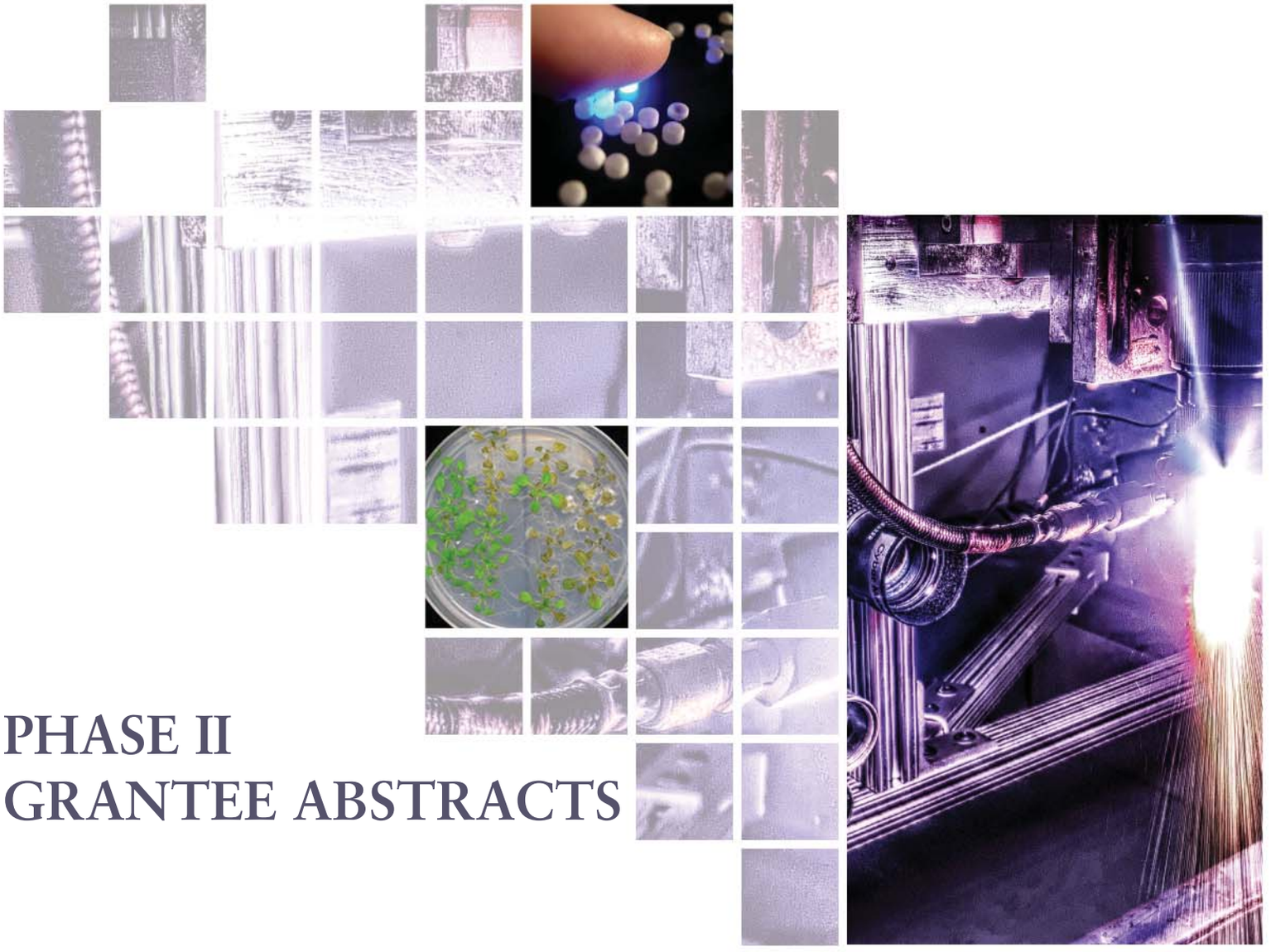


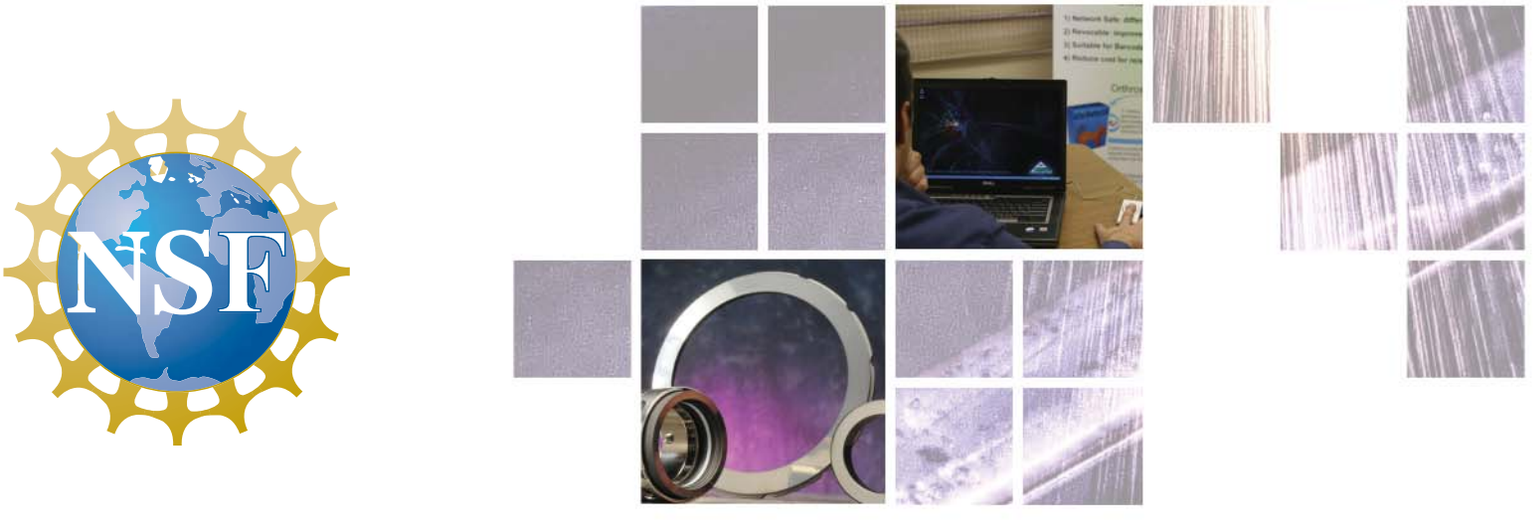
PHASE II GRANTEE ABSTRACTS

National Science Foundation

Division of Industrial Innovation & Partnerships

SBIR/STTR Phase II Grantee Conference

May 18-21, 2009 • Baltimore, Maryland



About IIP

The Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program is housed in the Division of Industrial Innovation and Partnerships (IIP) within the Directorate for Engineering of the National Science Foundation. The IIP Vision is to be the pre-eminent federal resource driving the expansion of our nation's innovation capacity by stimulating partnerships among industry, academe, investors, government and other stakeholders. In addition, the IIP mission is to enhance our nation's economic competitiveness by catalyzing the transformation of discovery into societal benefits through stimulating partnerships and promoting learning environments for innovators. The strategy for the SBIR/STTR Program is to invest in cutting-edge, high risk, high quality applied research in science, engineering and education with a clear goal of innovation that benefits society and the nation through commercialization. The SBIR/STTR Program seeks opportunities to integrate with other innovation-oriented NSF academic programs to achieve synergistic partnership with the academic and industrial sectors.

The Division of Industrial Innovation and Partnerships plays an important role in the public-private innovation partnership and funds research proposals from the small business community in leading technologies. IIP periodically issues SBIR/STTR solicitations with research topics selected from a broad spectrum of technologies including:

BIOTECHNOLOGY & CHEMICAL TECHNOLOGIES (BC)
EDUCATION APPLICATIONS (EA)
INFORMATION & COMMUNICATIONS TECHNOLOGIES (ICT)
NANOTECHNOLOGY, ADVANCED MATERIALS & MANUFACTURING (NAM)

Awards in these topics find applications in the following Sectors:

- **Biotechnology**
- **Coatings**
- **Devices & Instruments**
- **Education**
- **Energy**
- **Enterprise Software Applications**
- **Manufacturing Processes**
- **Materials**
- **MEMS & Electro-Optics**
- **Nanotechnology**
- **Robotics & Assistive Technologies**
- **Sensors**
- **Wireless Technologies**

The SBIR/STTR Program accepts only those proposals that are submitted in response to an open solicitation. Unsolicited proposals are not accepted.

For additional information, visit the website at http://www.nsf.gov/eng/iip/sbir/.

Images & Credits

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Blue Plasma-sphere for use as pixel elements in large area flexible; the Plasma-spheres are hollow gas encapsulating shells.
Credit: Imaging Systems Technology.

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The Cyber Materials Flux Sentinel characterizes a plasma spray plume.
Credit: Michael Cannamela and Matthew Tuttle.

Mendel Biotechnology Inc., 0450162
Transgenic Arabidopsis plants expressing a modified transcription factor show increased survival compared to non-transgenic plants when infected with the fungal pathogen Sclerotinia (white mold).
Credit: Sky Eales.

Securics, Inc., 0750485
Securics employee Charles Beckmann uses the Orthrus Secure and Private Biometric Login system to access his laptop.
Credit: Securics, Inc.

Advanced Diamond Technologies, 0521596
UNCD Faces enhance the wear resistance and robustness of mechanical shaft seals.
Credit: Argonne National Laboratory.

BIOTECHNOLOGY & CHEMICAL TECHNOLOGIES

Mendel Biotechnology Inc., 0450162
Transgenic Arabidopsis plants expressing a modified transcription factor show increased survival compared to non-transgenic plants when infected with the fungal pathogen Sclerotinia (white mold).
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Credit: Iris AO & Paris Observatory.

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Credit: istockphoto.com.

