materials into the vitrification zone eliminating subsidence that would otherwise occur as the soils densify during vitrification. The process is based on the use of modifiers that adjust the vitrified soil properties. The Phase I work demonstrated feasibility of the process and that the vitrified material was suitable for subgrade stabilization and resulted in materials having strengths qualified for structural reinforcement applications. Economic analysis completed in Phase I indicated that the method is competitive with conventional subgrade repair methods. The Phase II work will establish the commercial merit of the process by demonstrating its economy, robustness and versatility to produce subgrade synthetic rock from soils in the field. The Phase II work includes participation by a university and an end user. The proposed research and development will yield a fundamental understanding of the relationships between the vitrification process parameters, soil and synthetic rock properties. This will enable optimization of the process in commercial applications.

The commercial market for the proposed technology includes soil stabilization of inadequate foundation and slope materials around many kinds of structures including building, bridges and waterways. Customers will be highway departments (state and federal), airport authorities, municipalities and the industrial sector. Essentially, the process will be useful to any entity, including contractors that deal with maintenance of subgrade and/or new construction that have "local" subgrade instability issues to overcome.

Title: STTR Phase II: Support Material Characterization for Ultrasonic Rapid Prototyping

Award Number: 0548721
Program Manager: George Vermont

Start Date: January 11, 2006
Expires: December 31, 2007
Total Amount: $468,233
Investigator: Dawn White, dawn@solidica.com
Company: Solidica
3941 Research Park Dr C
Ann Arbor, Michigan 48108
Phone: (734)222-4680

Abstract:

This Small Business Technology Transfer Research (STTR) Phase II project will complete the development of a support material for Ultrasonic Consolidation (UC) direct metal rapid prototyping and demonstrate the ability to build structures with high aspect ratios or overhanging features. This ability to apply UC to more complex shapes will enable engineers to design important parts more rapidly and less expensively. Basic iinformation developed on the mechanical properties of metals experiencing ultrasonic excitation will also be useful in other industrial processes, such as extrusion and ball milling.

The project will use the results from Phase I to identify a user friendly, cost effective, environmentally benign and easily removed support material, and demonstrate that its application can be integrated with the commercial UC platform.

Title: STTR Phase II: Large Scale Freeform Fabrication for the Construction Industry

Award Number: 0646569
Program Manager: Deepak Bhat

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $500,000

Investigator: Charles Eason, charleseason@optemadevelopment.com
Company: OPTEMA
5179 Lakeshore Dr.
Fairfield, CA 94534
Phone: (800)427-8133

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and commercialize a novel way to construct large, modular objects, such as concrete walls and components used in building a home, using a solid freeform fabrication process. The novelty of the proposed process is that is is capable of producing structures with wall thicknesses which are thickner than other similar methods. The structures can have contoured faces and alignment guides to permit quick assembly of layerwise construction. The proposed research will focus on aerated concrete as the structural materiaol, having proven the basic concept on structural foam in the Phase I research. The method is expected to result in rapid construction of homes with minimal labor and onsight assembly of pre-fabricated components.

The broader impacts of this project, if successful, would represent a radical departure in a notoriously conservative industry, leading to the construction of inexpensive, pre-fabricated homes. The technology will address a significant market in the U.S. and developing countries to provide affordable homes to a very large population of low-income consumers. Other applications where this technique could be employed include construction of large objects such as boat hulls (pleasurecraft).

Manufacturing Processes

Title: STTR Phase II: IntelliStitch AI: Intelligent Computerized Embroidery Design Automation for the Textile Industry

Award Number: 0239356
Program Manager: Cheryl F. Albus

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,321
Investigator: David A. Goldman dgoldman@softsightinc.com
Company: Soft Sight, Inc.
3105 Knapp Road
Vestal, NY 13850-3038
Phone: (607)797-4073

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop an automated means for embroidery design specification for use in the textile industry. This technology will provide simplified mechanisms for converting scanned artwork into high quality embroidery design data. This data will then be utilized by commercial sewing equipment to produce embroidered artwork that has become quite common on all types of garments and woven goods. Embroidered artwork is often quite expensive to produce and in many cases may substantially exceed the costs of the actual garments being imprinted. These costs arise from a variety of factors including an embroidered design's size and complexity. Well-designed embroidered artwork permits efficient production with high yields (i.e. minimal defects produced). Automating design creation provides additional benefits by eliminating the time consuming manual process that must otherwise be undertaken by a human expert.

The commercial and broader impacts of this technology facilitate lower manufacturing costs while allowing consistent production of high-quality goods. Additionally, this research may have broader applications within other fields such as document processing, image recognition, or other areas where image understanding and interpretation are important.

Title: SBIR Phase II: Development of Porous Lubricated Nozzles for Suppression of Nozzle Wear in Abrasive Water Jet Systems

Award Number: 0422151
Program Manager: Cheryl F. Albus

Start Date: August 15, 2004
Expires: July 31, 2006
Total Amount: $485,362

Investigator: John Murphy, jbmurphy@jhu.edu
Company: Lubrijet, Inc
130 Starhill Lane
Baltimore, MD 21228
Phone: (410)516-5427

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop technology for prevention of nozzle wear in abrasive water jets, which limits the lifetime and accuracy of jet cutting, and currently requires entrainment of abrasives downstream of the nozzle in a larger mixing tube. The method consists of a porous nozzle surrounded by a reservoir containing high viscosity lubricant pressurized by the same pump that drives the slurry in the nozzle. The lubricant is forced through the porous walls by the pressure difference generated due to the high-speed slurry flow, and creates a thin film, which protects the nozzles' interior walls. Pilot tests have successfully reduced the nozzle wear by more than an order of magnitude. Two systems are being developed: A Porous Lubricated Mixing Tube (PLMT) that can be retrofitted into existing commercial systems, and a Porous Lubricated Abrasive Suspension Jet (PLAS-Jet) with premixed particles prior to injection. The latter enables operation at lower pressures, and cutting of harder materials with smaller jets (micro-machining). Extensive cutting and nozzle wear tests during Phase II will optimize the nozzle material, geometry and manufacturing procedures, and will determine the lubricant properties and injection rate. Other components will also be improved including the particle and lubricant feed systems.

The broader impact (commercial potential) of the proposed technology will be abrasive water jets that can be utilized for cutting and machining of sheet metal, ceramics and composites by diverse users, ranging from small machine shops to the automotive and aircraft industries. Wear of the mixing tube in present systems adversely affects all the applications of jet cutting by limiting the lifetime of the nozzle and accuracy of the cut, by causing machine-down time, and by preventing commercial applications of micro-jets. A PLMT retrofitted with minimal investment into the thousands of abrasive jet systems already in the market will greatly reduce these adverse effects. The PLAS-Jet with premixed particles has several additional advantages that reduce the cost and extend the applications of jet cutting technology. Cost reduction results from the lower pressure required for achieving the same cutting effect (e.g. 10000 vs. 50000 PSI), the more efficient use of the abrasives, and the less frequent replacement of nozzles. The lower pressures also simplify the development of compact portable systems for remote applications in hazardous environments, such as during decommissioning of nuclear plants, and for military applications, e.g. removal of mines and other obstacles. Furthermore, unlike mixing tubes, the PLAS-Jet diameter can be reduced to levels enabling expansion of jet cutting to precision micromachining.

Title: SBIR Phase II: Spray Forming Titanium Alloys Using the Cold Spray Process

Award Number: 0349787
Program Manager: Cheryl F. Albus

Start Date: February 15, 2004
Expires: January 31, 2006
Total Amount: $464,407

Investigator: Richard Blose, blose@ktech.com
Company: Ktech Corporation
2201 Buena Vista SE
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Phone: (505)998-5830

Abstract:

This Small Business Innovation Research Phase I project proposes to develop a new, low-cost methods for direct fabrication of metal parts at near-net shapes (NNS). This technology is critical for many industries and in particular, for manufacturing parts of expensive metals and alloys such as titanium. Such technologies have an impact on many industries because of the potential to quickly manufacture complicated parts with minimal waste. Currently used methods typically involve melting and solidification, which can cause high residual stresses, undesirable phases, and other problems. To solve the problems described a new method for spray forming is being used. This method is based on using the cold spray process avoiding undesired material, chemistry, and phase properties associated with thermal spray-forming methods. Studies conducted during Phase I demonstrated the feasibility of the cold spray process for rapid prototyping and direct fabrication of spray form shapes of Titanium alloys. The anticipated result of this activity is to deliver a technology yielding superior material properties of sprayed material and reduce cost of manufacturing.

The broader impacts of cold spraying near net-shapes technology could be very important technology for aerospace, including aircraft, military aircraft and spacecraft. This technology is promising for many other industries including automotive, medical, power, chemical, sport goods, and others. The proposed research activity will enhance scientific and technological understanding of the spray processes based on using high-speed particle flow.

Title: SBIR Phase II: Novel High-Temperature Molybdenum Alumino-Silicide Heating Elements for Advanced Manufacturing Processes

Award Number: 9983184
Program Manager: Winslow L. Sargeant

Start Date: June 15, 2000
Expires: May 31, 2003
Total Amount: $750,000

Investigator: Srinivas Penumella, r&d@mhi-inc.com
Company: Micropyretics Heaters International (MHI, Inc.)
613 Redna Terrace
Cincinnati, OH 45215
Phone: (513)772-0404

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop 2000 degree Centigrade (C) molybdenum alumino-silicide (Mo(Si,Al)2) heating elements for advanced manufacturing processes such as sintering, brazing, annealing, semiconductor processing, ceramic processing, and pyrolysis of solid waste. Current technology in heating elements permits temperatures only as high as 1850-1900 degree C. The main technical barriers are (1) spalling of the silica protective layer at 1850-1900 degree C, which exposes the bare MoSi2 to catastrophic oxidation, and (2) extensive weakening by rapid grain growth. Phase II will (1) use alloying elements to form oxidation-resistant ternary phase Mo(Si,Al)2, which leads to the formation of a stable (up to 2080 degree C) adherent alumina layer, and (2) add nano-scale alumina or zirconia (~ 40 nanometers) to stabilize grain growth. Two compositions in the molybdenum-alumino-silicon ternary alloy phase field were identified, synthesized, and tested in Phase I. A rapid heat-up 2000 degree C element would be a quantum leap in heating element technology and lead advances in high temperature manufacturing.

Rapid commercialization is expected because energy advantages and productivity (time wise) gains will accrue to the ceramic manufacturing, metal processing, compound semiconductor processing, glass processing, and joining industries. Total savings of nearly $40 million per year are anticipated in lower power consumption in the manufacturing industries that use this heating element technology.

Title: SBIR Phase II: Ceramic Cutting Tool for Titanium-Alloy Machining

Award Number: 9983385
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $399,512

Investigator: Tai-Il Mah, paiil.mah@afrl.af.mil
Company: UES, Inc.
4401 Dayton-Xenia Road
Dayton, OH 45432
Phone: (937)426-6900

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new ceramic material, yttrium-aluminum garnet (YAG), for cutting tools used in the machining of titanium (Ti) alloys. Phase I found it feasible to base a cutting tool on YAG, reinforced with silicon carbide (SiC) whiskers and TiC. Phase II will further explore the use of YAG-based composites as a cutting tool for Ti alloys through: 1) optimization of compositions and fabrication parameters to obtain a fully dense composite with uniformly dispersed reinforcement phases; 2) evaluate the optimized composite relative to state-of-the-art materials in machining Ti alloys; and 3) identify wear and failure mechanisms by detailed microstructural characterization of YAG-based composite cutting tools, before and after machining tests.

Potential commercial applications are expected in titanium-alloy machining operations in the aircraft and aerospace industries.

Title: SBIR Phase II: Rapid Fabrication of Titanium Boride (TiB_2) Anodes for Electrolysis of Aluminum

Award Number: 9983499
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: December 31, 2003
Total Amount: $650,000

Investigator: R Radhakrishnan, radha@matmod.com
Company: Materials Modification Inc.
2721-D Merrilee Drive
Fairfax, VA 22031
Phone: (703)560-1371

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop non-consumable and wettable titanium diboride (TiB_2)-based cathodes with near-theoretical densities and purity. Phase I demonstrated that titanium and boron powders could be reactively consolidated to produce near-theoretical density TiB_2 parts using plasma pressure compaction. A 4-inch diameter by 3/8-inch thickness near-net shape cathode will be fabricated for evaluation in Phase II, and a novel water jet nozzle and abrasive jet mixer tube will be developed based on TiB_2. Phase II will also develop zirconium dioxide (ZrO_2)- and titanium (Ti)-toughened titanium diboride composites for evaluation as cutting tools.

TiB_2 electrodes are expected to provide better performance, cost-effectiveness, a hazard-free workplace, and environmentally benign processing in aluminum production; and it is now thought that rapidly consolidated, near net-shape TiB_2 parts can also be used in cutting tools for hard metal machining, in mixing tubes for abrasive jets, and in nozzles for water jets.

Title: SBIR Phase II: Blind Fastener Inflation for Structural Joining of Aluminum

Award Number: 0078454
Program Manager: Cheryl F. Albus

Start Date: August 1, 2000
Expires: October 31, 2002
Total Amount: $349,922

Investigator: Jack Kolle, jkolle@tempresstech.com
Company: Tempress Technologies, Inc.
18858 - 72nd Avenue South
Kent, WA 98032
Phone: (425)251-8120

Abstract:

This Small Business Innovation Research (SBIR) Phase II project continues the development of a hyper-pressure fluid pulse system for installation of blind structural fasteners. Riveting is the preferred method of assembling load-bearing aluminum airframe structures. Upset riveting requires the application of high load to both ends of the rivet using impact or hydraulic pistons. A structural fastener that could be installed from one side of the structure - blind fastening - would simplify aircraft assembly and repair. Existing blind fasteners are expensive, time-consuming and do not match the corrosion and fatigue performance of upset rivets. Phase I of this project demonstrated that a compact, hyper-pressure pulse generator can inflate aluminum alloy rivets with an interference fit and strength approaching conventionally upset rivets. Blind fastening was demonstrated in unsupported aluminum panels. Phase I analysis showed that rivet inflation can be accomplished with a much smaller tool. The Phase II effort will involve the development of a lightweight, hand-held tool with an enhanced trigger mechanism that will provide the pulse control required for reliable fastener installation. The work will continue the development of techniques for inflating rivets with aluminum pins to form a solid, all-aluminum fastener.

The objective in Phase II is to meet the performance specifications for a fluid-tight aerospace structural rivet. Airframe assembly represents a major portion of the cost of military and commercial aircraft. The process to be developed will halve the cost of manual airframe fabrication and can be used in an automated flexible-manufacturing environment. There are a variety of other potential applications of hyper-pressure pulse technology including: fastening composite/titanium airframes; automotive aluminum sheet bonding; pulsed-jet peening for stress-relief and forming of aluminum sheet; and research into the behavior of materials under dynamic loading at extreme pressures.

Title: SBIR Phase II: Tricontinuous Diamond /Carbide/Metal Composite (TCCC) Cutting Tools for High Rate, High Precision Machining of Nonferrous Material, Composites, and Ceramics

Award Number	0078371
Program Manager:	Cheryl F. Albus
Start Date:	July 15, 2000
Expires:	June 30, 2003
Total Amount	$400,000

Investigator: Oleg Voronov, ovoronov@aol.com
Company: Diamond Materials Inc
120 Centennial Avenue
Piscataway, NJ 08854
Phone: (908)445-2245

Abstract:

This Small Business Innovation Research (SBIR)Phase II project will conduct research to develop a new class of cutting tools for high rate/high precision machining of Al-Si alloys, composites, and ceramics. Advanced cutting tools will improve machining economics in the automotive, aerospace and related industries. The new cutters will be made from a patent pending Tricontinuous Diamond/Carbide/Metal Composite (TDCC) material formed using high pressure/high temperature sintering technology. The potential of this TDCC technology was demonstrated in Phase I, wherein proof-of-principle TDCC cutters outperformed conventional PCD cutters and showed up to two times longer tool life in Al-Si alloy machining tests. In Phase II development of the TDCC sintering process will be carried out, with emphasis on demonstrating TDCC tool performance improvement, cost reduction, and quality control applicable for mass production. In addition development and performance demonstration of prototype cutting tools that use TDCC inserts are planned.

The primary objective of Phase II research will be to demonstrate the commercial feasibility of making machining tools using TDCC material. Collaboration with a leading automotive parts manufacturer, that will provide facilities and equipment for testing of the TDCC tools, has been arranged. This will help insure that the successful completion of the Phase II effort will lead to Phase III commercialization in the area of high rate / high precision tool manufacturing for automotive and other markets. Use of low wear high impact resistance TDCC tools will significantly impact the automotive and aerospace parts manufacturing industry allowing high transfer line speeds, lower operation count, and better surface finish which in turn will lead to improved production efficiency and lower product cost.

Title: SBIR Phase II: Copper Selective Silica-Polyamine Extraction Materials for Processing Copper Ore Leach Liquors

Award Number: 0109983
Program Manager: Rosemarie D. Wesson

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $500,000
Investigator: Robert J. Fischer, bfischerpsi@micro-mania.net
Company: Purity Systems, Inc.
3116 Old Pond Road
Missoula, MT 59802
Phone: (406)543-4228

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will investigate production of an exciting new material CuWRAM (Copper Waste Recovery from Aqueous Media). Evaluation of these pilot procedures will support the design of full scale manufacturing facilities. A processing system utilizing the patented ISEP separations hardware obtained from Calgon Carbon Corp. and CuWRAM as the extractant material for copper extraction and separation from iron (III) will be produced. Extensive testing will provide information to: (1) establish the effectiveness of the CuWRAM - ISEP system on real samples; (2) establish the economic feasibility of this system under various conditions; and (3) develop a targeted marketing strategy based on the first two items. Results from the Phase I project have generated excitement throughout the mining community. Initial testing on actual mining solutions will be conducted with one of the largest copper producers in the U.S.

Commercial applications for a CuWRAM copper extraction include use in the primary extraction circuit of copper mining operations, recovery of copper for reuse in copper plating processes and recovery of copper from remediation projects.

Title: STTR Phase II: Solid Freeform Fabrication Based Dental Reconstruction

Award Number: 0321712
Program Manager: Cheryl F. Albus

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $500,000

Investigator: Stephen M. Schmitt, sschm11977@aol.com
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P.O. Box 8042
Port Huron, MI 48061-8042
Phone: (210)887-3042

Abstract:

This Small Business Technology Transfer Phase II project will develop and optimize the Rapid Freeze Prototyping (RFP) technology, producing ice patterns used in investment casting to fabricate dental castings for crowns, bridges, implant-retailed restorations and other prostheses, as well as to integrate the developed RFP technology with commercial digital imaging and computer-aided design technologies into an Internet CAD/CAM dental restoration system.