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BIOTECHNOLOGY & CHEMICAL TECHNOLOGIES

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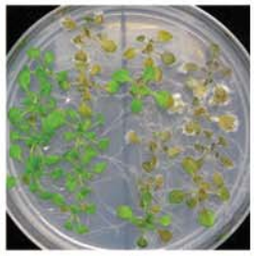
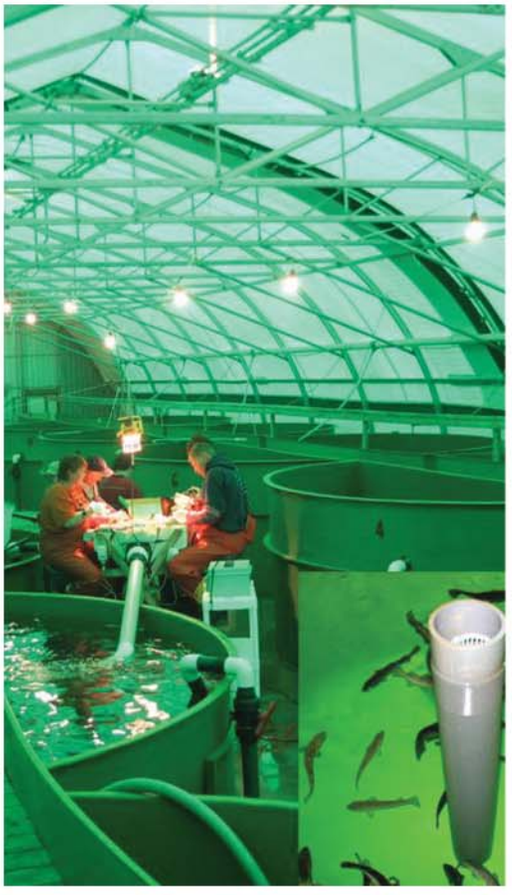
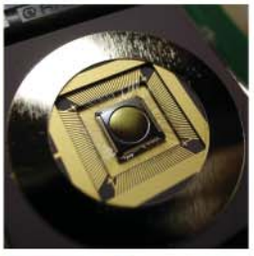
NANOTECHNOLOGY, ADVANCED MATERIALS & MANUFACTURING







Biotechnology & Chemical Technologies (BC)

ADA Technologies, Inc.

Phase II Award No.: 0724468

Award Amount: $505,993.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Program Director: Cynthia A. Znati

Sector: Energy

SBIR Phase II: Developing Advanced Ultracapacitors Using Carbon Nanomaterials and Environmentally Friendly Electrolytes

This NSF funded Small Business Innovation Research project develops advanced ultracapacitors for hybrid electric vehicles (HEVs). Ultracapacitors are energy storage devices that combine the high energy density of conventional batteries and the high power density of conventional capacitors. Able to provide power pulses in a short period of time, ultracapacitors are uniquely suitable as power assists for HEVs. However, currently available ultracapacitors suffer from limited performance (energy and power densities), poor safety, and short cycle-life, which are strongly determined by the limited properties of the electrode and electrolyte materials that are employed to fabricate ultracapacitors. The present project combines the unique properties of carbon nanotube (CNT) electrodes with those of environmentally friendly ionic liquid electrolytes to solve these limitations and develop ultracapacitors possessing high performance, high safety, and long life for advanced HEVs.

Phase I research achieved fast charge storage/delivery dynamics and high capacitance for CNTs in ionic liquids. Superior performance and cycle life have been demonstrated for test capacitors fabricated from the CNTs and ionic liquids. Phase II research has been optimizing CNT electrode materials and investigating the approaches to produce the selected CNT electrodes in larger scale. A method of in-situ growth of CNTs onto porous carbon fiber paper substrate has been determined to be appropriate for producing large-scale CNT electrodes for ultracapacitor applications. These electrode materials will be produced for fabricating prototype ultracapacitors with ionic liquid electrolytes. The technology under development of the present project promises a next generation of ultracapacitors, offering superior performance and lesser environmental concerns versus existing ultracapacitor designs. Advanced vehicular ultracapacitors are extremely useful in providing power pulses for HEVs. This will help achieve better fuel economy, decrease harmful emissions, and reduce our nation's reliance on foreign sources of petroleum.

Prior to this NSF SBIR project, ADA Technologies, Inc. initiated the research of ionic liquid electrolytes for ultracapacitor applications under a DoE SBIR project ("High Performance Electrolytes for Electrochemical Capacitors", DE-FG02-05ER84218), demonstrating the advantages of the use of ionic liquids as electrolytes for ultracapacitors with conventional activated carbon electrode materials. In this NSF SBIR project, with their improved properties, use of CNT electrodes to replace activated carbon electrodes has resulted in improved performance for ultracapacitors. Moreover, leveraging the knowledge learned from these projects, we developed an approach combining CNTs with activated carbons and ionic liquids to synthesize novel nanocomposite electrodes under another DoE SBIR project ("High Performance Carbon Nanomaterials for Electrochemical Capacitors", DE-FG02-07ER84688). Comparing to pure CNTs, these composite materials have a lower cost and are conductive to mass production. They have been demonstrated to be able to combine with ionic liquid electrolytes to fabricate high performance ultracapacitors.

Affinity Biosensors

Phase II Award No.: 0724350

Award Amount: $498,405.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Program Director: Gregory T. Baxter

Sector: Devices & Instruments

SBIR Phase II: Particle Metrology and Diagnostics using Microchannel Resonators

This project has produced an instrument, dubbed Archimedes, able to measure particles smaller than one micron (a millionth of a meter). It does this by weighing them one at a time, very quickly. Such particles are used throughout research and industry: in the paint on your car, in the ink in your printer, as vehicles for drug delivery, and in numerous high-tech materials. Measuring them is key to innovation and to ensuring quality and safety. Archimedes employs a miniaturized sensor with a very narrow channel that vibrates like a tuning fork – but at frequencies 10 times higher than humans can hear. Particles are suspended in water and flowed through the vibrating channel. Due to its mass, the presence of a particle will very slightly change the tone of the tuning fork, by about one part in a million. Archimedes measures that shift in tone with ultra high precision, and thereby reveals the particle's mass. By so measuring hundreds or thousands of particles in a few minutes, Archimedes provides a complete statistical picture of particle masses and sizes. Because it works with samples in water, it can also weigh living cells and bacteria (and, eventually, viruses), for which we anticipate many applications in fundamental biology ("what governs cell growth?"), clinical studies ("is this form of tuberculosis drug-resistant?"), and therapeutics ("does this compound interfere with tumor formation?")

This innovation stems from the research of Professor Scott Manalis (MIT Biological Engineering), whose group developed the SMR concept and produced the first prototype systems under grants from the Air Force, the Army Research Office, and the National Institutes of Health. Development was continued under a grant from the Institute for Collaborative Biotechnologies (Ken Babcock, principal investigator), which partnered MIT, the Food Safety Technology group at the Army's Natick Soldier Center, and Innovative Micro Technology, a leading MEMS foundry. The main outcomes of that project were ultra-high resolution SMR sensors manufacturable via MEMS in batch form, and measurements of molecular binding, particles, and bacteria. These results were described in a paper published in Nature in April 2007. Phase I of this SBIR program was started by IMT to test the feasibility of weighing bacteria for diagnostic purposes. Affinity Biosensors was then founded with the mission of developing SMR for commercial use, and partnered with IMT, which supplies the SMR sensors. Upon identifying particle characterization as a chief application, Affinity Biosensors proposed that topic for this Phase II program.

Air Control Techniques, P.C.

Phase II Award No.: 0822985

Award Amount: $490,912.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Program Director: Gregory T. Baxter

Sector: Manufacturing Processes

SBIR Phase II: Photochemical Treatment of Dioxin-Furan Compound Emissions from Industrial Processes

This SBIR Phase II research will advance the use of photochemistry for the control of toxic air pollutants emitted from industrial sources such as furnaces, boilers, and kilns. The types of ultraviolet lamp sources now used successfully for wastewater treatment, water purification, and air stream disinfection will be adapted for use in the more challenging environment of industrial process effluent gas streams. This research program concerns a photochemical system designed to destroy highly toxic compounds called dioxin-furans, which are unintended byproducts of some industrial processes. During an extended test program at an industrial facility, the researchers will evaluate: (1) long-term ultraviolet lamp energy efficiency in hot, dust-laden gas streams, (2) dioxin-furan destruction efficiencies during routine variations in source conditions, (3) reaction product characteristics, and (4) reductions in pollutants in addition to the targeted dioxin-furans.

The broader impacts of this research will include an improved understanding of the chemical reactions of dioxin-furan compounds at the gas temperatures and pollutant concentrations typical of industrial gas streams. The results will help assess the applicability of photochemical systems to provide high efficiency air pollution control while reducing emissions of greenhouse gases produced by existing control techniques. Photochemical systems that destroy toxic air pollutants will provide an attractive alternative to systems that retain the toxic compounds on adsorbents disposed in landfills. The development of ultraviolet light technology will result in reduced air emissions of persistent toxic pollutants that bio-accumulates in the food chain and cause adverse human health effects.

Algaen Corporation

Phase II Award No.: 0724411

Award Amount: $448,550.00
Start Date: 07/01/2007
End Date: 06/30/2009

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Program Director: Gregory T. Baxter

Sector: Manufacturing Processes

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

This NSF funded SBIR Phase II project is to develop an innovative biotechnology for commercial production of natural astaxanthin using a green alga Haematococcus grown in a proprietary large-scale photobioreactor. Astaxanthin is a powerful bioactive antioxidant, exhibiting strong free radical scavenging activity, protecting against lipid peroxidation and oxidative damage of cell membranes, proteins and DNA. In pharmaceutical and nutraceutical applications, astaxanthin has great potential and increasing market value. Haematococcus is the best known source of astaxanthin in the nature. However, the production cost is very high and, the bioavailability is low due to the thick and rigid cell wall of Haematococcus. This research & develoment efforts aim to overcome the major weakness inherent in the present production method. 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 Haematococcus and to demonstrate enhanced bioavailability of astaxanthin, using trout and mouse as experimental model organisms. The improved production system will increase astaxanthin productivity by 1.5- to 2-fold with at least 30% cost reduction per unit of astaxanthin produced, compared to existing production facilities.

The Principle Investigator, Dr. Fan Lu, has been working on astaxanthin/Haematococcus since he was a graduate student. In 2002, the idea of using cell wall-less mutant to improve bioavailability of astaxanthin was conceived, and was further validated by the NSF SBIR Phase I award. The concept was proven in this Phase I project and several mutants were isolated. In 2006, the second SBIR Phase I project was awarded for the continuation of the R&D efforts to commercialize this technology. The current Phase II award has greatly accelerated the progress for commercial production of natural astaxanthin from the Haematococus. Small scale sample is expected to be produced from this project in 2009, and we plan to start production in 2010.