The commercial and broader impacts of this project will be to provide a significant time and cost savings using the patented RFP technology compared with the hand-crafted process of pattern making currently used by the vast majority of dental laboratories. Hundreds of thousands of dental castings are made each year by hand. The high labor cost of making these castings makes the dental market ideal for the application of the proposed RFP technology and other allied CAD/CAM technologies.

Title: SBIR Phase II: Detection Systems for High-Speed Optoelectronic Sortation of Low Z Metal Alloys

Award Number: 0321298
Program Manager: Cheryl F. Albus

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $499,991
Investigator: Leigh A. Peritz, lapwte@aol.com
Company: wTe
7 Alfred Circle
Bedford, MA 01730-2349
Phone: (617)275-6400

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a novel prototype optoelectronic sensing system for the high-speed identification and sorting of metals, particularly aluminum alloys. The goal is to develop the capability to sort aluminum into its exact alloy designations. The technology is expected to sort materials in less than 50-milliseconds per item automatically without operator intervention while the scrap is in motion on a high-speed conveyor belt. The scrap recycling industry reports that more than 30 billion pounds of nonferrous metals are produced each year in the U.S. alone. The U.S. Environmental Protection Agency (USEPA) reports that more than 10 billion pounds of these nonferrous metals are discarded each year in landfills, because recycling is either technically or economically impractical. Existing methods of sortation that employ visual examination and hand sortation, or alternatively employ heavy media separation, cannot sort aluminum by alloy type. Refining is accomplished in smelting facilities that are expensive to build and often polluting. Using advanced spectrographic detection techniques, including computer analysis; the proposed technology will improve alloy identification accuracy and automatically sort aluminum metal alloys at speeds never before attainable.

The commercial impact of this project will be increased scrap utilization, increased scrap value, reduced pressure on non-renewable resources, and reduced environmental pollution. The potential worldwide market exceeds $2 billion annually.

Title: SBIR Phase II: A Process for Preparing Nanometer-Sized Ceramic Particles at High Production Rates

Award Number: 0131395
Program Manager: Cheryl F. Albus

Start Date: March 1, 2002
Expires: February 29, 2004
Total Amount: $500,000
Investigator: Wen C. Huang, Huang2001@yahoo.com
Company: Nanotek Instruments, Inc.
1214 43rd St. NW
Fargo, ND 58102
Phone: (701)277-1772

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize a new technology for mass-producing nanometer-sized ceramic powders at dramatically reduced costs. The technology, Combined Atomization and Reaction Technique (CART), involves providing an atomizing gas medium containing a reactant element such as hydrogen, oxygen, carbon, nitrogen, chlorine, fluorine, boron, or sulfur; preparing a metal alloy melt super-heated to a spontaneous reaction temperature at which the alloy can undergo a self-sustaining reaction with the selected reactant element; and introducing reactant gas to concurrently mix, atomize, and react with the critically super-heated alloy melt to form ultra-fine ceramic particles in an atomizer chamber. This Phase II project will design and build a prototype pilot-scale CART apparatus to demonstrate the commercial viability of the technology as applied to the synthesis of nano-sized oxides of selected metals that are deemed to have the greatest commercial potential.

The commercial potential of ultrafine powders are in the production of catalysts, coatings and films, conductive pastes, cosmetics, electromagnetic components, electronic devices, fire retardant materials, magnetic fluids, sintered and injection-molded parts, ceramic composites, magnetic storage media, phosphors, pigments, polishing media, and toners. Indium-tin oxide (ITO) powders are used to prepare sputtering targets for deposition of transparent films for use in flat-panel display technology. Nano-grained materials can be employed to replace various load-bearing and non-structural parts in automobiles, infrastructures, offshore structures, piping, containers, electronic equipment housings, etc. Nano-grained cermets and ceramics are outstanding cutting tool materials. Transparent nano-grained ceramics can be utilized in a broad array of applications, including transparent ceramic appliance components, clear "glassware" and artistic artifacts. Transparent ceramics may also be used in ballistic protection armor by law enforcement, security police and armored car personnel.

Title: SBIR/STTR Phase II: Rapid, Low-Cost Processing of Continuous Fiber-Reinforced Ceramic Composites

Award Number: 0132134
Program Manager: Cheryl F. Albus

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $499,756

Investigator: Stuart T. Schwab, stschwab@thortech.biz
Company: Thor Technologies, Inc.
P.O. Box 5188
Albuquerque, NM 87185-5188
Phone: (505)348-4980

Abstract:

This Small Business Technology Transfer (STTR) Phase II Project will validate the polymer infiltration/microwave pyrolysis (PIMP) process and ceramic product whose feasibility was demonstrated in Phase I. The Phase I project demonstrated a reduction in pyrolysis time of greater than 90%; the Phase II project will confirm a corresponding cost reduction. During the Phase I, a strategic partnership with a major original equipment manufacturer (OEM) was established. The Phase II project will reference the process to produce ceramic parts for a specific commercial application, and will validate the weight and performance enhancements projected in Phase I. The PIMP process will be expanded to the pilot plant scale, and with the collaboration of the OEM and a business development specialist.

Commercial applications exist for fiber-reinforced ceramics, if they can be produced at low cost. The potential applications range from gas-fired turbine engines for power plants and aircraft to brakes, waste incineration and chemical production

Title: SBIR Phase II: Volumetric Microbatteries Using Soft Lithography

Award Number: 0239326
Program Manager: Cheryl F. Albus

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,996

Investigator: Charles D. E. Lakeman, clakeman@tplinc.com
Company: TPL, Inc.
3921 Academy Parkway North, NE
Albuquerque, NM 87109-4416
Phone: (505)342-4471

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop novel microbatteries. As microsystems emerge from the lab into applications such as implantable medical devices, smart surgical tools, and discrete, autonomous sensors, there is a critical need for power systems of a similar physical size (a few cubic mm or smaller) to the new miniaturized systems themselves. The microbattery developed under the Phase I effort exploits a volumetric approach to deliver power with a minimum volume and a minimum footprint. Compared with thin film batteries, which are surface area devices requiring a large footprint to achieve useful capacities. These novel devices meet the need for a small self-contained source of electrical power. The objective of the project will be to reduce the critical dimensions of the device to the order of 1mm, fully characterize their performance, and develop production and assembly procedures to manufacture integrated devices.

The commercial and broader impacts of this technology will be to emerging new devices based on microsystems technology (devices containing microelectronics and MicroElectroMechanical Systems, (MEMS)) such as implantable medical devices, microsensors for broad area surveillance, and microsatellites.

Title: SBIR Phase II: ELEX - Innovative Low-Cost Manufacturing Technology for High Aspect Ratio Microelectromechanical Systems (MEMS)

Award Number: 0216665
Program Manager: Cheryl F. Albus

Start Date: November 1, 2002
Expires: October 31, 2004
Total Amount: $497,929

Investigator: Adam L. Cohen, acohen@memgen.com
Company: MEMGen Corporation
1103 W. Isabel St.
Burbank, CA 91506-1405
Phone: (818)295-3996

Abstract:

This Small Business Innovation Research Phase (SBIR) II project will further develop ELEX (Electro-Extrusion) which is a manufacturing process for prototyping and batch manufacturing high-aspect ratio microelectromechanical systems (MEMS) and related microparts and microstructures. The goal is to replace (in many applications) the so-called LIGA process, which is an electrodeposition-based technique, requiring the use of a clean room and synchrotron.

The commercialization potential of this project to the MEMS industry will provide a dramatic reduction in cost and time, which will greatly accelerate the commercialization of MEMS and other microscale devices.

Title: SBIR Phase II: Innovative And Cost-Effective Process for Net-Shape Microfabrication of Ceramic Components

Award Number: 0321692
Program Manager: Cheryl F. Albus

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $499,759
Investigator: Balakrishnan G. Nair, bnair@ceramatec.com
Company: Ceramatec
2425 South 900 West
Salt Lake City, UT 84119-1517
Phone: (801)978-2121

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a ceramic hydrogen fuel appliance (CHFA) using ceramic microreactor modules (CMMs) using a low-cost, net-shape manufacturing process, and a new material, that was developed in the Phase I project. The new material developed was demonstrated to have excellent capability for cost-effective microfabrication of ceramic components with sub-micrometer precision. Further, it has good materials properties, including very high component surface area and thermochemical stability to temperatures as high as 1000 degrees C, that make it an ideal material for fabrication of CMMs.

The commercial and broader impacts of this technology will be as hydrocarbon fuel reference that supply hydrogen to fuel cells used as auxiliary power units (APUs) on board automobiles/trucks.

Title: SBIR Phase II: A Novel Joining Process for Tubular Structures in Automotive and Aerospace Applications

Award Number: 0132096
Program Manager: Cheryl F. Albus

Start Date: April 1, 2002
Expires: March 31, 2004
Total Amount: $495,399

Investigator: Wentao Cheng, wcheng-emc2@columbus.rr.com
Company: Emc2
3518 Riverside Drive
Columbus, OH 43221-1735
Phone: (614)459-3200

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize the Magnetic Pulse Welding (MPW) system, a novel materials joining process. The goal is to establish MPW as a reliable and economic method to weld tubular structures. The project will conduct research and engineering that will address the critical technical hurdles for the commercial implementation and dissemination of the new welding technology.

The commercial applications would revolutionize the assembly process of the hydroformed tubular structures in automotive chassis and space frame applications. This process will promote the hybrid automotive body structure design that uses tubes of both aluminums and steels and will enable joining of different materials such as titanium to superalloys for aerospace and electronic applications.

Title: SBIR/STTR Phase II: Development of High Efficiency NanoFilter Media

Award Number: 0132118
Program Manager: Rosemarie D. Wesson

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $499,999

Investigator: Jayesh Doshi, nanofiber@aol.com
Company: eSPin Technologies, Inc.
100 Cherokee Blvd., Suite 325
Chattanooga, TN 37405-3860
Phone: (423)870-9994

Abstract:

This Small Business Innovation Research Phase II project will demonstrate using a prototype design the commercial feasibility of electrospinning to produce nanofibers. Nanofibers will be combined with conventional filter media to form a novel NanoFilter media for liquid and air filtration applications. These applications have been shown to remove particles smaller than 3 microns from effluent streams with superior filtering efficiency and attractive cost potential. The acrylic nanofibers will be electrospun as a nanoweb directly on to a conventional support (filter media) substrate. The web will be combined with a protective cover layer to form a sandwich structure, which will be collected as a roll. The filter will be easily tailored to achieve the desired composite filter performance by varying architecture: substrates, nanofiber diameter, nanoweb density, and the nanoweb thickness. This project will be carried out collaboratively with academic centers and major corporations as its strategic partners. Nanotechnologies developed in the coming years will form the foundation for a significant commercial platform.

Commercial applications in a variety of filtration processes such as: high-end industrial raw material purification, biological separations, ultra pure air and water systems, hospital clean rooms, agriculture and food industries filters, and microelectronic industries next generation clean environment needs are anticipated.

Title: SBIR Phase II: Photo-Curable Silicon Oxycarbide Fiber for Diesel Engine Particulate Filters

Award Number: 0239336
Program Manager: T. James Rudd

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $500,000
Investigator: Edward J. Pope, matech@thegrid.net
Company: MATECH Advanced Materials
31304 Via Colinas Ste 102
Westlake Village, CA 91362-3901
Phone: (818)991-8500

Abstract:

This Small Business Innovation Research Phase II project will scale-up a manufacturing process for curable preceramic polymers in the fabrication of high yield and low cost Silicon Oxycarbide (SOC) fibers and bonded fiber mats for diesel engine particulate filters. In the Phase I effort, SOC fibers and fiber mats were successfully fabricated and the critical materials properties required for the diesel particulate filter application were attained. This development represents the first Silicon Oxycarbide glass-ceramic fibers to be fabricated from curable poly (dimethyl) siloxanes. In addition, the photo-curable and chemically-curable polysiloxane preceramic polymers demonstrated also have potential as a binder or matrix phases for other structural composites. This Phase II effort seeks to optimize fiber mat production techniques through collaboration with Cummins Engine Company's subsidiary Fleetguard/Nelson (FGN), the world's largest manufacturer of filters for the automobile and truck market.

In the project, critical factors related to automated manufacturing, process scale-up, fiber mat performance characteristics, and performance testing will be addressed to ensure a smooth transition to a commercial product. The diesel particulate filter (DPF) market will grow dramatically due to EPA requirements that all diesel vehicles be equipped with diesel particulate filters by 2007, thereby significantly improving the nation's air quality. The diesel manufacturing industry in North America now exceeds $85 billion in gross output annually. Total U. S. "on road" vehicles requiring DPF's will exceed 3 million units annually, resulting in a potential on road market size of in excess of $6 billion per year. The DPF product to be scaled up in this project has comparable performance to the current extruded ceramic honeycomb filter but with a projected unit cost of about one-tenth. This will have a dramatic impact on diesel filtration system costs with substantial environmental, energy, and trade deficit benefits.

Title: SBIR Phase II: Magnetohydrodynamic Formation of Metal Monospheres

Award Number: 0132241
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2002
Expires: January 31, 2004
Total Amount: $499,999
Investigator: Robert C. Dean, Jr., RCD@Synnovations.com
Company: Synergy Innovations, Inc.
10 Water Street, Rm. 405
Lebanon, NH 03766
Phone: (603)448-5454

Abstract:

This NSF Small Business Innovation Research Phase II project continues research and development of a commercial process for the manufacture of mono-size-dispersed, spherical powder (size 1-10 micron) from metals melting up to 200C. A unique magnetohydrodynamic (MHD) jet exciter will be designed, fabricated and developed as a component of the system essential to producing monosphere powder to high tolerances (e.g., as demanded by the electronics industry of ball grid arrays for surface-mount components). The electrostatic means, for preventing coalescence in the drop cloud, will be developed further. Development of cooling means for solidification will be completed. Specific industry quality control standards and testing will be applied to qualify the monosphere product. Finally, a referenced analysis of cost of manufacture, and a complete business plan will be produced. The outcome expected from this project is the technology base for the commercial, large-scale production of monospheres. This unique process innovation for large-scale production of monospheres, will provide a major new source of precise and economical powder for electronic solder balls and paste, powder metallurgy, composites, magnetorheological fluids, catalyst carriers, solid/fluid reactions and a multitude of other uses.

Title: SBIR Phase II: A Multilevel Method for Rapid Evaluation of Sound Fields

Award Number: 0548629
Program Manager: Rosemarie Wesson

Start Date: December 29, 2005
Expires: December 31, 2007
Total Amount: $499,706
Investigator: Rajendra Gunda, rajendra.gunda@ansol.com
Company: Advanced Numerical Solutio
3554 Mark Twain Ct.
Hilliard, OH 43026
Phone: (614)771-4861

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to extend the current high frequency limit of acoustic analysis by two orders of magnitude and facilitate numerical simulation of extremely large sound structure interaction problems. The proposed method will advance the state of the art in numerical acoustics by integrating the Fast Multipole Method (FMM) with the direct and indirect formulations of the Boundary Element Method (BEM).

The FMM-BEM technology reduces analysis time in computational acoustics by two orders of magnitude. Accurate acoustic analysis of automotive and aircraft interiors in the entire audible frequency range will become practical for the first time. The technology will also allow detailed computation of the acoustic characteristic of submarine hulls, and quantitative assessment of the occupational safety concerns of workers subjected to jet engine noise at airport ramps.

Title: SBIR Phase II: Modular Oxygen Enrichment Device to Improve Combustion Efficiency

Award Number: 0548714
Program Manager: Rosemarie Wesson

Start Date: December 13, 2005
Expires: January 31, 2008
Total Amount: $506,000

Investigator: David Walker, sdgroup@separationdesign.com
Company: SDGroup
931 Rolling Meadows Road
Waynesburg, PA 15370
Phone: (724)852-1035

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an innovative modular oxygen enrichment system. It is accepted that the reduction of cycle time can lead to a concurrent decrease in the mass of a sorptive separation system. However, ultra-rapid-cycle systems invariably create mechanical and physical challenges. Specifically, limiting factors are the operational lifetime of the mechanical components, and the micro diffusion rate of the adsorbent system. This project will remove these limitations by replacing mechanical valves with electro-kinetic pumps, and by utilizing microscale adsorbent structures that radically improve diffusion rates.

Conventional air separation units exhibit a poor mass/output ratio, which contributes to high cost. Oxy-air combustion offers the possibility of significant fuel savings and other environmental benefits. The broad impact of this research is not only fuel savings attainable from improved combustion efficiency, but also application to other processes where oxygen is the rate limiting factor. Fuel cells, aquaculture, biomass conversion, and water treatment will also profit from this exportable technology.

Title: SBIR Phase II: Non-Traditional Material Removal

Award Number: 0548735
Program Manager: George Vermont

Start Date: January 23, 2006
Expires: January 31, 2008
Total Amount: $337,214
Investigator: Aric Shorey, shorey@qedmrf.com
Company: QED
1040 University Ave
Rochester, NY 14607
Phone: (585)256-6540

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop abrasive jet technology for manufacturing/finishng microoptics. Abrasion is accomplished by shear flow at the surface of the substrate submerged in an abrasive suspension and impinged upon by a bubble jet. This technology will allow the precision finishing of surfaces with an aperture size as small as 1 millimeter, and provide a scientific basis for, and demonstrate the feasibility of, new technology for optics fabrication.

Enabling the finishing of small, high precision molds and lenses will allow manufacture of higher resolution cameras for camera phones and other consumer products, and for medical and surveillance devices.

Title: SBIR Phase II: Powder-Powder Mixing and Powder-Liquid Mixing by a Novel High-Intensity Vibrational Mixer

Award Number: 0548753
Program Manager: Joseph Raksis

Start Date: February 14, 2006
Expires: January 31, 2008
Total Amount: $460,987

Investigator: Joel Pierce, jpierce@resodyn.com
Company: Resodyn Corporation
130 N Main St Ste 600
Butte, MT 59701
Phone: (406)497-5252

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will enable the development of a high intensity, low frequency resonant-acoustic mixer for industrial uses, focusing on the incorporation of solid powders into liquids. Since there are no mixing blades or moving parts, issues of clean up and cross-contamination are minimized. The work will expand the scientific understanding of powder-liquid mixing in a high intensity resonant acoustic field, and provide an alternative mixing approach for emerging nano-sized materials.

Outcomes of the work will be a deeper understanding of the powder mixing phenomenon and a knowledge base for the design and optimization of complete industrial mixing systems.

Title: SBIR Phase II: Advanced Laser Patterning of Large Area Thin-Film Electrochromic Devices

Award Number: 0618631
Program Manager: Joseph Raksis

Start Date: July 13, 2006
Expires: June 30, 2008
Total Amount: $497,013
Investigator: Harvey Kalweit, hkalweit@sage-ec.com
Company: SAGE Electrochromics Inc
One Sage Way
Fairbuilt, MN 55021
Phone: (507)331-4902

Abstract:

This Small Business Innovation Research (SBIR) Phase II project has the objective of developing and transfering to the production line laser ablation technology for the manufacture of large area thin-film electrochromic (EC) windows. Shadow masking is commonly used to pattern the electrochromic coatings on glass, but it results in unacceptable edge definition and is expensive. Laser ablation can replace masking to allow precise definition of window areas, regardless of size and shape, and has the potential to significantly reduce manufacturing costs.

Broader acceptance of electrochromic windows for commercial and residential buildings will enable significant energy savings, and the laser ablation technology is applicable to non-flat shapes, which could extend use of EC windows to other applications.

Title: SBIR Phase II: Ultrahigh-Pressure Flash Abrasive-Waterjets for Precision Machining

Award Number: 0620277
Program Manager: Joseph Raksis

Start Date: August 11, 2006
Expires: August 31, 2008
Total Amount: $345,708

Investigator: Peter Liu, peterl@omax.com
Company: OMX
21409-72nd Ave S
Kent, WA 98032
Phone: (253)872-2300

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and optimize a flash abrasive-waterjet for precision machining of delicate materials. The use of water in a phase change mode will offer advantages over abrasive waterjets, that can damage delicate materials, and liquid nitrogen abrasive cryogenic jets, that require expensive equipment.

The technology will be most useful for manufacturing parts with complex geometries from composites, glasses, laminates and other advanced materials, for use in the aerospace, electronics and defense industries.

Title: SBIR Phase II: Advanced Tonnage Analysis System for Forging Processes

Award Number: 0620436
Program Manager: Rathindra Dasgupta

Start Date: September 1, 2006
Expires: August 31, 2008
Total Amount: $500,000

Investigator: Tzyy-Shuh Chang, chang@ogtechnologies.com
Company: OG Technologies, Inc.
4300 Varsity Dr Suite C
Ann Arbor, MI 48108
Phone: (734)973-7500

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will develop an advanced tonnage signal processing system for the forging industry. This system will utilize advanced signal processing methods and statistical control techniques to distinguish between normal (in-control) and abnormal (out-of-control) tonnage signals, detect faulty process conditions (cold die, die wear, mismatch, improper lubrication, etc), and to conduct real-time process monitoring in the forging process.

The use of the advanced tonnage signal analysis system will contribute to reduction in energy consumption and carbon emissions, and improved tool (die) life in the forging process. This system also has the potential to be used in other deformation processes including rolling, stamping, extrusion, and drawing.

Title: SBIR Phase II: Long-Life Nozzles for Abrasive-Slurry-Jet Cutting

Award Number: 0622266
Program Manager: Rathindra Dasgupta

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $471,821

Investigator: Robert Dean, RCD@Synnovations.com
Company: Synergy Innovations, Inc.
10 Water St Ste 324
Lebanon, NH 03766
Phone: (603)448-5454

Abstract:

The Small Business Innovation Research (SBIR) Phase II project will develop a high-pressure abrasive slurry jet cutting tool for almost all materials. The key aspect of this innovation is the elimination of nozzle grit erosion by fluid dynamic means. Past attempts to use abrasive slurry cutting tools have been troubled by unacceptable wear of the nozzles by the abrasive, and the associated loss of the abrasive.

The successful development of this technology will lead to a new generation of cutting equipment with reduced operating times and costs. This project will also provide internship opportunities for college undergraduates.

Title: SBIR Phase II: Low Cost Pressure Infiltration Casting Process to Support High Volume Manufacture of Graphite-Metal Thermal Management Components

Award Number: 0646263
Program Manager: Rathindra DasGupta

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $499,963
Investigator: James Connell, jconnell@charter.net
Company: Advanced Thermal Technologies
91 S. Streeet
Upton, MA 01568
Phone: (508)529-4413

Abstract:

The Small Business Innovation Research (SBIR) Phase II project seeks to develop the use of a gas pressure infiltration casting process to manufacture graphite-metal billet materials that would be used to produce components for high power electronic device packaging. The heat dissipation rate of electronic devices has increased dramatically as a result of advances in semiconductor materials, faster switching speeds, compression of circuit physical architecture, and miniaturization of device envelops. These market trends are expected to continue and there is a critical need for advanced materials with improved thermal conductivity capable of meeting the package heat dissipation requirements of current and future high power electronic systems. In addition the materials will need to have a coefficient of thermal expansion (CTE) that minimizes the CTE mismatch that occurs at the interface between packaging components of different materials. The objective of the Phase II effort is the development and demonstration of cost-effective package assemblies that incorporate graphite-metal components with a thermal conductivity of from 500 to 600 W/m-oK and a coefficient of thermal expansion that can be adjusted between 5.0 and 10 ppm/oC.

The markets for packaging products based upon the graphite-metal material technology include: (1) RF power amplifiers for communications systems; (2) switching devices for power conversion systems; and (3) light emitting diode devices for solid state lighting. The research will produce the key knowledge required to enable the production of low-cost, high-volume graphite-metal components to satisfy the packaging requirements for the above applications. The packaging products supported by this manufacturing technology will benefit a broad spectrum of commercial, industrial, and military high power electronics end users. The adoption and wide-spread use of the graphite-metal packaging products for electronic systems will enable commercial electronic devices based upon more efficient higher power semiconductor materials that will provide benefit to society in the form of reduced energy consumption and improved environmental quality.

Title: STTR Phase II: Predictive Molding of Precision Glass Optics

Award Number: 0646503
Program Manager: Rathindra DasGupta

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $499,757

Investigator: Yazid Tohme, tohme@nanotechsys.com
Company: Nanotech
426A Winchester St
Keene, NH 3431
Phone: (603)352-3030

Abstract:

The Small Business Technology Transfer Research (STTR) Phase II project will develop physics based computational models of the glass molding process that accurately predict the shape of the optic from knowledge of the mold geometry, the material properties of the glass, and the molding parameters. The computational models will be developed through systematic characterization of the properties of glasses at high temperatures, and incorporation of the viscoelastic response of the glass with thermal expansions and elastic deflections of the mold and glass. This project will also develop user interface software capable of building the finite element (FE) model directly from user input of coefficients of the industry-standard Asphere Equation and translating results of the FE analysis into Asphere coefficients.

The computational tools developed in the proposed research will eliminate the current need for production of more expensive trial mold geometries before discovering the proper mold geometry and processing parameters required to produce in-tolerance optics. The proposed research will allow manufacture of opto-electronic products with superior capabilities compared to those available today. In addition, the project will contribute to the development of science and engineering workforce through training of graduate students at the University of Florida and Clemson University.

Title: SBIR Phase II: Micro-quantity Internal Cooling (MQuIC) of Cutting Tools for Increased Productivity via Micro-ducts

Award Number: 0646365
Program Manager: Cheryl F. Albus

Start Date: March 15, 2007
Expires: February 28, 2009
Total Amount: $499,951
Investigator: William Endres, wjendres@endresmachining.com
Company: Endres Machining Innov.
1402 E Sharon Ave, Ste 1001
Houghton, MI 49931
Phone: (906)487-9364

Abstract:

This Small Business Innovation Research (SBIR) Phase II research aims to develop and commercialize cutting tools with internal micro-geometric features to provide relatively direct and localized cooling of the tool-chip contact zone. The proposed innovation is (i) incorporation of micro-scale internal features and (ii) a production process that can provide high-volume manufacturing of these modified cutting tool inserts. Conventional approaches of using coatings for effective cooling during machining have limited effectiveness, but the proposed approach is claimed to provide a novel method of providing internal cooling mechanism to machine difficult-to-machine (DTM) materials.

If successful, this technology will enable better tool-life during the machining of hard-to-machine materials at finish feeds, which can have tremendous impact for machining of DTM alloys. By requiring minimal coolant use due to effective heat transfer from machining operation, the research will lead to new manufacturing methods with a positive impact on environmental pollution.

Manufacturing Process Control

Title: SBIR Phase II: High Sensitivity Raman Spectrometer

Award Number: 0110453
Program Manager: Rosemarie Wesson

Start Date: August 15, 2001
Expires: June 30, 2003
Total Amount: $499,997

Investigator: Stuart Farquharson, stu@rta.biz
Company: Advanced Fuel Research Inc
87 Church Street
East Hartford, CT 06138
Phone: (860)528-9806

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will design, build, and test a hybrid Raman analyzer suitable for "on-demand" or continuous process monitoring. The Phase I project demonstrated feasibility by designing and testing a unique combination of components that yielded greater than 100 times improvement in sensitivity (defined as the signal-to-noise ratio) compared to traditional Raman analyzers. The novel design also demonstrated high resolution (1 cm -1), invariant wavelength stability, and freedom from fluorescence interference; which are critical requirements for autonomous chemical process monitoring or rapid raw-material identification. The Phase II project will further improve sensitivity, as well as demonstrate long-term temperature and vibrational immunity, and fast "turn-on" time. Complete internal analyzer diagnostics will allow greater than 1000 hours of unattended operation. As such, the analyzer will be rugged, compact and portable (10"x 12" footprint), low-maintenance, require minimum power, and suitable for numerous industrial applications.

The commercial applications will be directed toward the chemical manufacturing industries. The Phase II prototype will be used to develop specific applications with customers during Phase III.

Title: SBIR Phase II: High Speed Optoelectronic Recognition of Al, Si, and Mg Alloys

Award Number: 0450452
Program Manager: Joseph E. Hennessey

Start Date: January 1, 2005
Expires: December 31, 2006
Total Amount: $499,998

Investigator: David Spencer, dbswte@aol.com
Company: wTe Corporation
7 Alfred Circle
Bedford MA, 01730
Phone: (617)275-6400

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will apply an optoelectronic detection system into an integrated high-speed manufacturing system aimed at commercial identification and sortation of aluminum scrap by alloy type - particularly aluminum alloys containing various alloying elements such as silicon and perhaps magnesium. The goal of the program is to commercially sort mixed aluminum alloys from an automobile shredder. Commercial technologies in existence today sort automobile shredder nonferrous metals based on density, but there are no technologies in commercial operation that sort the metals into 1) cast and wrought alloys, 2) various aluminum alloy series (100, 200, 3000, 7000 etc.), or 3) into individual alloy types. Sorting aluminum alloys based on chemical composition is the objective of this SBIR Phase II program. A very sophisticated, proprietary sensor and detection system has been developed and demonstrated in Phase I in order to demonstrate the capabilities of the technology.

The broader impacts (commercial potential) of this proposed technology has the potential to transform the efficiency and utilization of scrap metal in the U.S. In 2001, the aluminum industry consumed nearly 800 trillion Btu, was responsible for 1.8% of the total manufacturing energy consumed, emitted 43.5 million tons of CO_2, and consumed 1.6% of all U.S. electricity - mostly from primary production. Secondary production is much more efficient - economically and environmentally. Recovering aluminum from scrap consumes only about 6% of the energy required to produce primary aluminum and requires only 10% of the capital. In spite of efficiencies in making aluminum from scrap, exports in 2003 were 562,090 million tons because the industry could not utilize much of its low-grade scrap. This technology will allow utilization of this scrap in existing U.S. plants because the scrap will be converted from low-grade to high-grade scrap which is more consistent with U.S. consumption and needs. The result will be job preservation, reduced emissions, reduced energy needs, reduced raw material imports, and a better balance of payments.

Title: SBIR Phase II: Two-Wavelength Thermal Imaging Solutions to Materials Process Control Needs

Award Number: 9983275
Program Manager: Winslow L. Sargeant

Start Date: July 15, 2000
Expires March 31, 2004
Total Amount: $513,288

Investigator: James Craig, Info@stratonics.com
Company: Stratonics Inc
23151 Verdugo Drive Ste 114
Laguna Hills, CA 92653
Phone: (949)461-7060

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype two-wavelength imaging pyrometer. To monitor high-temperature materials processes, it uses an indium gallium arsenide (InGaAs)-based camera. Two-wavelength imaging uses intensity ratios to provide accurate temperature measurement of objects with emissivity variation. Single wavelength imaging sensors mistake absolute intensity changes, caused by emissivity variation, for temperature changes. Temperature is a central parameter in many high-temperature materials processese. Long production runs require temperature control for consistent product quality. This thermal imaging sensor is expected to meet industry needs for accuracy, low temperature operation, and low cost.

Phase II will develop a 'research grade' imaging pyrometer for use in specialized laboratory experiments and a 'ruggedized grade' imaging pyrometer for testing in industrial facilities. Potential commercial applications of the thermal imaging sensor (with its 1-2 mm sensitivity) are expected in industrial process control sensors for high temperature materials processing.

Title: SBIR Phase II: Chatter Avoidance Software for High Speed Milling

Award Number: 0078904
Program Manager: Cheryl F. Albus

Start Date: September 1, 2000
Expires: August 31, 2002
Total Amount: $424,000
Investigator: Donald Esterling, don@vulcancraft.com
Company: VulcanCraft
201 Stable Road
Carrboro, NC 27510
Phone: (919)942-0423

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will integrate a novel, inexpensive device to measure tool dynamics with a general purpose analysis program that will optimize the use of high speed machining centers as a routine shop floor practice. High speed machining is often limited by chatter conditions. These conditions depend on system dynamics and cutting conditions. The product to be developed will provide an integrated hardware/software solution to assist users in selecting optimal spindle speeds and tool depths without the intervention of experts or specialized equipment. The product will handle general tool geometries, tool paths and in-process part geometries working in conjunction with an industrial grade NC verification program.

The program will specifically provide recommendations under low tool immersion (light cut) conditions that are commonly used to avoid tool wear in hard materials. Novel aspects include: (1) the study of chatter under transient conditions; (2) sculptured surface parts; (3) a new analytical solution that provides important physical insights under low tool immersion conditions; (4) a new simulation model that is not restricted to uni-directional feed; and (5) the extension of a new measurement device to provide full tool dynamic data.

Title: SBIR/STTR Phase II: Machine Vision System for Automated Imaging and Process Control

Award Number: 0132025
Program Manager: Cheryl F. Albus

Start Date: February 15, 2002
Expires: January 31, 2004
Total Amount: $499,994
Investigator: Steven D. Summers, ssummers@tplinc.com
Company: TPL, Inc.
3921 Academy Parkway North, NE
Albuquerque, NM 87109-4416
Phone: (505)342-4471

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an entirely new form of machine vision technology for process control of metallic components. The technology is based on an array of giantmagnetoresistance (GMR) sensors that produce high-resolution images of hidden defects, missing parts, and other features. Minute GMR sensors detect magnetic fields associated with eddy currents induced in the component being imaged. High spatial resolution images are achieved through the high density and small size of the sensors in the array, coupled with the high sensitivity, low noise, and fast response of the sensors. A GMR sensor array, combined with a magnetic field generator, can produce high resolution, three-dimensional images of parts as they are produced, using a rugged, non-contacting sensor system. The images provide on-line feedback for process control, quality assurance, and safety protocols. The Phase I project developed functional GMR sensor arrays, and successfully imaged defects in metallic parts clearly demonstrating that the technology is feasible.

The commercial potential of the proposed technology will be in manufacturing, quality assurance (QA), and process control. It will be used for rapid imaging and inspection of parts used in electronics, aerospace, automotive, transportation, construction, biomedical and other industries.

Title: SBIR Phase II: Reference Electrode with an Invariant Liquid Junction Potential

Award Number: 0110520
Program Manager: Cheryl F. Albus

Start Date: August 1, 2001
Expires: July 31, 2004
Total Amount: $497,215

Investigator: Scott T. Broadley, sbroadley@broadleyjames.com
Company: Broadley-James Corporation
19 Thomas
Irvine, CA 92618
Phone: (949)829-5524

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a long-lived, stable Reference electrode that dramatically improves potentiometric measurements, such as pH, redox, and other ion-specific measurements. The new Reference electrode exploits recent developments in microfluidics and nanotechnology to stabilize the liquid-junction potential, a source of error and a cause of frequent sensor calibration and maintenance. Stabilizing the liquid-junction potential of the Reference electrode opens a new realm of potentiometric sensor design and application. The technical feasibility of this innovative electrode was demonstrated in the Phase I project. Testing in a variety of environments showed variations less than 0.5 mV in the Reference electrode potential over an 8 hour period and response times less than 60 seconds, compared to potential variations up to 20 mV and response times of over an hour for conventional Reference electrodes. The flow of electrolyte through the junction was less than 0.1 l per minute, or 50 ml per year of continuous operation. The Phase II project will develop assembly processes, more robust structures, and develop and build sensors for field-tests.

The potential commercial application reduction in sensor calibration and sensor replacement would save the US process industries approximately $240 million per year in sensor costs and labor expenses. Exports of US manufactured sensors with this technology will significantly increase as foreign process industries seek similar cost savings. Furthermore, this Reference electrode can serve as a basic building block in microfluidic sensors, estimated to be a multi-billion dollar industry in the next decade.

Title: SBIR Phase II: Integrated Diagnostics for Operations and Maintenance of Installed Systems

Award Number: 0078670
Program Manager: Cheryl F. Albus

Start Date: January 1, 2001
Expires: December 31, 2004
Total Amount: $773,404

Investigator: Carole Teolis, carole@technosci.com
Company: Techno-Sciences, Inc.
10001 Derekwood Lane
Lanham, MD 20706
Phone: (301)577-6000

Abstract:

This Small Business Innovation Research Phase II project will focus on enhancing maintenance operations scheduling methodologies with condition assessment and diagnostic tools to produce an 'integrated' maintenance management system. The company has developed scheduling tools that allocate maintenance resources on the basis of elapsed calendar time and unit utilization. This project will augment these tools with condition assessment modules. If successful, the result would be a generally applicable system combining condition, time, and utilization as drivers for the maintenance process. The project will develop algorithms for condition assessment based on signal processing and feature extraction using both conventional sensors such as accelerometers, and 'next generation' sensors such as eddy current devices, fiber optic sensors, and MEMS sensors.

These methods, when applied to a maintenance service program, will lead to new methodologies for the synthesis of integrated diagnostics techniques and for the design of new hardware and software systems to realize those techniques for a wide range of practical applications.

Title: SBIR Phase II: A New Technology for Rapid Identification of Aluminum Metals

Award Number: 0239055
Program Manager: Cheryl F. Albus

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $500,000
Investigator: Edward J. Sommer, nrtinfo@nrt-inc.com
Company: National Recovery Tech Inc
566 Mainstream Drive
Nashville, TN 37228-1223
Phone: (615)734-6400

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a new technology for rapid identification and sorting of aluminum and its alloys from a mixture of non-magnetic metals and will provide a new high quality source of these valuable materials for industrial manufacturing processes. This project plans to complete development of an innovative new optoelectronic sensing method integral to the new technology and then design, construct, and test a near commercial scale prototype metals processing system based upon the new technology. The prototype system will be integrated into an existing pilot plant test facility located on-site at the commercial partner's metals recycling facility and will be tested on metal feed streams derived from an automobile shredder processing line located at the recycling facility. A primary objective is to develop an environmentally friendly computerized dry process which can be situated locally and which can rapidly and cleanly sort aluminum scrap from mixtures of nonmagnetic metals at low cost to replace large, costly, and environmentally burdensome heavy media processes and smelting processes for mixed metals.