American BioOptics, LLC

Phase II Award No.: 0823064

Award Amount: $500,000.00
Start Date: 07/15/2008
End Date: 06/30/2010

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Program Director: Cynthia A. Znati

Sector: Devices & Instruments

SBIR Phase II: Optical Spectroscopy for Colon Cancer Screening without Colonoscopy

This SBIR Phase II project aims to develop a commercial grade optical probe and system for FDA clinical trials and subsequent commercialization of a population-wide colon cancer screening test. An interdisciplinary research team of engineers, biologists, and clinicians has developed low-coherence enhanced backscattering (LEBS), an optical technique which enables sensing tissue microarchitectural correlates of the genetic/epig enetic changes in otherwise histopathologically normal mucosa. The preliminary animal and human studies demonstrated the potential of LEBS to detect subtle alterations in histologically normal-appearing tissue that occur with the presence of precancer in a different part of an organ, a consequence of the well-established concept of field carcinogenesis. This opens a possibility to detect colonic adenomas by means of LEBS analysis of rectal tissue, which is readily accessible using a rectal probe and without the need for colonoscopy or bowel preparation. Indeed, ex vivo human studies and a small-scale trial of the in vivo LEBS probe from Phase I research demonstrate that rectal LEBS is remarkably accurate for predicting neoplasia anywhere in the colon. In continued close collaboration with the research team, American BioOptics endeavors in Phase II to refine the prototype LEBS probe into a medical-grade probe for use in a patient without bowel preparation and to develop a low-cost LEBS optical system for multi-center FDA trials and subsequent commercialization.

LEBS has the potential to become the first truly population-wide test for colon cancer screening performed during an annual exam by a primary care physician, without colonoscopy or bowel preparation to determine the need for colonoscopy. The proposed test would be simple, inexpensive, minimally intrusive and highly accurate without the need for bowel cleansing. Colon cancer is the second leading cause of cancer deaths in the U.S. largely because of especially poor screening participation relative to other major cancers. Only a small fraction of eligible population (90 million Americans over age 50) undergoes screening colonoscopy due to a variety of reasons including expense, patient reluctance, complications, and insufficient number of endoscopists. Development of a minimally invasive test to identify patients who do and do not harbor colonic adenomas is of crucial importance to enable, for the first time, population-wide screening for this disease. Currently, no such initial screening test is available. Based on the results of the LEBS test, the physician could recommend either no colonoscopy (the majority of cases) or need for colonoscopy (which the patient will be more compliant with). Thus, with a readily available LEBS screening test developed in Phase II and subsequent FDA approval, more patients with colonic neoplasia will undergo colonoscopy. The LEBS test would not only prevent many more colon cancer deaths by screening a larger part of the population, but it would also reduce costs/complications of screening in the majority of the population who are not destined to develop neoplasia.

Aspen Products Group, Inc.

Phase II Award No.: 0750259

Award Amount: $500,000.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Program Director: Cynthia A. Znati

Sector: Materials

SBIR Phase II: Catalytic Filter for Diesel Exhaust Purification

Emissions from diesel engines are estimated to contribute to over 25,000 premature deaths and greater than 2.5 million lost work days annually in the United States. New emission regulations to be phased in through 2010 by the Environmental Protection Agency are projected to significantly reduce public health costs associated with diesel exhaust emissions. Unfortunately, current exhaust purification products are complex, expensive and impose significant fuel economy penalties on diesel engines.

This program aims to develop an advanced particulate filter that removes harmful exhaust components more efficiently than existing products. The advanced filter traps particulates and continuously oxidizes the particulates at typical diesel exhaust temperatures. The filtration technology utilizes ultrafine fibers comprised of a unique catalytic material disposed in a novel configuration to minimize the effects that the filter has on engine operation. At the conclusion of the development program, an efficient, low-cost diesel particulate filter suited to clean up of heavy duty diesel engine exhaust will be demonstrated. Utilization of the proposed technology will reduce the cost of diesel engine exhaust systems, enable wider application of highly fuel efficient diesel engines, and reduce overall fuel consumption and pollutant emissions.

The feasibility of employing ultrafine fibers to efficiently filter particulates and catalyze gas phase reactions was originally demonstrated under grants DMI-0419313 and OII-0611162 from the National Science Foundation.

BioSense Technologies Inc.

Phase II Award No.: 0750054

Award Amount: $429,080.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Program Director: Gregory T. Baxter

Sector: Biotechnology

SBIR Phase II: Early Growth Metabolic Responses of Mycobacteria

Infectious disease does not respect geographic borders and the onset of multi-drug resistant strains of Mycobacterium tuberculosis (M. tb), the bacterium responsible for the disease tuberculosis, leaves the United States and all other countries unprepared to mount an adequate defense in the event of an epidemic or intentional widespread exposure. It currently takes many weeks to determine the correct drugs for treating a patient with an active case of TB because existing laboratory test methods have to monitor the very slow growth of this bacterium to see if a drug is effective or not in killing it.

BioSense Technologies is developing a new approach to obtain this same information in near real-time. This is accomplished by monitoring the physiological stress response of the tuberculosis causing bacterium during exposure to a particular therapeutic drug to obtain its effectiveness. The approach is analogous to touching a hot stove with one's hand where the response is immediate. Because the BioSense approach no longer depends on the very slow time necessary for cell division, test results can be provided to the clinician within hours. With this information now in hand, clinicians no longer need to rely on their best guess when prescribing a cure and can now prescribe targeted drug therapies without delay. This is particularly important in an age of widespread antibiotic resistance where the effectiveness of a drug is no longer guaranteed.

The availability of a practical and affordable rapid diagnostic test to determine the correct drugs to cure TB infections will globally impact the management of effective policies. Avoiding the prescription of inappropriate therapies would thereby improve patient outcomes, decrease the spread of drug resistant mycobacteria, and reduce healthcare costs.

This work was developed at BioSense Technologies by Drs. Ronald Rieder and Boris Zavizion and was funded through the NSF and NIH SBIR Programs.

BlueinGreen

Phase II Award No.: 0750402

Award Amount: $494,416.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Program Director: Gregory T. Baxter

Sector: Devices & Instruments

SBIR Phase II: A Portable Dissolved Oxygen Delivery System for Rapid Treatment of Organic Spills

The SDOX technology is a new method for cost effectively dissolving oxygen into water to improve environmental water quality. The SDOX was developed with NSF SBIR phase I funds and is currently being studied in the phase II program for use at Norfork Dam in Arkansas. The problem at Norfork Dam is that So far, data from this study indicates that by using the SDOX, oxygen can be added to the river at the outlet of the dam and will allow improvements not only in water quality of the river, but also improve the economy of the region that is based on fishing, improve the efficiency of electrical power generation and allow improved flexibility for operating the dam for flood damage prevention. Data from the phase II NSF study has allowed BlueInGreen to design a full-scale system and estimate operating costs based on the previous 10 years of measurements of dam operation. The study results indicate that the SDOX unit can effectively treat twice the water flow rate as competing technology at less than half the operating costs. Also, the SDOX has been studied in a wide variety of applications including wastewater treatment and aquaculture. In all cases, documented operating cost and energy savings of the SDOX over other dissolved oxygen delivery systems has approached 80%. Other benefits of the SDOX include ease of installation, automated operation delivery of high concentrations of dissolved oxygen. The overwhelming benefits of this technology have allowed the company to grow rapidly and BlueInGreen now has sales representatives across the nation. A demonstration of the SDOX unit developed in the NSF phase I project resulted in a sale to a local wastewater treatment plant and helped the operators of the plant win three awards for green technology and operations.

The SDOX technology was first invented by Osborn, Matlock and Teltschik at Texas A&M University and was supported by a SEAGRANT project. The IP was released to the inventors by Texas A&M. The inventors assigned the IP to the University of Arkansas. The invention was tested against existing aeration technology for treating animal and human wastewater as part of an NSF SBIR phase I grant. The tests proved very successful as 80% operating cost savings were realized. The phase II proposal for this work was not funded. Another phase I NSF grant was awarded to this work and a full-scale demonstration unit was designed and constructed. Tests of this demonstration unit resulted in 80% operating cost savings at three different wastewater treatment plants. This phase I was successfully converted into a phase II NSF SBIR grant and this current work is being used to establish a foothold in the environmental water treatment market with specific focus on treatment of low oxygen water at hydroelectric dams.

CCL Biomedical, Inc.

Phase II Award No.: 0849005

Award Amount: $463,713.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Program Director: Cynthia A. Znati

Sector: Materials

SBIR Phase II: Biocidal Textiles for Active Infection Control

This Small Business Innovation Research Phase II project focuses on the development of patented antimicrobial compounds to provide superior infection control to textiles. 5-10% of patients admitted to hospitals in the US acquire an infection while in hospital. Consequences of hospital-acquired infections (HAIs) include prolonged hospital stays, increased treatment costs, and cause more than 100,000 deaths each year. The financial costs of these infections run into billions of dollars annually. Laboratory and clinical studies have shown that bacteria can survive for weeks on items found in patient rooms, which are suspected of playing a role in the transmission of pathogens. This program continues the development an innovative fabric finish to create textiles that will kill microbes on contact. The performance of these compounds has been shown to be superior to current non-leaching antimicrobial technologies. The biocide is chemically attached to fabric using a water-based solution. Chemical immobilization of the antimicrobial agent minimizes migration into the environment. During Phase II, the efficacy of treated fabrics will be assessed against pathogens, including strains associated with HAIs. Physical characterization of the fabrics will be performed to determine the effects of laundering. Finally, the effectiveness of treated fabrics in the clinic will be demonstrated.

The number of hospital acquired infections (HAIs) is increasing, with a larger proportion being caused by antibiotic-resistant bacteria. Policy changes of cost reimbursement related to HAIs have already been implemented, placing the burden on hospitals to prevent such infections. Inevitably, infection control policies within hospitals will be expanded in order to reduce rates of infection. Creating actively biocidal surfaces will provide a new method of infection control, augmenting current practices without significantly adding to the workload of staff. In this program, novel antimicrobial technology is being developed for use on fabrics. Ultimately, it is expected that strategic deployment of this technology as a complement to hand-hygiene (the most important component of infection control) will reduce the number of HAIs, improve patient outcomes and reduce the costs of healthcare. Other commercial textile applications of this technology include protective garments for military personnel, emergency responders, and fabrics for sports apparel. The antimicrobial product may also be applied to non-textile items, such as computer keyboards and bedrails.

CeraMem Corporation

Phase II Award No.: 0724326

Award Amount: $426,821.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Program Director: Cynthia A. Znati

Sector: Materials

SBIR Phase II: Low-cost Ceramic Membranes for Drinking Water Treatment

Membrane filtration provides in drinking water treatment provides complete barrier protection to dangerous pathogens such as Cryptosporidium and Giardia. Specifically, ceramic membrane installations around the globe have proven more reliable than their polymeric counterparts while requiring less maintenance. Still, the relative high initial cost has limited ceramic membranes to just a few water treatment facilities worldwide. CeraMem Corp had previously developed several improvements to ceramic membrane technology that have dramatically lowered the cost of ceramic membrane elements. This has allowed ceramic membranes to be competitive with polymeric membranes when water quality is a high concern. This project seeks to combine those previous improvements with new manufacturing techniques that will cut the cost of fabrication in half. If these goals are achieved, it will be possible for ceramic membranes to be installed in drinking water treatment at the same cost as polymeric alternative, which will make safer drinking water more readily accessible.

The most significant outcome of CeraMem's R&D in water filtration membranes was the interest it generated from outside parties. In 2008, the assets of CeraMem Corp, including the technology developed under this SBIR grant, were acquired by Veolia Water Solutions & Technologies (VWS). VWS is the technology subsidiary of Veolia Water, the world leader in water and wastewater services. VWS continues to develop the subject technology under subcontract to CeraMem.

The CeraMem® ceramic membranes were first conceived in the 1986 and through a series of government grants (USDA SBIR # 87-SBIR-8-0150, and USDA SBIR # 93-33610-9095). The low-cost supports used in the current grant were developed under USDA SBIR # 2004-33610-02656. In conjunction with this program to develop membrane fabrication methods, CeraMem Corp has also been developing an advanced water treatment process under ONR Contract # N00014-05-C-0396. All relevant technologies were acquired from CeraMem Corp by Veolia Water Solutions & Technologies in 2008. VWS continues the development and commercialization of these products.

CFD Research Corporation

Phase II Award No.: 0724878

Award Amount: $456,150.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Nanotechnology

SBIR Phase II: Enabling Low-Temperature Synthesis of Vertically Aligned Carbon-Nanotubes by Selective Heating of Catalyst

In this project, researchers at CFD Research Corporation (CFDRC) and NanoLab Inc., funded by NSF Small Business Innovation Research (SBIR) grant, are developing a novel low-temperature synthesis of vertically-aligned carbon nanotubes (VACNTs). VACNTs are expected to be the key components of next-generation electronic devices including supercapacitors, field emission sources for high-power defense electronics, bio and chemical sensors, and interconnect in computer chips. Currently, high crystalline quality material such as VACNTs can be produced only at a very high temperature and in very limited quantity which negate the use of VACNTs in the forward-thinking applications. The most popular method for the synthesis of VACNTs is the Catalytic Chemical Vapor Deposition (CCVD) process during which both catalyst and substrate are heated to temperatures in excess of 700 C to initiate the growth of carbon nanostructures. The substrate heating is not necessary for the actual synthesis process of VACNTs and often results into substrate damage or makes impossible the integration of VACNT synthesis with device and temperature-sensitive materials fabrications.

CFDRC and NanoLab Inc have demonstrated the feasibility to reduced the growth temperature of VACNTs with two complementary approaches: a) by controlling graphene layer formation and catalyst deactivation via catalytic oxidation, and b) by selective heating of catalytic nanoparticles using electromagnetic fields generated by an radio-frequency (RF) source. The first method can be used, for example, for the direct fabrication of VACNT based electrode of supercapacitor, while the second method will enable the direct growth of VACNTs on nonconducting surfaces of many other electronic devices.

The innovation is related to the research at CFDRC under Phase I grants from NSF (# 0441412 and #0611099) and Samsung Advanced Institute of Technology (SAIT) contract. The initial feasibility for low-temperature growth was shown by CFDRC and Oak Ridge National Lab in 2006. The feasibility for multi-scale computational simulator was established by CFDRC during NSF and SAIT funded projects.

Chemica Technologies Inc.

Phase II Award No.: 0450618

Phase IIB Award No.: 0752004
Award Amount: $1,011,891.00
Start Date: 10/01/2005
End Date: 09/30/2009

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Sector: Materials

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

Radiometals are used to indicate the location and size of tumors, and also to treat some types of cancer. The drawback to this type of therapy is the high toxicity of radiometals. Dr. Takuji Tsukamoto (PI) of Chemica Technologies, Inc (Beaverton, OR) is developing a novel radio-imaging agent (NRIA) that substantially increases the uptake of certain radiometals by tumors thereby reducing the amount of radiometal required for imaging or treatment and the subsequent toxicity to the patient. When properly complexed with a radiometal, such as 67Ga, Chemica's NRIA increases the uptake of the radiometal up to 100 times in tumor cells in vitro. Although the formulation studies have been very successful, in vivo studies have been hampered by the complex interaction of the NRIA and radiometal with components of the blood, especially serum proteins, and we have been continuing to improve the formulation of the NRIA and radiometal complex to overcome these interactions. We have now identified a new NRIA which appears to be a better in vivo candidate. The extended safety tests using mice have been thoroughly performed. We can safely conclude that there is no evidence of toxicity for any of the agents (NRIA) tested at the concentrations used.

If this technology is adequately applied in vivo, it will drastically reduce the toxicity and increase the avidity of radiometals. This could have profound implications for the diagnosis and treatment of many types of cancer. Further, with use of this NRIA, radiometals such as 67Ga can be used to image tumors with high efficiency and in a cost effective manner using a simple -camera, SPECT or SPECT/CT. This technology is also applicable to PET using other radiometals, such 68Ga.

The origin of this project was a serendipitous finding of enhanced gallium uptake in tumor cells by photodegraded nifedipine (nitrosipine) by Dr. Kathryn Morton while at Oregon Health and Science University (OHSU). However, in vivo studies proved ineffective with this compound. Dr. Tsukamoto proposed significant chemical modification of the compound and formulation with gallium to increase the strength of the complex with the radiometal and to decrease interaction with serum components, the basis for this NSF-supported study.

ChK Group, Inc.

Phase II Award No.: 0724463

Award Amount: $486,232.00
Start Date: 09/15/2007
End Date: 08/31/2011

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Sector: Materials

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

The United States generates 7.1 million tons of this biomass and it is an added cost to the farmers for its disposal. For instance, the rice mill owners in Texas are being paid $8 per ton for their rice hulls which in most cases does not even pay for its freight. Hence, rice hulls are a definite expense to most rice mill owners in Texas and throughout the country. The United States Environmental Protection Agency (USEPA) restricts open heap burning of this product as it generates undesirable smoke. In addition, dumping rice hulls in a landfill site is undesirable because the anaerobic decomposition results in the subsidence of the landfill site.

The NSF Phase II research project is addressing the manufacturing and testing of off white rice hull ash (OWRHA) as rice hulls contains 18 to 21% of amorphous SiO2. The purpose is to utilize the OWRHA (a biomaterial) as a-high performance cement (HPC) for highway and other applications. There are several benefits of using this processed byproduct, such as significantly increasing the compressive strength, reducing heat of hydration to prevent concrete cracking, and enhancing resistance to chemical weathering due to harsh environmental conditions. Therefore, there is an urgent need to make value-added products utilizing this biomass. Furthermore, several state governments and including federal agencies, e.g., U.S. Department of Transportation and Federal Highway Administration have mandated the use of HPC for structure durability and longevity. We have successfully generated off white rice hull ash (RHA) using our patented product, and full pilot-scale testing on concrete made from cement and off white RHA is ongoing.

Cool Energy, Inc.

Phase II Award No.: 0848689

Award Amount: $499,976.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Energy

SBIR Phase II: Solar Thermal Stirling Engine Combined Heat and Power System

This Small Business Innovation Research Phase II project advances the development of an integrated solar energy system which delivers heat and electrical energy to a building's occupants. At Cool Energy, development continues on the SolarFlowTM System, a solar thermal system for combined heating and electrical power generation from medium-temperature heat energy (100-300°C) captured with evacuated-tube solar thermal collectors. The innovative system design integrates high-performance solar collectors with a novel advanced-materials Stirling engine and controller to use a single solar system to produce electricity and thermal energy for space and water heating. Economic value to the customer is maximized using an optimizing predictive control system to regulate the delivery of heat and electricity. Building on the successful Phase I program for selection of advanced engine components and the demonstration of significant electricity production from the engine prototype, the Phase II demonstration program encompasses system integration of the next-generation Stirling engine prototype with the system controller and solar collectors. The core intellectual merits are the advances in the Stirling engine design (with broader applications than solar power), the implementation of the predictive control system, the integration with the solar collectors for field testing, and the advanced engine and system design tools.

This project supports a technology demonstration that has enormous potential for helping to replace the world's depleting supply of highly polluting fossil fuels with cleaner, sustainable sources of energy. The costs of traditional energy are rising rapidly, causing significant hardship to much of the world's population, including in the US. Disproportionate effects are visited on the poor as the costs of heating fuels and electricity escalate. Rising carbon emissions threaten ecosystems and human populations worldwide over the coming centuries. Cost reduction of renewable energy technology is a main driver of this Phase II demonstration project, as only through lowered costs of clean energy will the US and the world be able to attain domestic energy security, economic stability, and environmental responsibility. Concentrating on market success to enable widespread adoption, Cool Energy has expended a great deal of effort on modeling the economics of the SolarFlow System in various regions of the US. Further, partnerships have been cultivated with potential customers, distribution partners, manufacturing partners, and investors to build a strong business foundation to

Divergence, Inc.

Phase II Award No.: 0848854

Award Amount: $500,000.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Biotechnology

SBIR Phase II: Control of Lesion Nematodes by Transgenic RNA Interference

This Small Business Innovation Research Phase II project will use RNA interference (RNAi) to limit damage to corn from the plant parasite lesion nematode by silencing genes in the parasite. Phase I demonstrated in culture that expression of specific double-stranded RNAs (dsRNAs) from lesion genes limited nematode reproduction and increased root mass. In Phase II, validated constructs will be progressed to whole plant transformation. Transgenic plants with expression of the dsRNAs will be tested in greenhouse assays for control of lesion nematode. In parallel, the validated laboratory assays validated will be used to select next-generation constructs. Success in Phase II research will justify a field trial program.

The broader impact of this research is to increase corn yields by commercializing a biotechnology trait for control of lesion nematode. Agriculture is under tremendous pressure to achieve improved yields and ensure the availability of crops. A major limitation on crop are parasites that damage root systems causing annual yield losses valued at $8 billion in the U.S. Currently available nematicides are toxic. In corn, there are no genetic sources of nematode resistance. Using RNAi, we aim to create biotechnology traits that provide season-long resistance to lesion nematode. Benefits to this approach for the grower include increased yield, increased tolerance to drought and stress, decreased input cost and preservation of soil microenvironment. Benefits for consumers include increased availability of corn and enhanced food and environmental safety.