The commercial and broader impacts of this technology will be to reduce the amount of scrap aluminum alloys that are discarded each year in landfills because recycling of these materials are neither technically nor economically practical. Existing methods of sortation use visual examination and hand sortation, or hand-held/bench-top analyzers that are cumbersome and slow in speed. Heavy media separators and smelting facilities for mixed metals are polluting and expensive to build and operate. Using advanced optoelectronic detection techniques, including computer analysis, the proposed technology will sort aluminum alloys from mixed nonferrous metals automatically at speeds never before attainable. If the approach is successful, the impact to increased scrap utilization, increased scrap value and reduced environmental pollution is enormous. The potential worldwide market exceeds $2 Billion annually.

Title: SBIR Phase II: Residual Stress and Part Distortion Prediction in Machined Workpiece Surfaces

Award Number: 0237958
Program Manager: Cheryl F. Albus

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,965

Investigator: Troy D. Marusich, troym@thirdwavesys.com
Company: Third Wave Systems, Inc.
7900 W. 79th Street, Suite250
Minneapolis, MN 55439-2340
Phone: (952)832-5515

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and validate the predictive capability industry needs to dramatically improve machined workpiece quality by controlling machining induced stresses while simultaneously reducing distortion in aerospace and automotive parts. The objective for Phase II will be to continue the development and verification of analysis tools for predicting residual stress and part distortion. The goal is to supply industry with a validated analytical tool to easily and economically predict and prevent part distortion-reducing costs due to testing trials, part scrap, and time-to-market, increasing product quality and competitiveness.

The commercial and broader impacts of this technology will be provide industry with the ability to predict and prevent part distortion due to machining induced residual stress. Current techniques, which rely upon testing, and experience are not sufficient technically nor are they cost effective. Aerospace parts (large, monolithic, thin-walled, and expensive) and critical automotive powertrain applications, which demand flat surfaces to maintain fuel efficiency, component life, and lower emissions, are typical examples. A significant impact will be to manufacturing costs, lower scrap material, higher productivity, lower time-to-market, and increased product quality and performance.

Title: SBIR Phase II: On-Line, Non-Destructive, Rapid Characterization of Nanopowders and Agglomerates

Award Number: 0110341
Program Manager: Rosemarie D. Wesson

Start Date: September 1, 2001
Expires: August 31, 2003
Total Amount: $499,997

Investigator: Sivakumar Manickavasagam, siva@blazetech.com
Company: Synergetic Techs, Inc
One University Place Suite D-210
Rensselaer, NY 12144-3456
Phone: (518)525-2650

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will further develop, test, and demonstrate a novel approach for characterizing nano-scale powders and their agglomerates. Nanostructures are a novel family of materials that allow customization of structural, electrochemical, electrical, electronic, optical, magnetic, and chemical properties. The use of nanomaterials to fabricate valuable devices and to manufacture new products depends in large part on the ability to characterize these materials during synthesis, processing, and device production. Current high-resolution characterization techniques are off line, slow, expensive, and unreliable; the few on-line particle-sizing instruments available make questionable assumptions (e.g., that all particles are spherical in shape), which introduce unnecessary error into the diagnosis.

The commercial applications of this project is to use nano-scale powders, which are the fundamental building blocks of many products used in a wide variety of industries (e.g., advanced ceramics, pharmaceuticals, consumer products, etc.). As the technology develops, the application areas will increase. The ability to characterize nano-scale particles and agglomerates on-line is crucial for controlling the quality of products and for the invention of new products and processes. In addition, characterization of environmental particulates is critical for understanding air quality concerns and health effects - leading to improve clean air regulations and monitoring.

Title: SBIR Phase II: A Novel Instrument for the Determination of Extensional Rheology

Award Number: 0132046
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2002
Expires: January 31, 2004
Total Amount: $499,127

Investigator: Gavin J. Braithwaite, gavin@campoly.com
Company: Cambridge Polymer Group
52-R Roland Street
Boston, MA 02129-1234
Phone: (617)629-4400

Abstract:

This Small Business Innovation Research Phase II project describes the development of a Capillary Breakup Rheometer (CaBER) from a proven breadboard design to a commercially viable instrument for both analytical and process control functions. In this document the results of the successful completion of a Phase I SBIR are outlined. The fundamental operation of the CaBER's component parts is supported by data that validates the chosen components and verifies the suitability of the design. In addition, sample data from model fluids will be used to both illustrate the functionality of the CaBER and to highlight the broad applicability of the instrument. Ongoing developments of the CaBER include more robust software analysis, cheaper manufacturing costs and a more intuitive user interface. These improvements will result in an instrument that is invaluable to industry in both a research laboratory and a process control environment.

Currently there is only one commercially available extensional rheometer and a handful of academic rheometer designs. By providing a virtually unique tool for the determination of extensional viscosity in a freely draining fluid thread, this instrument will fill a segment of the instrumentation field that as here to fore been neglected.

Title: SBIR Phase II: A Novel Technique for Polymer Encapsulation of Nanopowders

Award Number: 0216489
Program Manager: Cheryl F. Albus

Start Date: July 15, 2002
Expires: June 30, 2004
Total Amount: $500,000
Investigator: Sanjay Kotha, skotha@matmod.com
Company: Materials Modification Inc
2721-D Merrilee Drive
Fairfax, VA 22031-0113
Phone: (703)560-1371

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will focus on developing polymer coated superparamagnetic nanobeads for isolation of biomolecules; namely cells and nucleic acids. The superparamagnetic nature along with the "nano" size of the particles offers low remnant magnetism, magnetization at low fields, and larger active surface area per unit volume. A proprietary microwave plasma synthesis technique was adopted to reduce these nanospheres and the feasibility of the technique was established during Phase Process scale up and extensive cell/DNA isolation testing will be the main R&D objectives for the Phase II project. Industrial partners will evaluate beads produced to evaluate parameters, which are critical for transitioning the technology to an immediate useful product.

The commercial potential of polymer-coated nanospheres can be used in various separation modules. This technology could also be extended to isolation and detection of pathogens in water.

Title: STTR Phase II: Advanced Control of Electron-Beam Deposition for High Precision Optical Coatings

Award Number: 0548726
Program Manager: James Rudd

Start Date: April 13, 2006
Expires: March 31, 2008
Total Amount: $505,940

Investigator: Douglas Smith, dsmith@vptec.com
Company: Cyber Materials
70 Industrial Park Road
Plymouth, MA 02360
Phone: (508)732-5107

Abstract:

This Small Business Technology Transfer (STTR) Phase II project leverages the substantial improvements in e-beam process control capability developed in Phase I into an integrated control system that can significantly increase yield and throughput for the $1.8 billion precision optical coating industry. Manufacturing partners indicate that the target performance levels would cut manufacturing costs by 35% and enable manufacturers to routinely achieve greater tolerances for advanced designs. This research is driven by a first-principles systems based approach that has created new intellectual property for monitoring, control, and process design.

Commercially, precision optical coatings are critical components for all optical instruments including microscopes, telescopes, vision and imaging systems, projection systems, and laser systems. Coatings have served these industries for years, but in a world where application requirements and scientific inquiry are constantly advancing, precision coatings are demanded that comply with even tighter tolerances. In particular, high energy laser science such as the NIF facility at Livermore require very precise and reliable coatings. This STTR research will be key to further improving manufacturing capabilities for a variety of important applications.

Title: SBIR Phase II: A Robust and Cost-Effective Tool for Diagnosing Manufacturing Noise Problems

Award Number: 0620287
Program Manager: Ian Bennett

Start Date: August 23, 2006
Expires: July 31, 2008
Total Amount: $500,000

Investigator: Manmohan Moondra, manmohan@sensound.com
Company: SenSound
221 Lewsiton Rd
Grosse Pointe Farms, MI 48236
Phone: (313)885-4550

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize a next generation quality control tool to assess the quality of any sound-generating product on a production line. The most significant scientific merit of this new technology is its capability to suppress the interference of background noise and extract the real acoustic characteristics of any target source in a noisy environment. Current measurement devices measure the overall signal, which includes the signal of a target source and background noise.

This research is expected to have broad impact on reducing noise pollution and improving workforce capabilities in a manufacturing environment. This technology will help the U.S. manufacturers to compete globally by reducing noise emissions, lowering warranty costs associated with noise related issues, and helping ensure compliance with a growing number of local and federal government regulations and laws on noise pollution.

Title: STTR Phase II: Development of an In-Line Cylinder Bore Inspection System

Award Number: 0723669
Program Manager: Cheryl F. Albus

Start Date: July 15, 2007
Expires: June 30, 2009
Total Amount: $500,000

Investigator: Stephen Segall, segall.ioms@gmail.com
Company: IOMS
1349 King George Blvd.
Ann Arbor, MI 48108
Phone: (734)971-1065

Abstract:

This Small Business Technology Transfer (STTR) Phase II project is working toward commercialization of cylinder bore probe inspection technology. During Phase II continued improvements and enhancements to the existing cylinder bore probe technology (in cooperation with the ERC for Reconfigurable Manufacturing at the University of Michigan) will continue. The scientific feasibility of this cylinder bore inspection technology was proven during the Phase I project; continued work on the operation of an automated inspection station with an array of probes working in parallel in a factory environment will be demonstrated during the Phase II project. Enhancing the technology may create opportunities for performing inspections at other locations on the engine block production line and for other cylindrical machined surfaces.

The broader impacts anticipated from this inspection process will be improved quality, reduced production costs and improve performance of vehicles used by hundreds of millions of people worldwide. It is also anticipated that this technology could lead to an optimized manufacturing process that would produce engines with reduced emissions, reduced oil consumption, improved efficiency and longer lives. Optimizing surface finish may have a greater effect on diesel engines, which are more efficient than gasoline engines.

Title: STTR Phase II: An Inference Engine for an Intelligent Imaging System for Detecting and Eliminating Hot Rolled Surface Defects

Award Number: 0646502
Program Manager: Rathindra DasGupta

Start Date: February 15, 2007
Expires: January 31, 2009
Total Amount: $500,000
Investigator: Tzyy-Shuh Chang, chang@ogtechnologies.com
Company: OG Technologies, Inc.
4300 Varsity Dr Ste C
Ann Arbor, MI 48108
Phone: (734)973-7500

Abstract:

The Small Business Technology Transfer Research (STTR) Phase II project will develop an inference engine for an intelligent imaging system that can detect and eliminate surface defects in hot rolling operations. These defects account for roughly 50% of steel rejects. The proposed product is an automatic system that generates appropriate corrective actions for defect elimination. It is proposed to further develop the inference engine and validate it on selected industrial cases.

The potential value of the research is to reduce material waste by over 200,000 tons of steel, or $120 million in productivity, per year for the US steel industry. It is also expected to deliver benefits in North America with energy savings of 1.14 Tetra W-hr and reduced carbon-equivalent emission of 94,000 tons per year. Other benefits include reduced water usage and more efficient downstream processes. The project carries strong educational implication, with the company working closely with academia and facilitating student interns.

Chemical Synthesis and Characterization

Title: SBIR Phase II: Advanced Fullerene Production

Award Number: 0321643
Program Manager: Rosemarie D. Wesson

Expires: June 30, 2005
Total Amount: $500,000
Investigator: Michael D. Diener, mikee@tda.com
Company: TDA Research, Inc
12345 West 52nd Avenue
Wheat Ridge, CO 80033-1917
Phone: (303)940-2301

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop electron transfer methods for the recovery of the giant, insoluble fullerenes that comprise about half of the fullerenes made by the hydrocarbon combustion route. Of the fullerenes produced by the combustion process developed at TDA, and practiced at the tons/year scale, ca. 20 % of the raw soot weight is recovered as fullerenes (C60, C70, etc.). It was shown in this project that another ca. 15 - 20% of the soot could be recovered as giant fullerenes using electron transfer methods. This Phase II project will further research the chemistry of the insoluble fullerenes and develop the recovery technique using xylene-extracted soot as a feedstock. We will also implement the process at 100 times the scale performed during the Phase I project, to 100g insoluble fullerenes recovered per shift, to better identify and address issues in the chemistry and engineering of the process. Following the Phase II project, the process will be installed at a plant producing ~32 tons/year of insoluble fullerenes.

The process being developed in this project will be commercialized by fullerene soot producers, giving them the ability to effectively double the yield of the synthesis process. The recovered fullerenes will be useful for applications demanding a more robust, but still fullerenic material or coating, such as carbon coatings for artificial biomaterials, optical limiters, or as scaffolds for nanotechnological devices.

Title: SBIR Phase II: Feasibility of On-line Metalloid Recovery in Gasification Systems

Award Number: 0422050
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $499,650

Investigator: Margaret Laumb, mlaumb@microbeam.com
Company: Microbeam Technologies Incorporated
4300 Dartmouth Drive
Grand Forks, ND 58203
Phone: (701)777-6530

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will demonstrate the ability to selectively condense and recover deposits rich in a valuable element from the gas-cooling regions of integrated gasification combined cycle (IGCC) plants. Deposits plugging gas-cooling heat exchangers in commercial coal IGCC systems are rich in a valuable element. The work will involve the design and construction of a pilot-scale on-line metalloid recovery (OMR) system that will be tested at bench scale on simulated synthesis gas, and on slipstreams from small-scale gasifiers. Phase II work will determine the effects of particulate matter and pressurized systems on the ability to concentrate and remove the valuable element from the gas stream. The on-line recovery of deposits rich in a valuable element will have two distinct commercial benefits. The first benefit is the cost savings associated with eliminating down time required for cleaning.

By eliminating one cleaning outage, a gasification plant could save $4.9 million. The second benefit is the creation of an additional revenue stream from the recovery of these deposits, which can be sold to a recycler.

Title: SBIR Phase II: Low-Cost Hydrogen for Next Generation Vehicles

Award Number: 0422223
Program Manager: Rosemarie D. Wesson

Start Date: July 15, 2004
Expires: June 30, 2006
Total Amount: $491,721

Investigator: Robert Copeland, copeland@tda.com
Company: TDA Research, Inc
12345 West 52nd Avenue
Wheat Ridge, CO 80033
Phone: (303)940-2301

Abstract:

This Small Business Innovative Research (SBIR) Phase II project will develop a low cost process for producing high-pressure hydrogen. This process uses a proven, regenerable, low cost CO2 sorbent to minimize capital costs and improve efficiency. The key to the process is a sorbent that shifts the equilibrium of the reforming and shift reactions that convert hydrocarbons to hydrogen. The sorbent will be produced using commercial production equipment and tested to determine its lifetime and performance. In the near term, an improved hydrogen production process would significantly reduce the cost of the hydrogen used in oil refineries to make reformulated (cleaner burning) gasoline, and bulk chemicals such as fertilizers and chemical intermediates.

In the longer term, the new system can significantly reduce the cost of producing hydrogen to distribution centers that will be needed for hydrogen fueled vehicles and other fuel cell applications.

Title: SBIR Phase II: Purification of Metallic Nitride Nanomaterials by Chemical Separation

Award Number: 0349691
Program Manager: T. James Rudd

Start Date: January 1, 2004
Expires: December 31, 2006
Total Amount: $724,884

Investigator: Steven Stevenson, steven.Stevenson@usm.edu
Company: Luna Innovations, Incorporated
PO Box 11704
Blacksburg, VA 24062
Phone: (601)266-4119

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will involve production and purification of a powerful Magnetic Resonance Imaging (MRI) contrast agent based on a newly discovered nanomaterial (Trimetasphere), consisting of a metallic nitride nanocluster inside a fullerene type cage. Trimetaspheres recently demonstrated a factor of 21 times improved relaxivity over currently used MRI contrast agents. The project will involve designing and building a powder-feed continuous reactor, including large rod capability, developing chemically-based separations techniques and optimizing heat treatment of the chemically separated Trimetaspherses mixtures. The nanoproduction and chemical-based separations techniques for these Trimetasphere nanomaterials will provide the basis for the large-scale production of the Trimetasphere based MRI contrast agents.

Commercially, these Trimetaspheres have tremendous medical applications that will benefit US citizens with better medical care through improved diagnostics, new pharmaceuticals, and simultaneous diagnostic and treatment reagents, at a fraction of current cost. The development of more sensitive contrast agents, if translated into smaller, less expensive MRI instruments, will open entirely new markets for the equipment manufacturers.

Title: SBIR Phase II: Uncopying Xerox - Acoustic Coaxing Induced Microcavitation (ACIM) Assisted DeInking of Paper

Award Number: 0078897
Program Manager: Rosemarie D. Wesson

Start Date: January 15, 2001
Expires: December 31, 2003
Total Amount: $397,345
Investigator: Sameer I. Madanshetty, sameer@ksu.edu
Company: Uncopiers, Inc.
6923 Redbud Drive
Manhattan, KS 66503
Phone: (785)293-4917

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an optimized prototype of the UNCOPIER-a chemical-free, energy-efficient, ACIM-based device designed to non-destructively deink laser-xerographic prints one sheet at a time. Acoustic Coaxing Induced Microcavitation (ACIM) is a novel, chemical-free, and energy-efficient process, which uses only "Silent Sound and Clean Water." Underlying ACIM's energy efficiency is microcavitation's ability to concentrate an enormous amount of energy on an extremely small (i.e. sub-microscopic) point. These controlled concentrations of energy result in nearly spontaneous cleaning, which does not hurt the substrate. ACIM is the ideal technology for deploying energy exactly at the point of use.

UNCOPIER technology will revolutionize the paper recycling industry in a number of ways, as well as innovation in the recycling process itself. Since the UNCOPIER leaves the deInked paper immaculately white and undamaged, it will save environmental resources by making it possible to manufacture new print grade paper from the recycled laser-xerographic prints. The UNCOPIER is being developed as an office machine to advocate a pioneer method for recycling paper-at-source deinking, "one sheet at a time." DeInking paper prior to recycling protects confidentiality. This novel approach will appeal to banks, hospitals, law firms, government agencies, and other institutions interested in recycling, but also concerned with safeguarding confidentiality. The UNCOPIER system will reduce recycling costs and enables vital commercial motivations for its improved recycling endeavors.