DNA 2.0

Phase II Award No.: 0750206

Award Amount: $500,000.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Biotechnology

SBIR Phase II: Multivariate Analysis of Heterologous Protein Expression

The ability to rapidly and cheaply synthesize genes with full sequence flexibility has vastly improved our ability to manufacture valuable proteins, such as protein pharmaceuticals, industrial enzymes and diagnostic enzymes. In sum, protein products constitute a >$40B and rapidly growing worldwide market. Production efficiency is a frequent barrier to the development of new protein products and hinders market growth. Cost-effective production generally requires protein expression in an organism other than the natural host. Natural genes are often difficult to manipulate with standard molecular biology tools because of several common sequence features and they rarely are coded in a way that supports high expression in a good production host. Gene synthesis now allows the coding sequence to be designed for simple manipulation as well as high expression for any desired host; however, rules for gene sequence optimization are far from understood.
For our project, we've utilized our gene synthesis capability to create variant gene sets for multiple proteins. In each set, gene design parameters were systematically varied and their impacts on protein production were assessed using multivariate data analysis methods. With each set characterized we've had exciting and unpredicted findings. Three fundamental observations are 1) Coding variation, where no change in protein sequence is made, can dramatically impact production level, 2) High levels of expression could be achieved for each protein tested, 3) The rules for optimal gene design are non-obvious and quite distinct from conventional wisdom. We have now applied this methodology to protein expression in both E. coli and, in collaboration with the lab of Dr. Robert Stroud at UCSF, the yeast S. cerevisiae, with similar qualitative conclusions. This suggests that our gene optimization method may be relevant for any production host.

The scientific staff of DNA2.0 has strong expertise in protein engineering, developed over more than a decade of academic and previous industrial research. Our particular strength is the application of machine-learning methodologies to protein sequence improvement. For this project we are using similar principles of multivariate analysis, but applying them to gene design parameters instead of protein sequence changes. As a gene synthesis company we are well aware of the need in the marketplace for gene design improvement and our multivariate analysis approach was a natural fit for this goal.

Dynamet Technology Inc.

Phase II Award No.: 0724433

Award Amount: $500,000.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Materials

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

Dynamet's titanium alloy containing 30% tantalum is of interest for implantable medical devices such as hip implants because it is strong, flexible and readily accepted by the body without adverse reactions. Current implants are rigid and limit the ability of the bone to adequately share the load placed on the body. As a result the bone may not fuse properly to the implant resulting in severe complications. The titanium-30%tantalum alloy has a remarkably low modulus of elasticity (meaning that it is very flexible), therefore allowing the bone to adequately share the load ensuring healthy bone functioning. The titanium-tantalum alloys also have potential as cardiovascular stents. Cardiovascular stents are tubular structures that are placed in constricted blood vessels involved in heart function. After they are implanted, stents either expand automatically as they reach body temperature or are expanded mechanically to open the blood vessel. The metals used today for cardiovascular stents contain nickel that can cause hyperallergenic reactions in patients who are sensitive to nickel. In contrast, titanium-tantalum alloys are nickel-free and are well-accepted by the body.

Titanium-tantalum alloys are technically difficult and economically prohibitive to produce by conventional methods because of the wide difference in melting point and density between titanium and tantalum. Dynamet Technology has developed a radically different method of producing these alloys. NSF's Phase I support allowed Dynamet to demonstrate the technical viability of its advanced powder metallurgy technology for producing titanium-tantalum alloys. This work is now in Phase II of NSF funded research. The results of Dynamet's evaluation of the titanium-30%tantalum alloy performed in Phase II confirm that the alloy is strong, flexible and highly biocompatible. Materials produced by Dynamet are now being evaluated by Biomet, a major manufacturer of medical devices. Also, MIT is assisting Dynamet in the evaluation of the properties of a wide range of titanium-tantalum alloy compositions in order to identify specific compositions that have the desired properties for cardiovascular stent applications.

The development of the unique titanium-tantalum alloys being evaluated under this NSF funded research program stems from Dynamet Technology's research into the manufacture of titanium-tungsten alloys that could not be readily produced by conventional titanium production methods. This work resulted in the development of high strength titanium-tungsten alloys produced by an advanced powder metallurgical process. This work was then supported by an NSF Phase I SBIR which led to an NIH Phase II SBIR program to research and develop titanium-tungsten-titanium carbide alloys directed toward the potential of these materials for wear resistant medical implants. Dynamet also had experience in producing tantalum components for military uses. Titanium-tantalum alloys had shown potentially interesting properties, but are extremely difficult to produce by conventional processing technology. The challenge of producing titanium-tantalum alloys was expected to be similar to that of titanium-tungsten. Dynamet recognized that the titanium-tantalum alloys had excellent commercial potential if an economically viable production process could be developed to produce them. Dynamet applied its know-how in processing tantalum and titanium-tungsten alloys to demonstrate that titanium-tantalum alloys could be produced economically. Subsequent Phase I SBIR NSF funding allowed Dynamet to demonstrate the technical and economic viability of producing titanium-tantalum alloys by its advanced powder metallurgical processing. The success of this research lead to continued funding by NSF in a current SBIR Phase II program.

Electron Energy Corporation

Phase II Award No.: 0848996

Award Amount: $500,000.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Nanotechnology

SBIR Phase II: Fe-nanoparticle coating of anisotropic magnet powder for nanocomposite permanent magnets with enhanced (BH)max

This Small Business Innovation Research Phase II project proposes the development of an innovative and facile method to synthesize composite magnet powders coated with Fe and/or Fe-Co nanoparticles and to consolidate them into high performance anisotropic nanocomposite magnets. It was theoretically predicted in the 1990s that two phase exchange-coupled nanocomposite magnets consisting of a hard magnetic phase with high magnetocrystalline anisotropy and a soft magnetic phase with high saturation magnetization may exhibit a maximum energy product (BH)max twice the value of the current magnets. In this research effort, Fe and Fe-Co nanoparticles will be deposited onto hard magnetic powders by combined chemical and physical methods. Unlike previously employed techniques, the proposed approach allows the control of the size of soft magnetic phase to the nanoscale. Moreover, the approach is compatible with mass production. Subsequent consolidation of these composite powders by pressure and temperature assisted methods will lead to a new generation of high performance anisotropic nanocomposite permanent magnets with a (BH)max much higher than that of the current commercial magnets. The multiple choices for the core powder will result in new improved magnets for close-to-room-temperature applications (Nd2Fe14B-based), high temperature applications (SmCo5- and Sm2Fe17Nx-based) and ultra-high temperature applications (Sm2Co17-based).

The success in the development of the new (nano)composite magnets will directly result in the improvement of the functionality of electromagnetic devices and eventually lead to new applications not possible with the current permanent magnets. The higher performance magnets will result in even lighter weight, smaller footprint and lower the total system cost for electromagnetic devices in both commercial and military applications. The most well known applications are in: hybrid cars (permanent magnet motors and generators, sensors and actuators), spacecraft (momentum wheels, reaction wheels, stepper motors, ion propulsion), microwave sources (traveling wave tube amplifiers, klystrons, magnetrons), microwave components (isolators, circulators), inertial guidance (accelerometers, gyros), and other commercial systems (computer disk drives, computer printers, audio systems, satellite communication, medical imaging, stepper motors, etc). The proposal is a multidisciplinary enterprise involving physics, chemistry, and metallurgy. The bottom-up approach to the synthesis of nanocomposite magnets with uniform and controllable thickness of the soft magnetic shell formed from the precursor nanoparticle coating, will allow for an in-detail experimental characterization of magnetic interactions. This will provide valuable information to understand and substantially diminish the gap between the theoretical predictions and engineering capabilities.

EndoShape Inc.

Phase II Award No.: 0848626

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Novel SMP-based TCD Devices

This Small Business Innovation Research Phase II project aims to continue work from Phase I around the development of novel trans-cervical devices (TCD) for permanent female sterilization using unique and proprietary shape memory polymer (SMP) technology. The intellectual merit of the proposed activity rests in several areas. First, development of advanced finite element analysis (FEA) methods specifically focused on shape memory polymers will provide a time- and cost-effective means of evaluating medical device designs. Second, large-deformation FEA models have not been thoroughly developed for shape memory polymers; further, user materials routines specifically for shape memory polymers are not available currently and would provide ease-of-use advantages in implementing and optimizing device design. Lastly, although some work has been performed in understanding materials-based aspects of shape memory polymer behavior, much less work has been done in developing useful biomedical devices with this promising technology.

The broader impacts of this work lie in the development of the next generation of medical devices using advanced materials with characteristics that can be customized to the patient. The successful development of useful devices from such technologies should pave the way for a plethora of commercial opportunities including tissue-engineered devices delivered using minimally invasive methods into the target site to eventually grow healthy tissue. Lastly, successful completion of the overall project should have immediate impact on a procedure that is the most common form of permanent birth control in the world.

EndoShape Inc.

Phase II Award No.: 0823015

Award Amount: $450,989.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Materials

SBIR Phase II: Shape memory polymer AAA Endograft

This SBIR Phase II project aims to continue the development of novel endografts for percutaneous treatment of abdominal aortic aneurysms (AAA) using unique and proprietary shape memory polymer (SMP) technology. Abdominal aortic aneurysms are both common and lethal in the older population, affecting between 7 and 13 % of older persons (> 60 years), accounting for between 13,000 and 18,000 deaths per year in the US alone, and increasing in diagnostic prevalence as both diagnostic techniques improve and the population ages. Endovascular treatment using covered stainless steel or Nitinol stent-grafts is now the preferred option for AAA treatment. However, current devices are far from perfect, and complications from endovascular repair such as endoleaks, continued growth of the aneurysm, device migration, arterial dissections, and other problems persist at very high (> 25-35%) rates. Most if not all these problems can be traced to the inherent limitations of the materials used in current devices. We propose to continue the highly promising Phase I work with particular focus on four areas: finalize polymer formulation; develop methods to manufacture patient-specific endograft designs; finalize biocompatibility evaluation; and evaluate endografts in acute and chronic animal studies. Anticipated deliverables at the end of the Phase II project are a finalized polymer formulation particularly suitable for endografts, complete ISO 109993 biocompatibility evaluation, methods to manufacture patient-specific endografts, and comprehensive data on the acute and chronic vascular response of the shape memory polymer endografts.

The broader impacts of this work lie in the development of the next generation of medical devices using advanced materials with characteristics that can be customized to the patient. The successful development of useful devices from such technologies should pave the way for a plethora of commercial opportunities including tissue-engineering applications whereby the "seeds' of new tissues or organs can be incorporated into shape memory polymer devices and delivered using minimally invasive methods into the target site to eventually grow healthy tissue. The ability to fuse shape memory polymer technology with advanced three-dimensional imaging and automated manufacturing methods, such as rapid prototyping and stereo-lithography, promises to open up the exciting prospect of creating patient-specific devices within the operating suite; devices that once manufactured can be compacted in situ into a catheter and delivered immediately into the patient. Lastly, successful completion of the overall project should have immediate impact on a disease that is the 13th leading cause of death in the US, and consequently on human health.

Eneregtics Incorporated

Phase II Award No.: 0750325

Award Amount: $490,317.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Compact membrane reactors for high-purity hydrogen

This project has fabricated and is currently testing the production of high-purity hydrogen from natural gas, gasoline and diesel, through the use of compact membrane reformers. The high-purity hydrogen produced thereby will be capable of being used in fuel cell automotive vehicles, without the need of a full-scale hydrogen infrastructure. In addition, the compact membrane reformer will be capable of instantaneous start-up and fast transient response, which are not currently possible with on-board reformers, thereby enabling synchronized load-following by the fuel cell power-plant in a car. Current fuel infrastructure for natural gas, gasoline and diesel can be used to produce hydrogen-on-demand.

The project is unique in a scientific and technological sense, since it integrates mini-channel compact reformers with membrane reactors, to perform auto-thermal fuel reforming, a system integration which has never been attempted before. In addition, load following capability of conventional reformers have a delay of more than 30 minutes, while the fabricated reformer has a load following capability of less than 5 seconds, an imperative need for automotive power-plants.

The US Department of Energy has been investigating on-board fuel reformers since 1990 for supply of high-purity hydrogen to future fuel cell vehicles, under its HFCVs program, also called the PNGV and the FreedomCar program. However, the DOE basically stopped further R&D on on-board reformers since 2003/2004, due to the problems of size, weight, start-up time and transient response characteristics on on-board reformers for HFCVs. This project seeks to overcome these barriers by engineering a compact membrane reformer which can be used in future HFCVs, while using the existing fuel infrastructure in the country.

Exelus, Inc.

Phase II Award No.: 0548636
Phase IIB Award No.: 0802699
Award Amount: $860,100.00
Start Date: 01/15/2006
End Date: 12/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Solid Acid Catalyst with Optimally Distributed Active Sites

Many technologies used today in refining and petrochemical industries are decades old. Most oil refining processes, for example, were developed between 1940 and 1960. Since then, progress has been in the form of incremental improvements. Yet, much scope remains for radically different, step-out technologies that offer the potential for significant savings in energy and manufacturing costs. The economic benefits of new technologies offer the single greatest driving force for change in the chemical-based industries. Environmental benefits, in the form of reduced GHG emissions, and improved process safety are others. Exelus has developed a "green" solid-acid catalyst – ExSact - to convert inexpensive heating-value LPG feedstocks into high-octane gasoline. ExSact integrates the active catalyst sites found in hazardous liquid acids (such as sulfuric acid or hydrofluoric acid) with innovative micro-reactor design into a benign solid particles that can held in the palm of our hands.

Research on developing a viable solid-acid catalyst to produce high-octane gasoline has been ongoing since the 1970's. However, the approach in the past appears to have been one where oil companies have simply screened every known solid acid for its alkylation activity. Indeed, one or more companies have patented all of the known solid acids, yet no viable process has emerged. Exelus started work on developing a solid-acid catalyst using an SBIR grant from NSF (DMI-0215552) in 2001. The work culminated in a solid-acid catalyst design (EZCat) with an order of magnitude greater stability than the competition – but producing gasoline with low octane rating. Exelus built on knowledge developed with that grant to design the ExSact catalyst which produces gasoline with an octane rating exceeding 98 (RON).

Fundamental Applied Biology, Inc.

Phase II Award No.: 0522337

Phase IIB Award No.: 0753744
Award Amount: $1,000,000.00
Start Date: 09/01/2005
End Date: 08/31/2009

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Sector: Biotechnology

STTR Phase II: Commercial Cell-Free Technology for Insulin-Like Growth Factor I (IGF-I) Production

Recent advances in Cell-Free Protein Synthesis (Cell-Free) have transformed it from a bench-top novelty into a viable manufacturing platform for protein pharmaceuticals. The unprecedented speed and systemic control provided by Cell-Free promises to change the entire paradigm for protein production, from discovery and development through final product manufacturing.

In the cell-free system developed by Sutro Biopharma (formerly, Fundamental Applied Biology, Inc) and Stanford University, the disulfide/sulfhydral redox potential is controlled and disulfide isomerases added to enhance the proper formation of disulfide bonds. Since only a single protein is translated by the system, interference from other nascent proteins is eliminated. All of these factors are combined within a natural chemical environment to produce a system with unprecedented folding efficiency. For cost reduction, central metabolism is activated so that inexpensive substrates provide an abundant energy supply and also avoid the need for expensive nucleotide triphosphates (NTPs). A novel plasmid preparation method was also developed to further reduce the reagent cost. For scale-up, simple and inexpensive technology allows Cell-Free to be conducted in standard fermentors. We demonstrated that cell-free technology is Scalable from 15μl to standard bioreactors. In Dec 2007, Sutro announced the completion of a $21 million Series B financing. The proceeds from the financing will be used to develop Sutro's novel, cell-free protein synthesis technology to produce biologic drugs and vaccines for unmet medical needs. In Dec 2008, Sutro successfully scaled up GMCSF cell-free reaction to 100 L. It became one of the milestones of cell-free technology development.

The innovation is related to basic research in the lab of Prof Jim Swartz at Stanford University under grant from NSF.

Gevo Inc.

Phase II Award No.: 0823122

Award Amount: $500,000.00
Start Date: 11/01/2008
End Date: 10/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: Isobutanol biocatalyst - Engineering pathway enzymes for higher isobutanol productivity.

The intellectual merit of this Phase I SBIR research is the development of a biocatalyst for the commercial production of isobutanol using molecular techniques. During Phase I of this proposal, a bacterial microorganism was engineered that produced isobutanol at reasonably high rates and reaching high concentration, indicating that a biotechnological process for the production of isobutanol is feasible. During Phase II research, any limitation to biocatalyst productivity will be removed using molecular techniques resulting in a microorganism that produces isobutanol at a rate that allows for economically competitive production of isobutanol.

The broader impacts of this Phase II SBIR research will be reneweable isobutanol produced for both the transportation fuel market as well as the chemical market. Higher alcohols, such as butanol and isobutanol that can be produced from the same biomass as ethanol are attractive second-generation biofuels due to their higher energy content and their low hygroscopicity. Successful completion of the Phase II work will help enable a process for the biotechnological production of isobutanol that is economically competitive with the petrochemical market. This not only delivers a better second-generation biofuel but also reduces the dependence on imported oil, lowers greenhouse gas emissions and expands the use of biobased products in the chemicals market.

Granger Engineering

Phase II Award No.: 0548663
Phase IIB Award No.: 0849184
Award Amount: $674,840.00
Start Date: 10/01/2006
End Date: 09/30/2009

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Sector: Materials

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

The Small Business Technology Transfer Research (STTR) Phase II project develops a new ceramic fiber technology for reinforcing injectable bioplastics used in orthopaedic applications. Dr. Mason and his team at Granger Engineering has brought a significant increase in strength and stability of the injectable polymer based biomaterals through a combination of variable shaped 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.

Insite Medical Technologies

Phase II Award No.: 0848916

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Improving the safety and efficacy of epidural anesthesia

This Small Business Innovation Research Phase II project is focused on commercializing a proprietary medical device to provide safe and accurate delivery of epidural anesthesia. Epidural anesthesia provides excellent pain control for childbirth, major surgery, and chronic back pain without having to expose patients to the risks of general anesthesia. Epidural anesthesia involves (1) accessing the epidural space, a miniscule potential space adjacent to the dura, the thin protective covering of the spinal cord, then (2) delivering local anesthetic to bathe the spinal nerve roots and block pain sensation. Currently, epidural access requires blind insertion of a sharp-tipped needle through the back that is immediately halted just prior to entering the dura. The difficulty of the current method poses risks of anesthetic delivery to incorrect anatomic locations and injury to nearby critical structures. Complications are estimated to occur in 6-25% of cases. InSite Medical Technologies has developed a technology that eliminates the sharp needle tip and provides highly controlled access to the epidural space by uniquely engaging surrounding tissue. During the Phase II project InSite will finalize product design, establish a quality manufacturing system, attain an FDA 510(k) approval and achieve the first human use of the device.

The epidural anesthesia market comprises an estimated 9.8 millions eligible patients each year in the United States of which only 3.4 million patients actually receive epidural anesthesia. The underutilization of epidural anesthesia results from several barriers including procedure difficulty and physician fear of complications. The epidural anesthesia market is segmented into obstetric, surgical, and chronic pain applications. With over 4 million births annually in the United States, obstetrics is the largest segment. Currently, during childbirth, 2.4 million women (60%) receive epidural anesthesia for pain control. The second largest segment is surgical anesthesia where, despite known patient-outcome benefits, epidural anesthesia is used in only 500,000 of 1.8 million eligible cases. Finally, spine-related pain syndromes are treated increasingly with epidural steroids and implanted stimulators, accounting for 600,000 annual cases. Outside the U.S., 19 million epidural access procedures are performed annually with a massive potential international market including 130 million births per year. By creating a safer and more accurate system for delivering epidural anesthesia, InSite Medical Technologies sees an opportunity to produce a premium medical device that positively impacts patients' experience with epidural anesthesia.

InstaRecon, Inc.

Phase II Award No.: 0750502

Award Amount: $453,488.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Devices & Instruments

SBIR Phase II: Ultra-Fast Software Image Reconstruction for Micro-CT

Micro-CT imaging is a prime tool for pre-clinical structural, molecular, and functional imaging in Pharma and Research. Already reaching a resolution of 1μm, with cross-sections up to 8000x8000 pixels, Micro-CT scanners allow in-vivo and ex-vivo 3D examination of entire small animals at microscopic resolution. Beyond microscopic morphology, Micro-CT is playing an increasing role in in-vivo quantitative imaging of molecular transport and accumulation, and in functional imaging. Micro-CT is useful in fields ranging from drug discovery to cancer research and genetics, and is being widely adopted by the pharmaceutical industry and research institutions. Micro-CT is also being widely adopted in materials science research and in industry for non-destructive evaluation, and the introduction of nano-CT is becoming an important tool in nanotechnology. This project addresses the computational bottleneck in x-ray Micro-CT image reconstruction, which can lead to waiting times of weeks for a high resolution reconstruction of a single data set, even with state-of-the art computational facilities. These delays limit the productivity of researchers in diverse fields ranging from drug development, where hundreds of animals are scanned in a single drug trial, to biology, to materials science and nanotechnology.

This project will develop, optimize, and evaluate software for ultra-fast image reconstruction for x-ray Micro-CT imaging. At the core of the project are InstaRecon fast hierarchical backprojection algorithms, which are a radical departure from the traditional backprojection algorithms used in Micro-CT, providing an algorithmic speedup by dramatically reducing the amount of computation required for image formation. This reduces the time to reconstruct high-resolution 3D Micro-CT images by unprecedented factors of 10x-100x (larger speedup for larger images. The software will be able to take advantage of multiple processor machines or clusters, or GPU accelerator cards for additional speedup. We will create and evaluate a fully operational system that integrates seamlessly with manufacturer's scanners.