Title: SBIR Phase II: High Rate Synthesis of Highly Reactive Solvated Metal Atom Dispersion Nanoparticles

Award Number: 0215816
Program Manager: Cheryl F. Albus

Start Date: July 15, 2002
Expires: June 30, 2004
Total Amount: $499,959
Investigator: Slawomir Winecki, slawek@nanmatinc.com
Company: Nanoscale Materials, Inc.
1310 Research Park Dr.
Manhattan, KS 66502
Phone: (913)532-0179

Abstract:

This Small Business Innovation Research Phase II project focuses on the development and implementation of a Solvated Metal Atom Dispersion (SMAD) technique to support high rate production and commercial application of metal nanoparticle materials. Synthesis of gold and silver nanoparticle colloids for commercial use in the health care industry will be pursued as part of the proposed effort; the SMAD synthesis method will be optimized for commercial-scale manufacturing of gold and silver colloids. This approach yields high purity colloids, free of unwanted byproducts and ready for further processing without the cumbersome purification steps characteristic of other synthesis methods. This innovation significantly simplifies the manufacturing process of colloidal products and reduces production cost. The proprietary digestive-ripening step will be scaled up and developed to achieve monodispersion and particle size control of the metal nanoparticles contained in the colloids. Methods for transferring solvent-based colloids into an aqueous environment will be developed. Synthesis steps involved in the manufacturing of colloidal gold and silver will be integrated in a semi-continuous or continuous process.

The commercial potential of this project will be for immunological labeling and DNA detection using the colloidal gold solutions. The project offers an alternative-manufacturing route that significantly lowers the cost. Silver-based colloids have potential applications in burn wound treatment or as effective disinfectants and anti-inflammatory agents. The development of SMAD technology will enable high-volume manufacturing of many nanoparticle materials whose availability is currently limited by production inefficiencies. These nanomaterials will support future technologies in industry and find application in both commercial and academic research, as highly reactive catalytic materials, magnetic information storage media, ferrofluids, and magnetic tracers.

Title: SBIR Phase II: "RT Photocurable Preceramic Polymers to Si3N4 Ceramics"

Award Number: 0132155
Program Manager: T. James Rudd

Start Date: April 1, 2002
Expires: March 31, 2004
Total Amount: $500,000
Investigator: Edward J. Pope, matech@thegrid.net
Company: MATECH Advanced Materials
31304 Via Colinas Ste 102
Westlake Village, CA 91362-3901
Phone: (818)991-8500

Abstract:

This Small Business Innovation Research (SBIR) project will develop a program that will optimize poly (ethynyl) silazanes (PESZ) synthesis with an emphasis on improved efficiency and low production costs; will scale-up the production of PESZ polymers to pilot scale batch sizes; will optimize PESZ processing for component fabrication; will fabricate "real world" components, such as thrust deflectors and diesel engine particulate filters; and will obtain "real world" mechanical and performance testing data. Through the course of achieving these objectives, commercial opportunities will be pursued. This approach potentially permits the fabrication of extremely large ceramic matrix composites (CMCs) structures never before possible in much the same manner as large polymer matrix aircraft structures and boat hulls are currently manufactured.

The commercial application will be the fabrication of extremely large CMC structures that can be used in the aircraft industry.

Title: STTR Phase II: Development of Fourth Generation High Temperature Materials

Award Number: 0548639
Program Manager: George Vermont

Start Date: December 21, 2005
Expires: March 31, 2008
Total Amount: $680,587

Investigator: Jason Lincoln, jason.lincoln@p2si.com
Company: P2SI
91 Westpark Road
Centreville, Ohio 45459
Phone: (937)298-3713

Abstract:

This Small Business Technology Transfer (STTR) Phase II project will develop and characterize the structure-property-processing relationships for a novel class of thermosetting organic/inorganic hybrid polyimide resins. The resins will be used to fabricate structural composites; expected properties of the composites are higher extended use temperatures, compatibility with existing fabrication procedures, and mechanical and environmental stability properties as good as currently used materials. The project will provide a scientific basis for a new class of thhermosetting resing with broad value in defense, aerospace and deep sea drilling applications.

Project activities will include an experimental design to identify top performing structures, scale up and statistical analysis of batch to batch variations, preparation and testing of flat panels and targeted structures, and user testing of the structures.

Title: SBIR Phase II: An Engineered Diffusion Barrier for Preparation of Pd Membranes on Tubular Porous Stainless Steel Substrate

Award Number: 0620528
Program Manager: Rosemarie Wesson

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $499,999

Investigator: Paul Liu, pliu@mediaandprocess.com
Company: M&P
1155 William Pitt Way
Pittsburgh, PA 15238
Phone: (412)826-3721

Abstract:

This Small Business Innovation Research Phase II project focuses on the development of an innovative diffusion barrier for the preparation of Pd thin film on tubular porous stainless steel substrate. A thin Pd film supported on tubular porous SS substrate provides a commercially viable avenue for the use of palladium membranes for hydrogen production/recovery, particularly for large-scale applications. During Phase II the diffusion barrier will be developed to a commercial scale membrane unit for performing field tests. Pd membranes due to their excellent hydrogen permeability and selectivity can streamline existing hydrogen separation and purification processes dramatically for fuel cell and hydrogen separation applications.

The projected worldwide market size when fully matured is in the range of $1 billion/yr. Refineries' demand for hydrogen is expected to post annual growth in excess of 10% as refiners use more hydrogen to meet clean fuel regulations. A Pd-base hydrogen selective membrane suitable for large scale operations will play a major role in meeting this demand, particularly for the retrofit market, such as hydrogen recovery from waste refinery streams, as an add-on stage for existing steam reformer for incremental capacity, etc. In summary the proposed diffusion barrier could offer a practically viable Pd-based hydrogen separation device, which can benefit fuel cell and industrial hydrogen applications, and greenhouse gas reduction.

Title: SBIR Phase II: Hydrogen Production via Ultra-Rich Superadiabatic Combustion of Hydrogen Sulfide in a Reverse Flow Reactor

Award Number: 0646419
Program Manager: Rathindra DasGupta

Start Date: February 1, 2007
Expires: January 31, 2009
Total Amount: $499,999

Investigator: Jacques Bingue, jpbingue@innesol.com
Company: Innesol
9800 Connecticut Dr
Crownpoint, IN 46410
Phone: (219)794-1492

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a new process employing the superadiabatic reverse flow reactor to reform hydrogen sulfide into hydrogen with the simultaneous recovery of sulfur. Currently, the seven million tons of hydrogen sulfide produced each year as a byproduct of the reaction of sulfurous compounds with hydrogen are processed by Claus reactors into sulfur while wasting the much more valuable hydrogen content through oxidation. The successful development of the process would provide an economical means of dealing with hydrogen sulfide by retaining hydrogen. The Phase I project obtained the highest hydrogen yield ever achieved by a hydrogen sulfide process without the aid of external energy. Furthermore, the project attested that the reactor operates in regimes that eliminate sulfur dioxide. Building on the positive Phase I results; during this Phase II, a small pilot plant will be built and tested forming the basis for designing the commercial reactor with minimal modification.

The high price of gasoline and natural gas is partly due to the high cost of extracting sulfurous compounds in the crude oil refining process. This desulphurization process uses hydrogen, obtained mostly from natural gas, to react with the organosulphur species to form hydrogen sulfide. A process that can produce hydrogen as well as sulfur from hydrogen sulfide would save the energy industry hundreds of millions dollars per year in addition to decreasing the cost of gasoline, diesel, and natural gas for consumers. In addition, the process will also eliminate millions of tons of acid-rain-causing sulfur dioxide produced during disposal of hydrogen sulfide.

Novel Catalytic Systems

Title: SBIR PHASE II: Novel Ambient Temperature Emissions Control Catalyst

Award Number: 0321551
Program Manager: Rosemarie D. Wesson

Start Date: June 1, 2003
Expires: May 31, 2005
Total Amount: $500,000

Investigator: James R. Kittrell, kseinc@aol.com
Company: KSE Inc
P O Box 368
Amherst, MA 01004-0368
Phone: (413)549-5506

Abstract:

This Small Business Innovation Research Phase II project is to complete the R&D to commercialize a novel catalytic technology for pollution control at ambient temperature. The novel technology will destroy VOCs using low temperature oxidation with a highly active class of novel Heteropoly Oxometalate (HPOM) catalysts. This new class of catalysts is dramatically more active than traditional platinum oxidation catalysts. The Phase II catalyst will provide new avenues for scientific research and education, by studying catalysis at mild conditions needed for advanced instrumentation at diverse geographic locations, and by expanding the applications to other societal needs in fuel cells, Fischer-Tropsch synthesis, etc.

Commercial applications will provide efficient, low cost industrial emissions control and enhanced indoor air quality. The firm's research facilities and prior SBIR licensing success will facilitate rapid deployment. The program should protect the nation's environment and improve economic competitiveness.

Title: SBIR Phase II: Redox Polymer Catalysts for Electrochemical Synthesis of Hydrogen Peroxide

Award Number: 0078383
Program Manager: Rosemarie D. Wesson

Start Date: September 1, 2000
Expires: August 31, 2002
Total Amount: $357,904
Investigator: Ram Gopal, ramgopal@electrosynthesis.com
Company: The Electrosynthesis Company, Inc.
72 Ward Road
Lancaster, NY 14086
Phone: (716)684-0513

Abstract:

This Small Business Innovation Research Phase II project will investigate the use of redox catalyst electrodes for the synthesis of hydrogen peroxide through electrochemical regeneration of the redox catalyst. In the Phase I research, catalysts were developed and their short-term stability for peroxide synthesis was successfully demonstrated. Flow cell operation with 10 cm2 electrode cells showed the preparation of hydrogen peroxide in acidic condition (1N H2SO4) at 60% current efficiency and up to 2% in peroxide concentration. However, Phase I work indicated poor catalytic current with oxygen for these redox systems, as well as an upper limit for hydrogen peroxide concentration (2%). Phase II research effort will be directed towards improving the catalytic effect of these redox catalysts through changes in preparative procedures, electrode structure, and fabrication technique. The electrodes will be tested and optimized for peroxide synthesis using oxygen/air and almost pure water (pH adjusted, if necessary) using flow cell experiments. The electrodes will be tested for long-tem stability (500 hours). Larger electrodes (100cm2) will be fabricated using the best composite electrode for long-term stability testing and process optimization. Commercialization of the process will be carried out with a Phase III partner upon the successful completion of Phase II work.

Potential Commercial Application of the Research Hydrogen peroxide is a clean oxidant, which reacts to form water as its reaction product. It is therefore environmentally acceptable in many industries. The market for hydrogen peroxide is expected to grow by almost 10% for the next few years. New technology (synthesis of hydrogen peroxide from water and air) described in this Phase II proposal could be implemented for various applications. These areas include wastewater treatment, on-site generation (for industrial and consumer application such laundry bleach etc.), as well as commercial peroxide production.

Title: SBIR Phase II: CO-Tolerant Pt-Mo Electrocatalysts for Proton Exchange Membrane (PEM) Fuel Cells

Award Number: 0078635
Program Manager: Cheryl F. Albus

Start Date: September 1, 2000
Expires: February 28, 2003
Total Amount: $400,000

Investigator: Hanwei Lei, hlei@tjtechnologies.com
Company: T/J Technologies, Inc
PO Box 2150
Ann Arbor, MI 48106
Phone: (313)213-1637

Abstract:

This Small Business Innovation Research Phase II project addresses the development of highly dispersed Pt-Mo electrocatalysts for application as anodes in proton exchange membrane (PEM) fuel cells. Alternative anode electrocatalysts remain a critical development area for the cost reduction and performance enhancement of PEM fuel cells operating on reformate hydrogen fuel. Specifically, there is a need for catalysts that are tolerant to reformate by-products such as CO. Supported Pt-Mo is a leading candidate for the next generation of these catalysts. The Phase I research successfully produced highly dispersed Pt-Mo catalysts supported on Vulcan XC-72 using two distinct methods. The catalysts produced by both methods show excellent hydrogen oxidation characteristics in 0.5 M H2SO4. The performance of these materials in 100 ppm CO/H2 indicated high activity but did not, however, show the degree of CO-tolerance expected on the basis of results from bulk Pt-Mo alloys. These findings were surprising in light of voltammetric evidence that showed electrochemical interaction between Mo and Pt. Phase II of this effort will develop a more comprehensive understanding of the nature of Pt-Mo interactions. The results from the Phase I research at T/J suggest that the promotion of enhanced H2 oxidation at lower potentials in CO/H2 fuel streams is critically dependent upon the nature of the Pt-Mo interaction. We intend to examine the influence of surface composition/coverage of Mo on solid Pt electrode surfaces in the presence of CO/H2 fuel streams as a function of potential using a rotating disk electrode (RDE) system. These fundamental studies of solid electrode surfaces will identify the basis of CO-tolerance.

Based on these results, we will pursue rational development of supported Pt-Mo catalysts with the appropriate surface chemistry and structure using three novel dispersion methods. As a part of this work, we will conduct in-depth physicochemical characterization of the catalysts as well as more comprehensive electrochemical analysis. We intend to produce prototype membrane electrode assemblies (MEAs) for testing in fuel cells. In addition, we will supply catalyst materials for external evaluation by leading catalyst manufacturers. These companies have committed over $840,000 in follow-on funding for this SBIR project. Low cost CO-tolerant catalysts developed under this SBIR project will enable the commercialization of high performance PEM fuel cells operating on reformed hydrogen. Reducing catalyst costs addresses a key obstacle hindering the commercialization of PEMFCs for vehicle propulsion and off-grid electric power generation.

Title: SBIR Phase II: Novel Catalyst Substrate for the Preferential Oxidation (PROX) of Carbon Monoxide

Award Number:	0078754
Program Manager:	Rosemarie D. Wesson

Start Date:	January 1, 2001
Expires:	December 31, 2003
Total Amount:	$756,000

Investigator: Marco Castaldi, mc2352@columbia.edu
Company: Precision Combustion, Inc.
410 Sackett Point Road
North Haven, CT 06473
Phone: (203)287-3700

Abstract:

This Small Business Innovation Research Phase II project advances the development of an improved catalytic reactor, based on a novel catalyst substrate design, for the preferential oxidation (PROX) of carbon monoxide in a hydrogen rich feed. The Phase I objectives were fully met and demonstrated the viability of this catalyst substrate for substantial reductions in the size, weight and cost of the PROX component and also identified parameters for designing a full scale PROX reactor. This Phase II effort will focus on catalyst optimization and integration of a PROX reactor based on the catalyst substrate in a fuel processor system for automotive fuel cell applications. This potential breakthrough could significantly advance fuel processing technology for automotive fuel cell applications. The proposed technology has the potential to provide near-order of magnitude improvements in fuel processor volume, weight and cost, with a broad range of potential spin off applications to other catalytic reactors.

Success with the PROX reactor would lead to exploring use of this substrate for other components in the fuel processor, including the reformer and the Water Gas Shift reactors.

Title: SBIR/STTR Phase II: Engineered Zeolite Catalyst for Paraffin Alkylation

Award Number: 0215552
Program Manager: Rosemarie D. Wesson

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $500,000

Investigator: Mitrajit Mukherjee, mm_exelus@hotmail.com
Company: Exelus, Inc.
99 Dorsa Avenue
Livingston, NJ 07039-1002
Phone: (973)740-2350

Abstract:

This Small Business Innovation Research Phase II project aims to develop a step-out technology for paraffin alkylation to produce high-octane clean gasoline. Conventional alkylation processes require large volumes of corrosive liquid acids, which can inflict serious injury via skin contact or inhalation. The new alkylation process will be fundamentally safer and cleaner, reducing the use and generation of toxic chemicals. It uses a first-of-a-kind engineered zeolite catalyst that is environmentally benign and eliminates the risks associated with liquid acids while producing alkylate of comparable quality. The new catalyst promises significantly improved yields and selectivities, minimizing waste by-products and disposal problems associated with liquid acids.

The engineered zeolite catalysts can be used most effectively for liquid phase alkylations of paraffins and aromatics, such as the production of high-octane alkylate, and industrially important petrochemicals such as
cumene and ethylbenzene.

Title: SBIR Phase II: Novel Low Cost Technology for High-Performance Integrated Microcombustor/Evaporator

Award Number: 0215792
Program Manager: Rosemarie D. Wesson

Start Date: August 15, 2002
Expires: July 31, 2004
Total Amount: $500,000

Investigator: Lev Tuchinskiy, ltuch@opusl.com
Company: Materials & Elctrochem/MER
7960 South Kolb Road
Tucson, AZ 85706
Phone: (520)574-1980

Abstract:

This Small Business Innovation Research (SBIR) Phase II project is aimed at the continued development of novel microscale combustors/evaporators, which are intended for evaporation of fuel and water in fuel reformers as well as for personal portable heating and cooling systems. The general objective of the Phase II program is to optimize and scale up a technology for microchannel combustor/evaporators demonstrated in the Phase I and to develop a compact device, which could generate at least 25- 30 watts of thermal energy per square centimeter of heat transfer area and transfer that energy to fluid with efficiency greater than 85 percent. Innovative fabrication technology and a new microreactor concept were combined to create a highly efficient device, which uses hydrogen or hydrocarbon fuel combustion for heating and/or boiling working fluids. Conditions of heat transfer and combustion of hydrogen and methane in microchannel combustor/evaporators will be determined and optimal design of the microscale device will be established.

Potential commercial applications include lightweight, safe and high performance microcombustors for microturbines, man-portable microheaters for cold climates, man portable cooling microsystems for hot climates, on-board fuel processors for hydrogen generation, distributed space conditioning of buildings, etc. Utilization of microchannel combustor/evaporators for these applications will result in increase of energy efficiency, reduction of air pollution and enhancement of life quality.

Title: SBIR Phase II: Novel Methodology for Purification and Separation of Platinum Group Metals

Award Number: 0216373
Program Manager: Rosemarie D. Wesson

Start Date: September 1, 2002
Expires: August 31, 2004
Total Amount: $500,000

Investigator: Waheguru P. Singh, waheguru.singh@lynntech.com
Company: Lynntech, Inc
7610 Eastmark Drive, Suite 202
College Station, TX 77840-4024
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research Phase II project is focused on designing a series of extremely efficient metal extraction products (MEPs) with tailor-made properties for specifically extracting and purifying platinum group metal (PGM) anions from acid solutions. Existing PGM recovery and separation methods are complex and expensive. The Phase II project will fully develop the separation and purification of PGMs, scale up the MEP synthesis and expand the scope of the work to launch the technology into PGM recycling market.

These novel MEPs will have wide applications in the precious metal refining as well as recycling industries. It is estimated that the total value of precious metal catalysts in spent automobile catalytic reactors in the United States alone is $ 800 million a year. Additionally, these MEPs could also be used in the separation and purification of actinides, such as plutonium, and in the pre-concentration of trace amounts of anions (e.g. chromate, arsenate) to aid in environmental analysis. Modifications of the structure may also lead to the production of highly specific environmental sensors for the in-situ detection of contaminants in groundwater and other aqueous streams.