Fast Hierarchical Backprojection was created by Professors Yoram Bresler & David Munson, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign. Further work by graduate students (Samit Basu, Shu Xiao, Jeffrey Brokish) extended the algorithms to other reconstruction geometries (supported by NSF grants Nos. CCR 99-72980 and CCR 02-09203). InstaRecon, Inc. was established to take the technology from academic algorithms to industry-grade products.

Iris AO, Inc.

Phase II Award No.: 0750521

Award Amount: $474,995.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Devices & Instruments

SBIR Phase II: Control System Development for Microelectromechanical Systems (MEMS) Segmented Deformable Mirrors

Adaptive optics promises greatly enhanced image quality when looking at details that are normally blurred by optical aberrations. In the life sciences, examples of instruments which benefit from this technology are high performance microscopes and retinal imaging systems. Recent research results in retinal imaging have showed, for the first time, resolution at the cellular level in-vivo. This enables new methods in diagnosis and treatment of diseases. Benefits are starting to be shown in the field of microscopy as well. Adaptive optics technology is not new -- it has been developed and deployed over the last three decades in multiple DoD applications. These applications were complex systems optimized for correction of aberrations due to atmospheric turbulence. In life sciences, on the other hand, the challenge is correcting optical aberrations inherent in the sample. In a microscope, this would come from peering deep into a tissue sample. In an ophthalmic system, this would come from imperfections in the eye itself. More importantly, a laboratory or clinical adaptive optics system must be simple, small, and inexpensive. Lack of such a system has limited widespread adoption of the technology. Research undertaken in this grant marries the inherently small size of MEMS (microelectromechanical systems) deformable mirrors with a new, compact, and powerful dedicated computing platform. This enables the embedding of this powerful adaptive optics technology in new high-performance scientific and clinical imaging instruments.

This work builds upon NSF funding, through the NSF Science and Technology Center for Adaptive Optics (CfAO), which provided essential early funding for Iris AO. NSF SBIR Phase II #0522321 funded development of piezo-electrically actuated continuous mirrors to which this control technology could also be applied, although the primary target is a series of electrostatically actuated segmented mirrors

Kona Blue Water Farms, LLC

Phase II Award No.: 0822862

Award Amount: $499,910.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Biotechnology

SBIR Phase II: Innovative control of ectoparasites: key to expansion of open ocean fish farming

This SBIR Phase II research targets innovative means for controlling ectoparasite pests in open ocean aquaculture. Offshore fish farming offers tremendous growth opportunities. Adaptive fish health management offshore remains a challenge for environmentally sound expansion of this potentially lucrative industry. PEDICURe (Passive Ectoparasite Device In Counter-current Underwater Reservoir) prototypes showed great efficacy in treating ectoparasite pests in marine fish in tank trials. Phase II research will refine therapeutic treatments, PEDICURe designs and protocols for use. Commercial-scale prototypes will be deployed and tested in offshore cages. PEDICURes could be sold or licensed to fish farms worldwide. PEDICURes could also provide compelling competitive advantages to drive expanded production in Hawaii, U.S. waters, or globally.

The broader impacts of this research are in increasing the environmentally sound means for optimizing fish health in open ocean aquaculture, and thereby aiding the growth in this innovative, exciting and potentially lucrative industry. Offshore farms can produce high-value marine fish without significant impacts on water quality, benthic habitats or other ocean user groups. Cost savings to a $1 billion U.S. offshore farming industry could be $115 million p.a. There are potential applications worldwide.

Luna Innovations, Incorporated

Phase II Award No.: 0724380

Award Amount: $529,831.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Nanotechnology

SBIR Phase II: Immunological Tools for Trimetasphere Fullerenes

Nanomedicine is an emerging area of research that has potential for greatly advancing biomedical science. The unique properties of carbonaceous nanomaterials make them potential candidates for imaging and therapeutic agents for diagnosis, treatment, and prevention of diseases. Fullerenes, or "Buckyballs", are a class of nanomaterials in which 60 to 80 carbon molecules are arranged in a soccer ball-like cage structure and can be made water soluble through organic derivatization. The fullerene family has very appealing properties which can be exploited alone, or through the addition of molecules within and on the outside of the cage. Recently, Luna Innovations and their collaborators demonstrated that fullerene derivatives have potential as, i) MRI contrast agents, ii) inhibitors of allergic responses and inflammatory arthritis and iii) therapeutics for neurodegenerative diseases such as Alzheimer's and Parkinson's.

For fullerenes to be useful as biomarkers, diagnostic agents, and therapeutics, new technologies must be developed that can detect and track them in biological materials during in vitro and in vivo studies and nano-therapy. Currently, there are no such methods. To that end, Luna recently developed several affinity purified goat and rabbit primary fullerene antibodies and secondary antibodies conjugated to biotin fluorescein, and horseradish peroxidase. These antibodies are now being used to develop immunoassays and immunoprobes for, i) measuring fullerenes in organs and body fluids, ii) tracking fullerenes in cell cultures and iii) immuno-histochemistry of fullerenes in tissues. In the near future, Luna will begin providing these antibodies to distributors for sale to fullerene manufacturing facilities and medical researchers for monitoring the workplace and developing the new therapeutics, respectively. The ultimate goal at Luna is to provide quality immunoreagents to accelerate the transition of the novel fullerene therapeutics to clinical trials and eventually provide means for routine monitoring of fullerene levels during specific therapies.

The feasibility of producing polyclonal antibodies to fullerenes was originally demonstrated with mice in 1998 by the Chief Science Officer of Luna nanoWorks, Dr. Steve Wilson, and collaborators at Columbia University (Chen et. al. 1998. PNAS, 95:10809-10813). In 2000, a mouse monoclonal antibody was produced to a C60 derivative and characterized by x-ray crystallography, but it was not commercially available (Braden et. al. 2000. PNAS, 97:12193-12197). In 2006, Luna Innovations began this NSF effort to produce large quantities of purified fullerene antibodies and derivatives and make them available for researchers and medical practitioners. C60 and C80 antibodies are currently being characterized at Luna Innovations for use in immunoassays and in vitro and in vivo fluorescent tracer studies. They are expected to be commercially available in FY09.

Maine BioTek, Inc.

Phase II Award No.: 0724041

Award Amount: $499,393.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Sector: Biotechnology

SBIR Phase II: Atlantic Cod Nodavirus Vaccine

Maine BioTek specializes in the development of vaccines for farmed aquatic animals. Vaccines are among the first "wonder drugs" to radically transform aquaculture and are unique among pharmaceutical products – they prevent, rather than treat disease. The preventive and collective benefits of vaccines have created a powerful commercial and environmental interest in these products. In addition to lowering the cost of production, vaccines fulfill market, trade and consumer preferences for wholesome (safe and quality) aquaculture products produced without the aid of antimicrobials and chemicals. Vaccines will play an integral and vital role in the growth and sustainability of Atlantic cod aquaculture.

Maine BioTek is developing Noda-Vac, an advanced, recombinant protein vaccine designed to prevent outbreaks of the most economically significant viral disease of farmed Atlantic cod in North America. During our Phase II project, a total of eight recombinant protein vaccines have been made. Synthesis of the recombinant proteins is extremely efficient and the proteins are readily formulated into vaccines. The ability of the vaccines to prevent nodavirus disease in cod is being assessed under controlled laboratory conditions and several promising vaccines have been identified. One vaccine in particular is highly effective in preventing mortality due to nodavirus infection in cod immunized by intraperitoneal injection and then challenged with an otherwise lethal dose of live virus. To our knowledge, this is the first report of successful development of a nodavirus vaccine specifically designed for cod.

The feasibility of developing a vaccine for the control of nodavirus disease of cultured Atlantic cod was established in the Phase I project (award no. 0610512) awarded to Maine BioTek, Inc. through the NSF SBIR program.

Marrone Organic Innovations, Inc.

Phase II Award No.: 0750549

Award Amount: $500,000.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Biotechnology

STTR Phase II: Commercialization of an Innovative Green Technology for Controlling Zebra Mussels

The development of a natural compound-producing organism, Pseudomonas fluorescens - Pf-CL145A, into a marketable biocontrol product with good shelf life and efficacy against invasive zebra and quagga mussels is making good progress, and has quickly advanced to a field testing phase. In July, scientists from Marrone Organic Innovations (MOI) and New York State Museum (NYSM) toured the power plants at Hoover and Davis Dams along Colorado River, and learned about problems and damage caused by quagga mussels currently infesting the facilities. Meeting with the facilities' managers and the representatives of US Bureau of Reclamation (USBREC) resulted in a successful biobox trial at Davis Dam and larger scale field study plans in the beginning of 2009. The field-scale tests at Davis Dam are authorized by both Arizona and Nevada State officials and will be conducted in collaboration with NYSM and USBREC. Included is a treatment of a domestic water intake pipe with the dead cells of P. fluorescens to demonstrate their mussel-control power under realistic field conditions. Material for these and future studies is produced in large-scale fermentation using growth medium that maximizes the production of the compounds toxic to the mussels. The dead bacterial cells are then formulated to a commercial product. MOI has made progress in the identification of the novel active compounds produced by this organism, has completed all toxicology tests required for registration and is going to submit the paperwork required for pesticide registration through EPA before the end of 2008.

This project is continuing the efforts of New York State Museum and their previous small-business partner, Particle Coating Technologies (PCT) funded by a NSF Phase I grant. Marrone Organic Innovations is working toward commercialization of this new biocontrol product against invasive mussel species.

Material Methods

Phase II Award No.: 0620587
Phase IIB Award No.: 0849013
Award Amount: $952,938.00
Start Date: 08/15/2006
End Date: 07/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Chiral Polymers for Pharmaceutical Purification

A typical barrel of oil is burned as fuel, save five percent that becomes plastics. Starch and cellulose are viewed as biofuels, but they also can become high-value polymers. Engineering biopolymers is more challenging than making plastics from petroleum, but the rewards are far greater. Biopolymers retain nature's precision in connecting molecules into long chains with repeating patterns. Proteins are biopolymers that comprise our bodies. Life is built upon patterned sequences of amino acids strung together to form proteins. Proteins are expensive compared to carbohydrates. Consider the price of a pound of steak compared to a pound of flour. Biopolymers made from carbohydrates (starch and cellulose) promise the value of steak at the cost of flour.