Title: SBIR Phase II: Carbon Monoxide-Tolerant Anode Catalysts for Proton Exchange Membrane Fuel Cells via Combustion Chemical Vapor Deposition

Award Number: 0091624
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2001
Expires: January 31, 2004
Total Amount: $499,938

Investigator: Richard Breitkopf, rbreitkopf@microcoating.com
Company: CCVD dba MicroCoating Tech
5315 Peachtree Industrial Blvd.
Atlanta, GA 30341-2107
Phone: (678)287-2400

Abstract:

This Small Business Innovation Research (SBIR) Phase II project seeks to implement a Combustion Chemical Vapor Deposition (CCVD) process for the production of anode electrocatalyst layers for Proton Exchange Membrane Fuel Cell (PEMFC) applications requiring reformate fuel feed gas. In Phase I it was demonstrated that fabrication of Pt:Ru electrocatalysts as unsupported, metallic nanoparticles is possible using CCVD. These electrocatalyst layers behave electrochemically in a similar manner to commercially available Pt:Ru electrocatalysts prepared on carbon supports using wet chemical methods, but can be deposited directly onto both gas diffusion media and proton exchange membranes. The Phase II project would involve optimization of catalyst composition, continued development of web coating technology for mass production of membrane electrode assemblies (MEAs) and commercialization of the technology through construction of production equipment and licensing.

Fuel cells are of huge interest to the marketplace, as illustrated by sizable investments in the technology and market capitalization of fuel cell companies. For example, Daimler Chrysler has targeted the year 2004 for planned production of fuel cell vehicles, and has slated more than $1.4 billion in investments to reach that goal. However, for commercial viability, performance and cost of the electrocatalyst layers must be improved. MCT, if successful, could contribute in both arenas.

Title: SBIR Phase II: Novel Low Temperature Partial Oxidation Reactor

Award Number: 0109981
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2001
Expires: July 31, 2004
Total Amount: $500,000
Investigator: Michael C. Bradford, mbradford@ceramem.com
Company: CeraMem Corporation
12 Clematis Avenue
Waltham, MA 02453
Phone: (617)899-4495

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop an economically competitive, novel, catalytic process for low temperature hydrocarbon partial oxidation. An innovative process for ethylene epoxidation will be developed as a commercially significant application. Most heterogeneous hydrocarbon partial oxidation reactions utilize engineered catalysts, which incorporate novel promoters to enhance selectivity. However, reactor heat management significantly impacts process energy efficiency, catalyst selectivity, and ultimately, process profitability. The Phase II project will develop an innovative process for hydrocarbon partial oxidation, which addresses these issues. In Phase I, technical and economic viability of the novel process was demonstrated. The Phase II project will focus on the intrinsic reaction kinetics, heat transfer, and mass transport. A continuous ethylene epoxidation process will be demonstrated at the bench-scale and small pilot-scale in novel, three-phase reactors. In addition, an engineering process design and cost analysis will be developed.

The commercial application from this project will be the heterogeneous hydrocarbon partial oxidation, if successful would greatly increase raw material and energy efficiency as well as increase process profitability in the chemical and petrochemical industries.

Title: SBIR Phase II: Novel Catalyst Substrate for the High and Low Temperature Water Gas Shift Reactor

Award Number: 0132126
Program Manager: Rosemarie D. Wesson

Start Date: March 1, 2002
Expires: February 29, 2004
Total Amount: $500,000

Investigator: Marco J. Castaldi, mcastaldi@precision-combustion.com
Company: Precision Combustion, Inc.
410 Sackett Point Road
North Haven, CT 06473-3106
Phone: (203)287-3700

Abstract:

This Small Business Innovation Research Phase II project seeks to develop a compact, lightweight, and low cost Microlith Water Gas Shift (WGS) reactor capable of rapid start-up, excellent transient response and high CO conversion efficiency with very low levels of methane formation. This technology offers a key low cost contribution to meeting objectives for efficiency and clean emissions. The Microlith based WGS reactor will be optimized by developing prototype reactor designs for fuel processor applications, and demonstrating predicted durability of up to 5000 hours.

Target customers and markets are fuel processor/fuel cell manufacturers developing and seeking to sell Proton Exchange Membrane (PEM) fuel cell products for stationary residential and distributed power, and for heavy duty vehicles in the short term, fuel processor/fuel cell manufacturers developing products for automotive markets in the long term and opportunistically, specialty chemical reactor applications (e.g. for hydrogen and syngas production and in ammonia synthesis) where the technology's size and performance.

Title: SBIR Phase II: Catalyst for Near-Zero NOx Emissions from Natural Gas Fired Power Plants

Award Number: 0109554
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2001
Expires: July 31, 2003
Total Amount: $499,900

Investigator: Joseph A. Rossin, Jarossin@GuildAssociates.com
Company: Guild Associates Inc
5750 Shier-Rings Road
Dublin, OH 43016-1234
Phone: (614)798-8215

Abstract:

This Small Business Innovative Research (SBIR) Phase II project involves the development of a catalyst to control NOx emissions from combined cycle power plants using natural gas fired turbines (natural gas fired power plants). During the Phase I effort, Guild Associates developed an environmental catalyst for the control of NOx emissions using NH3. Operating in the presence of excess (about 20-33%) NH3, the catalyst was able to achieve greater than 95% NOx reduction without NH3 slip. NH3 slip is avoided because the catalyst is able to simultaneously reduce the excess NH3 to N2 and H2O. The objective of this project is to modify the catalyst developed during the Phase I effort in order to enhance its commercial viability. Enhancing the commercial viability will involve increasing the reactivity of the catalyst and eliminating platinum metals from the formulation. Enhancing the reactivity will allow the catalyst to operate at higher space velocities. Eliminating platinum metals from the formulation will greatly reduce the cost of the catalyst. Successful completion of this effort will result in a simple, low cost technology for control of NOx emissions from natural gas fired power plants without NH3 slip.

Potential Commercial Applications include the control of NOx emissions from natural gas fired power plants. Other commercial applications include controlling NOx emissions from semiconductor manufacturing, fine and specialty chemical manufacturing and nitric acid manufacturing processes.

Title: SBIR Phase II: Combinatorial Synthesis of Electrocatalysts for Ozone Production

Award Number: 0091446
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2001
Expires: January 31, 2004
Total Amount: $500,000

Investigator: Charles L. Tennakoon charles.tennakoon@lynntech.com
Company: Lynntech, Inc
7610 Eastmark Drive, Suite 202
College Station, TX 77840-4024
Phone: (979)693-0017

Abstract:

This Small Business Innovation Research (SBIR) Phase II project describes an innovative combinatorial approach to the discovery of new electrocatalysts for electrochemical ozone generation. Ozone is increasingly being used in water treatment, as a sanitizing agent in the food industry and is preferred over chlorine and its derivatives. Electrochemical ozone generation, where ozone is generated by electrolysis of water, can potentially offer several cost and process advantages over the conventional electrical discharge methods of ozone generation. However, existing methods for generating ozone electrochemically use electrodes, which offer low Faradaic (i.e., current) efficiencies and have limited materials stability. In Phase I, ozone electrocatalysts were screened using a combinatorial approach, and two novel electrocatalysts for ozone formation were identified. A new rapid screening approach was also devised and will be used to evaluate focused combinatorial arrays in Phase II. Phase II will identify the precise stoichiometries of the new ozone electrocatalysts using the techniques pioneered in Phase I. The catalysts will then be synthesized on a macro scale and evaluated in ozone cells using existing ozone electrocatalysts as a benchmark.

The catalysts identified during this project will enable a more cost-effective generation of ozone with applications in municipal water treatment, point-of-entry and point-of-use water treatment, food sanitation, medical waste treatment and medical sterilization. Ozone could also be utilized in the chemical industry as a replacement for chlorine in a variety of processes, e.g. paper and pulp bleaching.

Title: SBIR Phase II: Bimetallic Oxygen Reduction Catalysts for Proton Exchange Membrane Fuel Cells

Award Number: 0110419
Program Manager: Cheryl F. Albus

Start Date: August 1, 2001
Expires: July 31, 2004
Total Amount: $400,000

Investigator: Devon J. Renock, drenock@tjtechnologies.com
Company: T/J Technologies, Inc
PO Box 2150
Ann Arbor, MI 48106-2150
Phone: (313)213-1637

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop platinum-transition metal alloy catalysts that are supported on high area carbon for oxygen cathodes in proton exchange membrane fuel cells. The Phase II project will build on the success of Phase I by optimizing the alloy composition and particle size of supported Platinum (Pt) alloy catalysts for efficient oxygen reduction. Low temperature synthesis methods allow T/J Technologies to produce supported Pt alloys with minimal Pt aggregation. Alloy compositions that reduce the over potential toward oxygen reduction by >50 mV versus Pt alone and will be produced with particles sizes (3-5 nm) that maximize Pt utilization and oxygen reduction efficiency. Performance will be demonstrated in half-cell and full fuel cell experiments. Catalysts resulting from this project will enable PEM fuel cells to operate more efficiently.

The potential commercial applications from this project would be improved oxygen reduction catalysts for proton exchange membrane fuel cells for vehicle propulsion and kilowatt-scale off-grid electric power generation. These are potentially large markets with beneficial impacts on energy efficiency, international competitiveness, and emissions reductions.

Title: SBIR Phase II: Solid Acid Catalyst with Optimally Distributed Active Sites

Award Number: 0548636
Program Manager: Rosemarie Wesson

Start Date: January 4, 2006
Expires: December 31, 2007
Total Amount: $513,600

Investigator: Mitrajit Mukherjee, mmukherjee@exelusinc.com
Company: Exelus, Inc.
99 Dorsa Ave
Livingston, NJ 07039
Phone: (973)740-2350

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to develop a practical, cost-effective solid-acid catalyst alkylation technology, which will be an economically viable replacement for current alkylation processes, which use toxic liquid acids such as HF and H2SO4. The new technology will significantly reduce capital cost and operating expenses by using a novel multifunctional solid-acid catalyst that produces high-octane ultra-clean gasoline in a simple fixed-bed reactor. The multifunctional solid-acid catalyst significantly outperforms conventional solid-acid catalyst both in terms of catalyst activity and long-term stability. The octane number of the alkylate product obtained using this new catalyst is substantially higher than that obtained using a conventional solid-acid catalyst.

Fifty refineries in the US use hydrofluoric acid (HF) in their alkylation units. The new "green" iso-paraffin alkylation technology is an economically viable alternative to HF catalyzed processes, which would eliminate such risks posed by toxic liquid acids. The multifunctional catalyst promises significantly improves yields and selectivities, minimizing waste by-products and disposal problems associated with liquid acids, and reduces CO2 emissions.

Title: SBIR Phase II: Compact, Lightweight Flexible Fuel Reformer for Solid Oxide Fuel Cells (SOFC)

Award Number: 0548677
Program Manager: Rosemarie Wesson

Start Date: January 23, 2006
Expires: February 29, 2008
Total Amount: $473,502
Investigator: William Whittenberger, waw@catacel.com
Company: Catacel
7998 Gotham Rd.
Garrett, OH 44231
Phone: (330)468-4984

Abstract:

This Small Business Innovation Research (SBIR) Phase II project demonstrates a flexible fuel reformer (FFR) that employs unique mechanical construction and operation to enable extended catalyst life in the presence of sulfur-containing heavy fuels. The FFR utilizes a low-cost heat exchanger that is constructed from metal foil and coated with a dual-function sulfur-tolerant catalyst. Combustion and steam reforming reactions occur simultaneously on opposite sides of the foil, allowing excellent heat transfer. Cycling the combustion and reforming reactions regenerates the catalyst by burning off carbon and sulfur deposits, resulting in continuous hydrogen production with low steam consumption. Selected catalyst formulations will be evaluated in the laboratory to understand their performance at conditions expected during both reforming and combustion. A 100 hour demonstration of a 1kw FFR that continuously produces hydrogen of a uniform composition from diesel fuel will complete the project.

The innovation demonstrates a new method of steam reforming, which shows high potential to yield a viable scheme for producing hydrogen from commercially available fuels. The FFR can operate with a variety of liquid fuels, including gasoline, diesel fuel, and jet fuel. Near-term SOFC commercial opportunities include fuel cell powered auxiliary power units for commercial trucks, aircraft, and military applications.

Title: SBIR Phase II: Nanocomposite Carbon and Graphitic Foams Produced via a Catalytic Approach

Award Number: 0620353
Program Manager: Rosemarie Wesson

Start Date: September 6, 2006
Expires: August 31, 2008
Total Amount: $467,005

Investigator: Seng Tan, sctan@sprintmail.com
Company: Wright Materials Res Co
7155-H Columbia Gateway Drive
Coumbia, MD 21046
Phone: (410)730-8600

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will optimize and scale up the processing of the proposed rapid post-processing and nanocomposite technique for microcellular carbon and graphitic foams to possess superior insulating and conducting properties, respectively. Thermal conductivity and insulation properties may be tailored to either very high or very low. Thermal-mechanical properties of the nanocomposite carbon and nanocomposite graphitic foams after the optimization and scale up research will be characterized. The results of this work will demonstrate that the oxidation stabilization time may be reduced by an order of magnitude, meanwhile enhancing the mechanical properties, as compared to the conventional technique.

Lower processing cost and superior thermal-mechanical properties may result in widespread uses of microcellular nanocomposite carbon and graphitic foams for various applications including high-temperature insulation, space structures, and thermal management applications like heat exchangers.

Title: SBIR Phase II: Novel Polycarbonate Synthesis

Award Number: 0620438
Program Manager: Deepak Bhat

Start Date: August 31, 2006
Expires: August 31, 2008
Total Amount: $500,000
Investigator: Scott Allen, sda@novomer.com
Company: Novomer
South Hill Business Campus
Ithaca, NY 14850
Phone: (607)330-2321

Abstract:

This Small Business Innovation Research (SBIR) Phase II project aims to commercialize a new class of biodegradable plastics from carbon dioxide and epoxides. The technology is based on an innovative catalyst system that significantly increases process efficiency and reduces cost. A novel approach for catalytic polymerization will be developed by directly incorporating carbon dioxide into the polymer, which will transform this greenhouse gas into a synthetic building block of a polycarbonate plastic material, with widespread industrial applications.

The project will demonstrate an alternative use of a significant greenhouse gas as an alternative feedstock for the plastic industry, which has the potential for greatly reducing the Nation's dependence on petroleum-based raw materials. In addition, the polycarbonate materials synthesized using the novel process will beneficially impact a number of industries, such as specialty adhesives, investment casting, ceramic binders and biomedical applications.

Title: SBIR Phase II: Enabling Low-Temperature Synthesis of Vertically Aligned Carbon-Nanotubes by Selective Heating of Catalyst

Award Number: 0724878
Program Manager: Cheryl F. Albus

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $499,820

Investigator: Alexsey Vasenkov, jls@cfdrc.com
Company: CFD Research Corporation
215 Wynn Dr NW FL 5
Huntsville, AL 35805
Phone: (256)726-4800

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop, validate, and demonstrate a new technology for a low-temperature synthesis of vertically-aligned carbon nanotubes (VACNTs) and nanofibers (VACNFs). The low-temperature manufacturing process is critical to decrease the cost and improve the quality of VACNTs/VACNFs-based materials and devices. This project will further advance and demonstrate the low-temperature technology by producing: a novel research-grade reactor with four special components: a RF plasma source for vertical alignment of free-standing VACNT/VACNF, a pulsed RF power source with tunable frequency in the GHz range for inductive heating of catalytic nanoparticles,.a nonconducting substrate to eliminate substrate Joule heating; and a system for active cooling of the substrate.

The broader impacts anticipated from the proposed low-temperature synthesis approach will result in a novel research-grade reactor and a multiscale simulator for a direct, low-temperature synthesis of VACNTs at pre-selected locations on the surfaces of temperature-sensitive materials. This approach could lead to a new US-based high-technology manufacturing business.

Photo/Electrochemical Applications

Title: SBIR Phase II: Electrochemical Chlorine Purification

Award Number: 0091596
Program Manager: T. James Rudd

Start Date: January 15, 2001
Expires: July 31, 2003
Total Amount: $499,999

Investigator: Srinivasan Sarangapani, icetinc@attglobal.net
Company: ICET Inc
916 Pleasant Street
Norwood, MA 02062-4640
Phone: (781)769-6064

Abstract:

This Small Business Innovative Research Phase II project will further the development of the electrochemical chlorine purification process and conduct a pilot trial with a 0.5 square meter cell at a chlor-alkali plant. During the Phase I phase, densities as high as 0.5 A/cm2 (at room temperature) were demonstrated for this process, with a potential of less than 300 mV at the highest current density. A pilot scale MP-cell with 100 cm2-electrode area was successfully demonstrated to purify chlorine in the flow through electrode mode using anion exchange membranes. Chlorine purity at the outlet was 100%. A complete mass balance was carried out for the chlorine gas and the chloride ion. The objectives of the Phase II program include (a) study and understanding of the mechanism of chlorine reduction in concentrated hydrochloric acid, (b) investigation of catalysis of both the chloride oxidation and chlorine reduction processes in concentrated HCl, (c) building a 0.5 square meter pilot cell, and (d) conducting field trials in a chlor-alkali plant with the pilot cell. At the end of Phase II, a detailed economic analysis would have been completed to enable commercialization efforts.

The world chlor-alkali industry is projected to grow from the current production capacity of 42.1 million tons to 49 million metric tons in the year 2002. The total amount of tail gas to be processed is 562 million dollars through the year 2007 for a technology that replaces third stage liquefaction. The market for the second stage liquefaction is approximately 1.7 billion dollars. The U. S. market size for a low cost, energy efficient technology such as electrochemical purification is approximately 160 million dollars through 2007.

Title: SBIR Phase II: Cost-Effective Manufacture of High-Power Li-Ion Batteries for NGV

Award Number: 0349621
Program Manager: Rosemarie D. Wesson

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $499,900

Investigator: Thomas Kaun, kauntd@juno.com
Company: InvenTek Corporation
320 Willow Street
New Lenox, IL 60451
Phone: (815)483-9564

Abstract:

This Small Business Innovative Research (SBIR) Phase II project proposes a prototype Lithium-ion battery that has inherent cost advantages for a NGV FreedomCar and hybrid electric vehicle, HEV, requiring compact pulse-power. The unique rolled-ribbon cell can meet the cost requirements and deliver thousands of pulses and recharges. The battery design projects power at 2-4kW/kg and power density at 7.5kW/liter similar to an ultracapacitor, with 20 times greater specific energy at 100- 120Wh/kg .

The rolled-ribbon design is a technology that enables US producers to compete by lowering the materials requirement, packaging and safeguard costs of a large high-power battery. It fulfills the need for high power at low cost. In addition, this disc-shaped design exhibits excellent passive thermal management with inherent safety. Gasoline savings will reduce air pollution and oil imports.

Title: SBIR Phase II: An Economical Continuous Metal Coating Method for Electronic and Other Applications

Award Number: 0078622
Program Manager: T. James Rudd

Start Date: August 1, 2000
Expires: July 31, 2002
Total Amount: $400,000

Investigator: Mandar Sunthankar, mandar@ionedge.com
Company: IonEdge Corporation
513 B N. Link Lane
Fort Collins, CO 80524
Phone: (970)491-9942

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will conduct research to develop a new approach to coating metals continuously and rapidly on large areas of moving substrates. Currently, these types of coatings are electrochemically plated resulting in higher operating costs due to environmental regulations in the U.S. This has added to the declining share of the world market for the U.S. electronic metal-coating industry. Consequently, the Phase I results on the technique have generated interest in the commercial sector and a prototype demonstration is needed for the identified customers. The proposed method is suitable for coating conductive as well as nonconductive substrates, and rigid as well as flexible substrates. In this Phase II project, a prototype will be developed for continuously coating nonconductive substrates used in electronic applications. Then metal coatings will be deposited at a rate better than that of the conventional methods. Further research will be conducted to meet customer's expectations of the coating quality and process economics. In addition, process repeatability will be assured by running the equipment for the identified customers. Finally, the coating price will be determined and a cost benefit analysis will be performed.

The proposed method has the potential to reduce operating costs in the intended coating operations substantially. Copper, nickel and other metal coatings are widely plated on nonconductive substrates in several electronic and automotive applications. Typical application include EMI/RFI shielding in cellular phones, conductor lines in printed wiring boards used in computers and flat panel displays, and decorative trims in automobiles. The method to be developed could provide a lower-cost alternative to the conventional methods in use today and make the US. coating industry more competitive in the international market.

Title: SBIR Phase II: Dynamic, Variable Area, Rechargeable Zinc-Air Fuel Cells as Small Power Sources for Cold Regions

Award Number: 9983433
Program Manager: Winslow L. Sargeant

Start Date: June 1, 2000
Expires: May 31, 2002
Total Amount: $391,325

Investigator: Tsepin Tsai, tsai@reveo.com
Company: Reveo Incorporated
3 Westchester Plaza
Elmsford, NY 10523
Phone: (914)345-9555

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will develop a zinc-air fuel cell for replacement of internal combustion engines in polar and other cold climates. Phase I examined the electrochemistry of the zinc-air fuel cell's anode, cathode, electrolyte, and system designs to identify and optimize critical low-temperature performance characteristics. This power source has inherently high energy- and power-density as well as exceptional reliability at start-up temperatures as low as -40 degrees Centigrade. Phase II will develop 500-watt prototypes, capable of internal and external recharging, for low-temperature, low-maintenance remote use.

Potential commercial applications include portable rechargeable power supplies, materials handling equipment, personal mobility vehicles, and cellular telephones operated in polar and other cold regions.

Title: SBIR Phase II: Improved Electrodes for Capacitive Deionization for Purifying Ocean/Well Water

Award Number: 0216299
Program Manager: Rosemarie D. Wesson

Start Date: September 15, 2002
Expires: August 31, 2004
Total Amount: $500,000
Investigator: Steven D. Dietz, sdietz@tda.com
Company: TDA Research, Inc
12345 West 52nd Avenue
Wheat Ridge, CO 80033-1917
Phone: (303)940-2301

Abstract:

This Small Business Innovation Research (SBIR) Phase II Project will develop improved monolithic carbon electrodes for capacitive deionization. Capacitive deionization technology (CDT) is a new method for purifying ocean and brackish well water. In this process, a constant voltage is applied between two porous carbon electrodes, and soluble salts are collected on their surface, thus purifying the water. The operating costs of CDT are roughly half those of reverse osmosis, the current system of choice.

Obtaining a reliable and plentiful supply of clean water is becoming a worldwide problem. From this work, society (both in the U.S. and worldwide) will benefit from an inexpensive method of producing potable water from large existing reserves of brackish (saline) water. Inexpensive mesoporous carbon electrodes could also be used in capacitive deionization for industrial processes such as boiler feed, as well as in electrical energy storage, such as in capacitive energy storage.

Title: SBIR Phase II: Electrochemical Disinfectant Generator for Multiple In-Situ Applications

Award Number: 0239197
Program Manager: Rosemarie D. Wesson

Start Date: February 1, 2003
Expires: January 31, 2005
Total Amount: $499,979
Investigator: Charles L. Tennakoon, charles.tennakoon@lynntech.com
Company: Lynntech, Inc
7610 Eastmark Drive, Suite 202
College Station, TX 77840-4024
Phone: (979)693-0017

Abstract:

This Small Business Research (SBIR) Phase II project is concerned with the development and commercialization of electrochemically operated devices that will revolutionize the disinfectant industry by providing on-site, on-demand generation of extremely potent dual disinfectants. Peroxyacids are well known disinfectants that remove even resistant microorganisms (i.e. spores) by attacking S-S and S-H bonds on cell walls. The conventional method of manufacturing peroxy acids involves mixing concentrated hydrogen peroxide, an organic acid, and a catalyst (usually concentrated sulfuric acid), and involves the transportation and storage of hazardous chemicals. During the Phase I, the feasibility of a novel approach for the generation of the dual disinfectant was amply demonstrated. In this process, reactants for converting organic acids to dual disinfectants are generated within the device, avoiding problems associated with storage. All the criteria of success specified have been successfully accomplished and a well-known industrial partner has shown a keen interest in commercializing the novel devices. In Phase II, further optimization of the electrochemical devices will be followed by fabrication of prototypes of three devices for demonstrating their efficacy for a variety of disinfection applications.

There is a considerable need for devices that produce potent disinfectants that are biocidal against a broad spectrum of microbes including spores and viruses. These devices that produce potent disinfectants on-demand have commercial potential in domestic health care and food service establishments as well as in infection control applications in hospitals and nursing homes. It is estimated that revenues of the entire cleaning/sanitizing industry will be $31 billion in 2007.

Separations Technology

Title: SBIR Phase II: Novel Facilitated Transport Membranes for Olefin Separations

Award Number: 0110193
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2001
Expires: July 31, 2003
Total Amount: $500,000

Investigator: Tim C. Merkel, tcmerkel@mtrinc.com
Company: Membrane Tech & Res Inc
1360 Willow Road Suite 103
Menlo Park, CA 94025-1516
Phone: (415)328-2228

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on olefin/paraffin separations. In the USA, ethylene and propylene are produced in larger quantities than any other organic chemical. Currently, olefin/paraffin separation is done by distillation, an extremely energy-intensive process because of their low relative volatility. Selectivities of polymeric membranes are inadequate for these separations, but selectivities of facilitated transport membranes are higher. However, membrane instability, low gas fluxes, and a required water-saturated feed limit their industrial application. To overcome these problems a new type of facilitated transport membrane is being developed. The membrane has high gas fluxes, dramatically improved olefin/paraffin selectivities over conventional facilitated transport membranes, operates with a dry feed, and is stable for several weeks.

The commercial applications from this project will be membranes that will significantly lower cost and energy consumption of industrial olefin/paraffin separations. Other applications include by product/vent gas streams in polyethylene/polypropylene, cumene, isopropanol and acrylonitrile plants. Subsequent applications are propylene recovery from FCCU off-gas and from large processes (propane dehydrogenation and steam crackers).

Title: SBIR Phase II: High-Efficiency Poly(Tetrafluoroethylene) (PTFE) Membranes

Award Number: 0522198
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2005
Expires: June 30, 2007
Total Amount: $505,994
Investigator: Hilton Pryce-Lewis, hilton@gvdcorp.com
Company: GVD Corporation
19 Blackstone St Ste 1
Cambridge MA, 02139
Phone: (617)661-0060

Abstract:

This Small Business Innovation Research (SBIR) Phase II project addresses the need for improved filtration in the semiconductor industry, where exceptional chemical stability, thermal stability, and purity make poly(tetrafluoroethylene) (PTFE) the media of choice. GVD has successfully demonstrated unprecedented filtration efficiencies for the retention of 20 nm size particles using PTFE membranes. The asymmetric structure of the GVD membranes avoided > 90% of the increase in energy utilization traditionally associated with improved filtration efficiency. The asymmetry was created using GVD's unique initiated chemical vapor deposition (iCVD) technology. In Phase II, GVD will demonstrate large area production at a competitive cost by designing, building, and operating an iCVD roll-to-roll coater, the first of its kind in the world.

The improved economics of roll-to-roll manufacturing will permit entry of a new family of PTFE membranes into a variety of markets where improvements in product quality and efficacy can be enabled by advanced filtration. These membranes can also address the separations needs of emerging industries such as nanotechnology, where unit operations at the nanometer scale still remain a challenge. More broadly, iCVD technology can produce composite membranes which marry the beneficial surface properties of PTFE with the improved mechanical strength and performance of a less costly base membrane. This could result in a family of membranes with multifunctional separations capabilities that do not sacrifice cost for efficacy

Title: SBIR Phase II: Multilayer Membrane-Based Permeation for Cost-Effective Olefin/Paraffin Separation

Award Number: 0421976
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2004
Expires: July 31, 2006
Total Amount: $500,000

Investigator: Yingjie Qin, yjqin1@yahoo.com
Company: Chembrane Research and Engineering Inc
183 Highland Avenue
Kearny, NJ 07032
Phone: (201)997-4366

Abstract:

This SBIR Phase II project focuses on olefin/paraffin separation. Ethylene and propylene are produced in larger quantities than any other organic chemicals. A new membrane system is under development, which provides high olefin recovery, extremely high olefin fluxes, drastically improved olefin/paraffin selectivities over conventional facilitated transport membranes, and long-term operation stability. During Phase II, a laboratory prototype will be demonstrated. Integration of this membrane system into an olefin plant will drastically improve ethylene, propylene and butadiene in a more energy efficient and economical way. Polymer-grade olefins can be easily produced with this membrane process with minor post-treatments.

Economic analysis showed that incorporation of the proposed membrane system into an ethylene plant can drastically reduce capital and operating costs of the entire plant. As a result of reduced power consumption, this membrane process will correspondingly reduce emission of greenhouse gas CO2.

Title: SBIR Phase II: Novel Lightweight, Low Cost Fuel Cell Membrane Electrode Assemblies

Award Number: 0422186
Program Manager: Rosemarie D. Wesson

Start Date: July 15, 2004
Expires : June 30, 2006
Total Amount: $500,000
Investigator: Anuncia Gonzalez-Martin, anuncia.gonzalez-martin@lynntech.com
Company: Lynntech, Inc
7607 Eastmark Drive, Suite 102
College Station, TX 77840
Phone: (979)693-0017

Abstract:

This SBIR Phase II project concerns the development of proton exchange membrane (PEM) fuel cells with improved power density (kW/L) and specific power (kW/kg), reduced cost, and simplified assembly. A new type of electrically conductive polymer sheet has been developed that can be used as both, gas diffusion layer and bipolar plate in PEM fuel cells. The material is light, inexpensive, highly conductive, chemically inert, easy to process, and corrosion resistant. The use of this conductive polymer in PEM fuel cells will reduce cell weight, volume, and cost, while simplifying cell assembly. During the Phase II project, the conductive polymer materials will be optimized as bipolar plates and gas diffusion layers, and they will be integrated into PEM fuel cell stacks.

The new material has significant commercial potential because of its multifunctionality, lightweight, effectiveness, and low cost. The potential customers are developers currently working with PEM fuel cells operating on hydrogen, methanol, and reformed hydrocarbon fuels. This includes all of the automotive manufacturers and the manufacturers of stationary fuel cell power systems.

Title: SBIR Phase II: Development of an Electrically Regenerated Diesel Particulate Filter

Award Number : 0349683
Program Manager: Rosemarie D. Wesson

Start Date: January 1, 2004
Expires: December 31, 2005
Total Amount: $499,326

Investigator: Luke Ferguson, harmonics@hmnx.com
Company: Harmonics, Inc.
9524 Roosevelt Way NE
Seattle, WA 98115
Phone: (206)525-6217

Abstract:

This Small Business Innovation Research (SBIR) Phase II project proposes to develop an effective diesel particulate filter (DPF) that can be reliably regenerated with integral electrical heating elements. A fabrication process will also be developed that ensures economical manufacturability of the filter in high volumes. The greatest challenge in the design of reliable particulate filter and trap systems has been achieving adequate regeneration, or the oxidation (burning) of particulates that accumulate in the filter substrate diesel engine operation. The objectives of Phase II will include designing an actively regenerating filter structure, optimization of EC material for use in the DPF substrate, development of manufacturing processes suitable for scale up to volume production, construction of prototype DPF substrates, testing, and ultimately integration of the EC-integrated DPF into a functioning DPF system ready for field testing. The anticipated result of the Phase II project is an actively regenerating EC-integrated DPF prototype substrate suitable for field testing in the US EPA.s Voluntary Retrofit Program. The EC-integrated DPF will fulfill new emissions controls scheduled to take effect in 2007.

There is presently a compelling need for a compact, simple-to-maintain, durable, and effective diesel particulate filter for both new and existing diesel- powered vehicles. The EC-integrated DPF could potentially reduce diesel particulate emissions by 9.5 million tons annually, preventing thousands of premature deaths due to respiratory illnesses, cancer and heart disease.

Title: SBIR Phase II: Separation of Light Hydrocarbon Mixtures by Pervaporation
Award Number: 0349776
Program Manager: Rosemarie D. Wesson

Start Date: January 15, 2004
Expires: December 31, 2005
Total Amount: $500,000
Investigator: Ingo Pinnau, ipin@mtrinc.com
Company: Membrane Technology & Research Inc
1360 Willow Road Suite 103
Menlo Park, CA 94025
Phone: (415)328-2228

Abstract:

This Small Business Innovative Research (SBIR) Phase II project focuses on the separation of light hydrocarbon mixtures-specifically, propylene/propane mixtures-by membrane pervaporation. A preliminary analysis indicated that the recovery of propylene from reactor purge gas streams using separation systems based on these materials is economically attractive. These purge streams are numerous-more than 400 streams of this type exist worldwide - but too small to be treated by distillation. Nonetheless, the amount of propylene involved is substantial. An estimated 685 million pounds of propylene are recoverable from reactor purge streams in the United States alone. In the Phase II project, the current best membrane will be optimized, scaled up and formed into bench-scale membrane modules.

This project involves the separation of propylene/propane mixtures; application to the separation of many other mixtures is possible. The proposed membrane pervaporation process addresses a market need - the economical recovery of propylene, a valuable chemical feedstock, from propane-containing waste gas streams that cannot be satisfied by alternative technologies.

Title: SBIR Phase II: Investigation of Novel, Low-Cost Materials and Manufacturing Methods for Polymer Electrolyte Membrane (PEM) Fuel Cell Bipolar Plates

Award Number: 9983456
Program Manager: Rosemarie D. Wesson

Start Date: May 15, 2000
Expires: April 30, 2002
Total Amount: $399,924
Investigator: Holly Grammer, hgrammer@vt.edu
Company: Directed Technologies, Inc.
3601Wilson Blvd., Ste 650
Arlington, VA 22201
Phone: (703)243-3383

Abstract:

This Small Business Innovation Research Phase II project will continue the development of inherently low cost, mass-producable conductive composite materials and novel manufacturing processes for Polymer Electrolyte Membrane (PEM, also called Proton Exchange Membrane) fuel cells. Current PEM fuel cell bipolar plates often achieve good overall technical performance, but have some combination of high materials, manufacturing and assembly cost. This high cost is a barrier to market penetration of fuel cells. In order to develop a fuel cellbipolar plate which has acceptable technical performance, as well as, low cost, novel composite materials amenable to low cost manufacture will be developed. Three novel manufacturing processes identified during Phase I will be used to fabricate small and large format bipolar plates from composite materials identified in Phase I. These bipolar plates will be tested for electrical conductivity and will be operated in both short-term, performance-oriented testing and longer-term, lifetime testing. Additionally, the materials development work of Phase I will be continued in order to further optimize the novel composite materials for performance and cost.

Successful completion of the project will lead to low cost, mass-manufacturable fuel cell stacks, thereby enhancing U.S. competitiveness in the emerging markets for fuel cells. This will further lead to a greatly accelerated market penetration of fuel cells especially in low cost applications such as light duty vehicles

Title: SBIR Phase II: Carbon Nano Composite Filtration Media

Award Number: 0078865
Program Manager: T. James Rudd

Start Date: September 15, 2000
Expires: August 31, 2002
Total Amount: $400,000
Investigator: Stephen Jaffe, smjaffe@materialmethods.com
Company: Material Methods
21571 Via Del Angel
Lake Forest, CA 92630
Phone: (949)707-1829

Abstract:

This Small Business Innovation Research Phase II project will make self-assembled, nanocomposite building blocks, composed of carbon nanotubes on a macroscopic support. Phase I demonstrated the growth of high quality, long nanotubes, adhered to a metal mesh. The support catalyzes the growth of a dispersed uniform structure of sootfree nanotubes. Additional processing is not required. Traditional manufacturing processes can convert the composite into filters, electrodes, and structures that transport mass, charge, and stress on nanometer scales. The nanotubes remain organized and connected electrically and mechanically. Intimate solid-gas and solid-liquid contact accompanied by high transport rates result. Unlike porous nanoscale media, the pore size can be independent of the nanotube diameter, allowing rapid access to their surface.

The Phase II product will be microfiltration media with unprecedented filtration efficiency and low energy cost. Carbon nanotubes have enhanced single-collector efficiencies and substantially high surface to volume ratios. These advantages produce enormous, pound-for-pound value. The industrial partner has committed Phase III funding based on initial testing and market pull for low-energy, cost-effective separation technology. The industrial partner is committed to nanoscale technologies and the tremendous physical properties of the supported nanocomposites.

Title: SBIR Phase II: Surface Enhanced Dry Magnetic Separation

Award Number: 9983422
Program Manager: Rosemarie D. Wesson

Start Date: May 1, 2000
Expires: January 31, 2003
Total Amount: $399,995
Investigator: Robin Oder, roder@magneticseparation.com
Company: EXPORTech Company Inc
P.O. Box 588
New Kensington, PA 15068
Phone: (412)337-4415

Abstract:

This Small Business Innovation Research Phase II project will apply the ElectriMag (tm) concept to separation of unburned carbon from coal combustion fly ash. A proprietary add-on reactor will be tested for separation of ammonia from fly ash particles at plants using catalytic nitrogen oxide separators. The ElectriMag (tm) separator (patent pending) combines triboelectric forces with magnetic forces to allow the separation of particles which have similar magnetic properties but differing surface electrical charging characteristics, or vice versa. An alpha prototype built and tested in Phase I showed the feasibility of the concept. A beta prototype will be designed, built, and tested on fly ash from coal fired power plants in Phase II; this model will incorporate changes suggested by the work of Phase I. A conceptual level engineering evaluation will be done and a conceptual design of a 2000 Lb/Hr pilot unit will be made.

Potential commercial applications include separation of unburned carbon from fly ash, recovery of activated carbon from municipal incinerator fly ash, and dry coal cleaning.

Title: SBIR Phase II: Membrane Hydrogen Dissolution for Bioremediation of High Strength Nitrate Waste

Award Number: 9983421
Program Manager: Om P. Sahai

Start Date: June 1, 2000
Expires: December 31, 2004
Total Amount: $411,500
Investigator: Stuart Nemser, snemser@compactmembrane.com
Company: Compact Membrane Systems, Inc.
325 Water Street
Wilmington, DE 19804
Phone: (302)999-7996

Abstract:

This Small Business Innovation Research Phase II project will expand the Phase I study, examine the effect of high nitrate loading and demonstrate the technology at a drinking water treatment site, by treating the brine regenerant stream from an ion exchange water treatment system. This would broaden utilization base of the technology and allow increased market penetration since the technology will supplement the existing technology base and reduce the operating costs of the currently practiced technologies for NO3 removal. This will lead to both high probability of commercial success plus a large sales base to allow for lower pricing in remediation markets. Across the United States there are a number of drinking water facilities that are wrestling with the problem of high concentrations of dissolved nitrates in their influent water streams. The present methods of removal resort to concentrating the NO3 into a small volume by means of reverse osmosis or ion exchange and then disposing off this concentrated stream, appropriately. The recovered NO3 in such a waste stream can be destroyed biologically using dissolved hydrogen gas as the electron donor. Hydrogen offers several economic and operational advantages over other organic electron donors in denitrification. The factor limiting hydrogen use is its low solubility, i.e. existing commercial gas-dissolution technologies cannot dissolve sufficient hydrogen in a safe, cost effective manner. Membrane-based gas-dissolution technologies can potentially supply the hydrogen required for these processes safely, but commercially available membrane suitable for bubble-free gas-dissolution have poor performance, biological fouling, or both.

Compact Membrane Systems, Inc., has developed a highly gas permeable perfluoropolymer coating for microporous membranes. The smooth, non-porous nature of the perfluoropolymer coating is highly resistant to biological fouling, especially compared to microporous hydrophobic membranes. This coating could remove the performance, fouling, and cost barriers that preclude the use of membrane-based gas dissolution technologies in continuous biological processes. The Phase I study established concept feasibility and demonstrated that nitrates could effectively remediate without the formation of nitrites in a continuous mode.

Title: SBIR Phase II: Chemically Resistant Gas Separation Perfluoromembranes

Award Number: 0078470
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2000
Expires: July 31, 2004
Total Amount: $686,048
Investigator: John Bowser, jbowser@compactmembrane.com
Company: Compact Membrane Systems, Inc.
325 Water Street
Wilmington, DE 19804
Phone: (302)999-7996

Abstract:

This Small Business Innovative Research Phase II project will optimize and scale up the system developed in Phase I (a nonporous perfluoromembrane system for harsh gas separations). These nonporous perfluoromembrane systems provide industry for the first time with a system (membrane module, glue lines, potting, valves, etc.) that has good gas transport rates and separation capabilities composed totally of perfluorocomponents. In Phase I, laboratory testing and economic evaluations showed these membranes could economically remove hydrogen, carbon dioxide, and key non-condensable gases from chlor-alkali tail gases and in so doing dramatically enhance the recovery of chlorine. Analysis comparing the Compact Membrane Systems, Inc. (CMS) technology to alternative membrane and other unit operations (e.g. absorption) technologies, indicated the CMS technology is significantly superior. Large sheet nonporous perfluoromembrane fabrication has been demonstrated in Phase I. All the key components are in place for large scale module fabrication in Phase II. In Phase II we will optimize and scale up the system. Detailed and representative (-20oC) end use testing and long term testing will be conducted in the laboratory prior to field testing. While the focus of this program is chlor-alkali harsh chemical separations, other harsh chemical processes (e.g. fluorochemical synthesis) will be considered.

A close working relationship with a number of large membrane manufacturers and end users allows us to rapidly and effectively drive this program. Phase I testing was done using both single gas testing and mixed gas testing. Materials evaluated include chlorine, Cl2CF2, SF6, hydrogen, oxygen, nitrogen, carbon dioxide, and helium. Results showed mixed gas results were equal or superior to single gas results. This suggests that minimal plasticization or other anomalies are occurring within the system. This would suggest we can project actual end use performance accurately.

Title: SBIR Phase II: Fabrication of Low-Cost Modules Incorporating Microporous Silica Membranes for Natural Gas Purification

Award Number: 0078474
Program Manager: Rosemarie D. Wesson

Start Date: August 1, 2000
Expires: July 31, 2003
Total Amount: $400,000

Investigator: Richard Higgins, higgins@ceramem.com
Company: CeraMem Corporation
12 Clematis Avenue
Waltham, MA 02453
Phone: (617)899-4495

Abstract:

This Small Business Innovation Research Phase II project addresses development of economical membrane-based devices primarily suitable for: (a) purification of sub-quality raw natural gas to pipeline quality and (b) carbon dioxide recovery from enhanced oil recovery operations. A large fraction of domestic natural gas reserves are uneconomical for recovery based on current market conditions because they contain significant amounts of non-methane gas. Membrane-based devices are currently commercially employed to purify sub-quality natural gas, but membranes with improved productivity compared to now state-of-the-art devices are required to allow economic use of currently unrecoverable natural gas. The overall objective of this program is to develop an innovative fabrication approach to incorporate microporous silica membranes within low-cost, highly compact modules. Microporous silica membranes exhibit combinations of carbon dioxide permeance and CO2/CH4 selectivity that are unrivaled by conventional organic gas separation membranes, but have not yet been incorporated in low-cost modules to allow their commercialization. Commercial availability of such modules would greatly reduce costs associated with upgrading sub-quality natural gas reserves. In Phase I, the feasibility of the novel module fabrication approach was demonstrated. In Phase II, the separation properties of very small modules will be improved through systematic optimization of processing. Modules with ca. 0.1 m2 membrane area will be fabricated and tested for extended duration for separation of simulated raw natural gas, and a detailed manufacturing scheme with related costs will be developed in preparation for commercialization of the technology.

The devices to be developed in this program would significantly reduce costs associated with purification of gas streams in the following applications: natural gas upgrading, carbon dioxide recovery from enhanced oil recovery operations, and biogas processing.

Title: SBIR/STTR Phase II: Development of Stable Membrane-Based Gas-Liquid Contactors for SO2 Removal from Flue Gas

Award Number: 0078527
Program Manager: Om P. Sahai

Start Date: January 1, 2001
Expires: December 31, 2004
Total Amount: $403,656
Investigator: Sudipto Majumdar, sudipto.majumdar@compactmembrane.com
Company: Compact Membrane Systems, Inc.
325 Water Street
Wilmington, DE 19804
Phone: (302)999-7996

Abstract:

This Small Business Innovation Research Phase II project will demonstrate the enhanced performance of membrane-based gas-liquid contactors to abate SO2 emissions from flue gas. SO2 present in flue gas streams leads to deforestation and damage to crops and property as a result of its participation in the formation of acid rain. In Phase I, Compact Membrane Systems, Inc. (CMS) developed a nonporous perfluorocopolymer composite membrane designed for use in membrane-based gas liquid contactors to scrub flue gas of SO2 using an aqueous absorbent solution. This membrane is designed to overcome the major drawbacks of conventional microporous supports, i.e. progressive wetting out of the microporous substrate by the (typically) aqueous absorbent and in some instances salt precipitation at the liquid-gas interface. In addition to all the operational advantages of membrane contactors, CMS membranes result in sustained improved SO2 removal efficiencies. During Phase I it was demonstrated that this membrane permeated SO2, scrubbed a flue gas simulant gas stream of SO2 as well as if not better than a conventional microporous membrane contactor under identical conditions, and showed no loss in performance despite exposure to an acidified silica suspension. Phase II will scale-up the process to employ large pilot-scale contactors, study absorbent regeneration technologies, demonstrate the whole process on a pilot-scale combustor, and demonstrate that the CMS system offers better efficiencies and economics of flue gas removal compared to existing systems.

The enhanced performance of membrane-based gas-liquid contactors to abate SO2 emissions from flue gas is of considerable interest to ore processors, pulp and paper industries, many oil and natural gas processors (particularly those which have to treat tail gases from gas sweetening processes), power plants employing coal as a fossil fuel, etc.

Title: SBIR Phase II: Segmented Proton Exchange Membranes with Edge Seals for Compact Fuel Cell Electrode Structures

Award Number: 0239174
Program Manager: Rosemarie D. Wesson

Start Date: January 15, 2003
Expires: December 31, 2004
Total Amount: $499,926
Investigator: Robert C. McDonald, rmcdonald@ginerinc.com
Company: Giner EC Systems, LLC
89 Rumford Avenue
Newton, MA 02466-1311
Phone: (781)529-0500

Abstract:

This Small Business Innovative Research Phase II project will demonstrate practical and cost-effective designs for a high energy density Proton Exchange Membrane (PEM) Fuel Cell. The approach taken will utilize the treatment of membranes with Interpenetrating Polymer Networks (IPN), as demonstrated in Phase I, to create regions with enhanced strength and the desired ionic, reactant and water transport properties for a viable Segmented Fuel capable of operating with ambient diffused oxygen for portable applications. A systematic modeling procedure will be developed to generate optimal, thermally and hydraulically stable segmented fuel cell designs, with specific electrode arrays, given voltage, and power requirements. Size/weight trade-offs will be considered.

The work supports the effort to develop fuel cells for portable consumer and industrial power, which is safe, durable and energy efficient. PEM based fuel cells are a mature technology which takes advantage of very simple chemistry and the introduction of the GES IPN-improved membranes will permit designers greater flexibility in producing fuel cells which meet the needs for portable computers, tools, communication, medical and industrial equipment.

Title: SBIR Phase II: The ResonantSonic Enhanced Mixer and Coalescer (RSEMC) as an Advanced Solvent Extraction Technology

Award Number: 0321499
Program Manager: Rosemarie D. Wesson

Start Date: July 1, 2003
Expires: June 30, 2005
Total Amount: $500,000

Investigator: Joel Pierce, jpierce@resodyn.com
Company: Montec Research
1901 South Franklin
Butte, MT 59701
Phone: (406)723-2222

Abstract:

This Small Business Innovation Research Phase II (SBIR) project will develop and demonstrate a novel prototype solvent extraction (SX) device, which, by virtue of its highly uniform shear and mixing intensity, has the potential to supplant existing SX units in terms of extraction and phase separation rates. The technical approach of the Phase II project is as follows: Develop performance and scale-up principles for the SX device, optimize the hardware configuration and process conditions; 2.) Apply the results to the design of a reliable prototype SX system that demonstrates improved mass transfer and phase separation, and decreased entrainment at power consumption levels equivalent to existing equipment. The Phase I copper extraction work showed a 3-5 fold improvement in extraction and phase separation rates over existing mixer-settlers that are used in the minerals industry for the recovery of copper.

The commercial benefits of the ResonantSonic solvent extraction device to the minerals industry are reduced equipment size and footprint, reduced solvent loss, and improved electrowinning efficiency. Reducing the solvent loss to the environment has great societal benefit as losses can exceed 100,000 gallons per year per mine site. Other potential applications are metals separation, and the recovery of vitamins, antibiotics, and other pharmaceuticals

Title: SBIR Phase II: Concentration of Thermally Labile Solutes

Award Number:	0110267
Program Manager:	Rosemarie D. Wesson
Start Date:	July 15, 2001
Expires:	June 30, 2004
Total Amount:	$500,000

Investigator: John J. Bowser, jbowser@compactmembrane.com
Company: Compact Membrane Systems
325 Water Street
Wilmington, DE 19804-2410
Phone: (302)999-7996

Abstract:

This Small Business Innovation Research (SBIR) Phase II project will demonstrate in actual field tests the novel room temperature dewatering process. In the Phase I project, Compact Membrane Systems, Inc. (CMS) demonstrated a stable osmotic distillation (OD) process on orange juice, grape juice, and coffee. In typical applications, solids levels were increased from approximately 10% sugar to approximately 70% sugar. Taste tests showed no significant difference between original juice and re-diluted OD product. Process stability was demonstrated by obtaining equivalent product when operating temperature was increased to 40C and maintaining performance after multiple juice dewatering and cleaning cycles. Product stability was demonstrated by leaving OD juice concentrate open to air with no microbiological growth due to very low water activity in the juice concentrate. In the OD process the solution to be dewatered is placed on one side of the hydrophobic membrane and a high salinity feed is placed on the other side. Water vapor then moves from the solution to the high salinity side. While OD has been around for 15 years, no significant commercial products have been developed due to these hydrophobic microporous membranes rapidly wetting out. This project will demonstrate a novel, non-porous perfluoromembrane that eliminates wet-out while maintaining high water vapor transport.

Potential commercial applications include beverages, pharmaceuticals, neutraceuticals, and industrial chemicals.

Title: SBIR Phase II: Reactive Nanoparticles as Destructive Adsorbents

Award Number: 0091369
Program Manager: Rosemarie D. Wesson

Start Date: March 15, 2001
Expires: February 29, 2004
Total Amount: $499,995
Investigator: Kenneth J. Klabunde, kenjk@ksu.edu
Company: Nanoscale Materials, Inc.
1310 Research Park Dr.
Manhattan, KS 66502
Phone: (913)532-0179

Abstract:

This Small Business Innovation Research (SBIR) Phase II project focuses on the development and optimization of a continuous, easily scalable and economical synthesis of reactive nanoparticles (RNPs); characterization and control of physical and chemical properties of these materials; development of flexible synthesis approaches for production of complex nanoparticle metal oxides; and identification and establishment of quality control procedures. This effort is critically needed in order to develop commercially viable nanomaterials for applications in both civilian and military markets. As demonstrated during the Phase I research, nanomaterials, produced using the proprietary continuous process, possess the same chemical and physical properties as those prepared in a batchwise mode.

The research is broad and spans a number of significant markets including decontamination technologies for military and civilian applications, improved catalysts and catalytic supports, industrial gas scrubbing, and active ingredients for high efficiency air and water purification systems. Each of these market applications represents an initial subset of the market opportunities for these highly reactive nanomaterials.

Title: SBIR Phase II: High Flux Metal-Ceramic Hydrogen Separation Membranes

Award Number: 0548757
Program Manager: Rosemarie Wesson

Start Date: March 6, 2006
Expires: February 29, 2008
Total Amount: $422,292
Investigator: Dimitri Routkevitch, droutkevitch@synkera.com
Company: Synkera
2021 Miller Dr Unit B
Longmont, CO 80501
Phone: (720)494-8401

Abstract:

This Small Business Innovation Research (SBIR) Phase II project targets development of an innovative membrane for separation of hydrogen. These membranes are based on an innovative nanostructured architecture and a unique fabrication process. The proposed approach enable an ultra-thin Pd separation layer, which can support a 10X or greater increase in hydrogen flux over the state of the art, with no reduction in hydrogen selectivity and superior reliability. The performance of the prototypes will be thoroughly validated in actual operating environments.

The expected result of the proposed work is a viable technology for the production of robust hydrogen separation membranes with advanced performance, superior reliability and lower cost. Such an enabling technology could facilitate a variety of current applications, such as hydrogen separation for fuel cells and point-of-use hydrogen purification. With further research and development, hydrogen could also serve as an alternative source of energy for heating and lighting homes, generating electricity, and transportation.

Title: SBIR Phase II: Catalytic Nanochannel Reactor Arrays for Fuel Reforming

Award Number: 0724408
Program Manager: Rathindra DasGupta

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000
Investigator: Dmitri Routkevitch, droutkevitch@synkera.com
Company: Synkera
2021 Miller Dr Unit B
Longmont, CO 80501
Phone: (720)494-8401

Abstract:

The Small Business Innovation Research (SBIR) Phase II project proposes to develop and commercialize advanced nanochannel array reactors for efficient and cost-effective fuel reforming for fuel cells and other applications. Conventional reformers have significant performance, size, reliability and cost issues that prevent broad-scale introduction of polymer electrolyte membrane (PEM) fuel cell systems, especially in the portable power market segment. To overcome these limitations, a highly innovative approach based on the nanoporous ceramics is being pursued to create ultra-light and ultra-compact reactors. That approach was successfully validated during Phase I. The results unequivocally demonstrated the feasibility of methanol reforming and confirmed the strong competitive advantages of the proposed architecture over conventional reactors.

The Phase II aims to develop application-specific reactor prototypes and to initiate their integration into PEM fuel cell systems. The expected outcome will be a manufacturing technology for low-cost and compact yet highly efficient and reliable reactors for point-of-use hydrogen generation. This technology has a potential to facilitate the development of more affordable fuel cell power system for broader government, commercial and consumer applications, especially in the portable power (0.1-1kW) market segments, and will benefit our society by contributing to energy security and availability of environmentally friendly energy solutions.

Title: SBIR Phase II: Low-cost Ceramic Membranes for Drinking Water Treatment

Award Number: 0724326
Program Manager: Rathindra DasGupta

Start Date: September 1, 2007
Expires: August 31, 2009
Total Amount: $500,000

Investigator: Christopher Hoffman, hoffman@ceramem.com
Company: CeraMem Corporation
12 Clematis Avenue
Waltham, MA 02453
Phone: (617)899-4495

Abstract:

The Small Business Innovation Research (SBIR) Phase II project seeks to develop a novel approach for fabrication of ceramic membranes that would provide a significant reduction in fabrication costs. Membrane filtration is becoming an important process for drinking water treatment. Much of this growth is due to development of low-cost polymeric membranes that can compete economically with traditional methods of water treatment. Ceramic membranes can be used to achieve the same level of water quality as provided by polymeric membranes, with several distinct advantages: ceramic membranes provide higher fluxes, reduced fouling rates, and longer lifetimes with fewer integrity issues. Historically, ceramic membranes have not been competitive with traditional methods or polymeric membranes due to high manufacturing costs. Recent developments that offset the high manufacturing costs have allowed ceramics to be competitive with polymerics in some markets. By developing the proposed innovation, ceramic membrane module cost will be further reduced, giving ceramics an advantage over currently employed polymeric membranes.

Increased membrane usage in water treatment will lead to safer drinking water for the 90% of Americans that receive their water from community water systems. For the water systems that employ ceramic membranes, there will be less cost, maintenance, and concerns of system integrity failures. Additionally, the technology developed in this program would be applicable to ceramic microfiltration and ultrafiltration membranes for all food, beverage, chemicals, pharmaceutical, energy, wastewater, and water applications. Energy efficient separation processes requiring robust membranes would become more economically viable, potentially lowering the 4,500 T Btu of energy consumed annually for industrial separations.