Starting with common carbohydrates we are developing polymers that are useful to medicine. One version of these polymers will purify drugs to make them safe and effective. Another derivative of these polymers enhances the time drugs spend in the blood stream to increase effectiveness. A third kind of carbohydrate biopolymer will make clinical assays more sensitive. To create these high-value applications of biopolymers, nature's polymers are disassembled and the sugar building blocks are reassembled according to engineering objectives. Success with high value applications will encourage more efficient processing of 'flour into steak.' Ultimately we hope to mimic the functionality of protein machines, made from amino acids, with bio polymer machines made from carbohydrates.

Motivated by the oil crisis of 1973, chemists in the former Soviet Union developed novel chemistry to make biopolymers from starch and cellulose. Their success was diffused by perestroika. This NSF phase SBIR has funded one of the original Soviet chemists to develop medical applications of these biopolymers in the USA.

Mayan Pigments, Inc.

Phase II Award No.: 0724210

Award Amount: $497,550.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Materials

SBIR Phase II: One-Step Environmentally-Friendly Synthesis of Novel Organic/Inorganic Hybrid Pigments

Mayan Pigments, Inc. was founded by researchers at the University of Texas at El Paso who unlocked the secret of the ancient Maya Blue colorant. Maya Blue is a hybrid pigment based on reacting an inorganic clay with an organic dye or pigment molecule. The Company has introduced some of the first new color chemistries since 1986. These unique hybrid pigments are eco-friendly and exhibit special properties in a broad range of applications. The Company is commercializing a full range of pigment and enhanced solvent-dye colorants in the plastics, architectural and industrial paints and coatings, printing ink, fibers, artist colors, graphic arts and cement/stucco markets. There is a growing need to have eco-friendly and cost-effective colorants that can be used in a broad range of applications. Customers are coming under more pressure to produce products that are safe to use and are manufactured in an environmentally acceptable fashion. In addition, new colors with better properties are valued in the marketplace, such as yellow and orange colorants in plastics such as nylon. The company's low-cost manufacturing process is environmentally friendly, based in the US and produces no known hazardous wastes. The only by-product during the production of the unique hybrid colorants is water.

Mayan Pigments, Inc. was founded by researchers at the University of Texas at El Paso who unlocked the secret of the ancient Maya Blue colorant. Maya Blue is a hybrid pigment based on reacting an inorganic clay with an organic dye or pigment molecule. Once the atomic level interaction of the clay and dye comprising Maya Blue was understood, the UTEP researchers extended this theory to create a broad range of hybrid pigment colorants based on the ancient Mayan technology. The innovation of the range of colorants with great chemical and physical properties led to the founding of Mayan Pigments, Inc. to commercialize them.

Media and Process Technology Inc.

Phase II Award No.: 0620528
Phase IIB Award No.: 0852630
Award Amount: $683,368.00
Start Date: 09/01/2006
End Date: 08/31/2009

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Sector: Materials

SBIR Phase II: An Engineered Diffusion Barrier for Preparation of Pd Membranes on Tubular Porous Stainless Steel Substrate

The US Government has vowed to make hydrogen-powered fuel cell cars practical and affordable by 2010 to 2020. Out of many technical challenges facing this hydrogen-based economy, hydrogen separation is one of the critical components, specifically:

- An effective hydrogen selective membrane functions as a hydrogen filter, providing a cost effective avenue to meet the hydrogen production cost target at the fueling station. The current hydrogen cost at the fueling station is estimated at >$6 per gasoline gallon equivalent (gge), which is >2 times of the DOE target.

- Hydrogen is also in considerable and increasing demand (~9% annually) in the petroleum refining industry. Instead of building new hydrogen production plants, hydrogen can instead be recovered for reuse from waste gas streams destined for fuel. The value of hydrogen as a chemical in a refinery is about three times its fuel value. A hydrogen selective membrane provides a low capital cost, no feedstock requirement, and short lead-time timely solution to relieve the hydrogen demand for refiners.

In summary, membrane processes can reduce hydrogen production cost to meet the DOE target. In addition, it can recover hydrogen from refinery's waste stream to meet growing hydrogen demand. This SBIR project focuses on the development, fabrication, field testing and commercialization of an innovative palladium-based membrane which can satisfy the above demands.

- Pd membranes for hydrogen separation and purification are not new. Due to their cost and lack of chemical stability, their use has been traditionally limited to the hydrogen purification for electronic industry.

- Recent surge in the interest in Pd membranes is resulted from the high purity hydrogen need as feedstock for fuel cell applications. Although the use of Pd membranes at a high temperature, i.e., >550C, and the development of supported Pd thin film have offered potential to reduce its cost for energy-related applications, the weak material stability at this higher temperature and with the composite structure have prevented its commercialization in spite of very active R&D.

- Our unique Pd composite membrane overcomes these technical barriers. More importantly, our process no longer limited to high yield/low purity/or low purity/high yield compromise. These two unique attributes of our product and process offer a commercially viable opportunity to introduce this technology to small scale hydrogen production to replace traditional PSA technology.

Medipacs Inc.

Phase II Award No.: 0848528

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Devices & Instruments

STTR Phase II: Dendritic Hydrogel Actuators for a Liquid Drug Delivery Patch

This Small Business Technology Transfer Phase II project will develop a class of new, stable, highly responsive Electro Active Polymer (EAP) hydrogel actuator materials. Incorporating dendrimers (dendritic macromolecules) and hyper branched polymers as chemical cross-linking agents into a poly(ethylene glycol) (PEG)-based EAP hydrogel to increase cross-linking densities at low polymer concentration will introduce systematic control of physical properties and performance through structural variables provided by the dendrimer (e.g. generation; end groups; branching ratio; subunit structure). Our research objectives involve the preparation of dendrimer containing PEG hydrogels and the investigation of dendrimer mole fraction, structure, and molecular weight on the stability, strength, physical and responsive properties of the hydrogel material. The new hydrogel actuator materials will enable low cost miniature infusion pump technology. These actuators will be the pump mechanism of a disposable (low cost), small patch like, device being commercialized by Medipacs as the Mini Infuser.

The Mini Infuser is a miniature, disposable, programmable drug delivery device designed to significantly lower the cost of patient care while improving a patient's lifestyle with increased pharmacological safety, patient mobility and fewer needle sticks. Medipacs is collaborating with the University of Arizona Chemistry Department to develop the first generation commercial prototype in the Phase II project. Broad application of this technology will impact and lower the cost of healthcare not only for millions of infusion patients but also the industry providers. The projected market in the United States alone is greater than $3 billion. The impact to poorer regions though out the world is immeasurable; life-improving drug therapies such as low cost continuous insulin delivery will be enabled and become available for the first time to patients within these regions.

Mendel Biotechnology Incorporated

Phase II Award No.: 0450162
Phase IIB Award No.: 0730916
Award Amount: $962,138.00
Start Date: 09/01/2005
End Date: 08/31/2009

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Sector: Biotechnology

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

Scientists at Mendel Biotechnology, Inc., in Hayward, CA, have created plants that resist many common fungal diseases through expression of genes called transcription factors that control a plant's natural defenses against disease. However, continuous expression of these genes also produced some undesired side effects, such as reduced plant size and delayed flowering, that could reduce the benefits of this technology in crop plants. Dr. Jules Ade and his collaborators at Mendel have modified these transcription factors through protein engineering to discover new sequences that produce disease resistance phenotypes with fewer negative side effects. Transgenic plants show improved size and flowering phenotypes while still retaining strong resistance to several fungal pathogens. Mendel scientists are piloting these studies in the small model plant Arabidopsis thaliana, but have previously shown that transcription factor-based disease resistance can be used in crop plants such as tomato. To ensure that the technology can be introduced to the market, Mendel has developed commercial partnerships with leading companies to bring this technology from the model plant Arabidopsis to market in commercial crops.

Plant diseases represent serious constraints in the profitable cultivation of crops, causing more than 12% of food loss worldwide and threatening our food supplies. Indeed, diseases contribute significantly to the current food shortage in which more than 800 million people are inappropriately fed. The technology developed at Mendel has the potential to improve global food security. In addition, by potentiating the plant intrinsic ability to resist diseases, this technology has an environmental benefit as it will reduce the need of pesticides which have negative impacts on the environment and raise concerns about food safety.

The initial discovery of the disease technology discussed here was made at Mendel Biotechnology, Inc. during a genomics screening program. The technology was further developed under Phase I and Phase II NSF SBIR grants.

Myomics, Inc.

Phase II Award No.: 0724445

Award Amount: $513,536.00
Start Date: 08/15/2007
End Date: 07/31/2009

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Sector: Biotechnology

SBIR Phase II: Physiologic High Throughput Screening of Bioengineered Tissues

Myomics has developed a rapid and cost effective in vitro drug screening method that can determine whether a compound, or combination of compounds, increases the strength of skeletal muscle tissue. The technology is called MFASTM (MyoForce Analysis System) and the robotic hardware and software were developed with the current NSF SBIR Phase II award. It is comprised of tissue engineered skeletal muscle (miniature BioArtificial Muscles or mBAMs) attached to micro-mechanical sensors in ninety-six microwell plates to quantitatively measure changes in muscle strength when exposed to different compounds. Myomics' mBAM tissue/sensor composite is capable of repetitive nondestructive force measurements over days to weeks. Such long-term studies can determine cumulative effects of drugs on tissues and provides physiological data regarding tissue function. The physiological measurement of force generation by mBAMs is not limited to any particular known biochemical pathway, but rather the measurement of force is the result of both positive and negative drug effects. Thus, MFASTM will not only screen compounds for positive muscle strength effects through known as well as unknown pathways, but will more rapidly eliminate target compounds with potentially adverse side effects. In its first commercial application, MFASTM was validated to screen for new compounds to treat Duchenne Muscular Dystrophy (DMD). DMD is a fatal genetic disease affecting tens of thousands of boys in the U.S. There is currently no cure for the disease and few drugs are available to slow the progressive loss in skeletal muscle strength. MFASTM will serve as an important bridge between target-based high throughput drug screening and follow-on in vivo animal studies. It will help identify new compounds that can improve the longevity and quality of life of the boys with this devastating disease.

The intellectual concept for the use of tissue engineered skeletal muscle for drug screening was developed by the Principal Investigator while Chief Scientific Officer at Cell Based Delivery, Inc. Proof of principle was performed at Myomics, Inc. under grants from the NSF (Award # 0610721) and NIH (R43-NS059098).

nanoComposix, Inc.

Phase II Award No.: 0848998

Award Amount: $456,511.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Nanotechnology

SBIR Phase II: Mass Spectrometry Imaging Using Gold Nanoparticle Matrices

This Small Business Innovation Research Phase II project will enhance the capabilities of imaging biomolecular ions from solid tissue samples using matrix assisted laser desorption time-of-flight imaging mass spectrometry (MALDI-IMS). Currently, organic acid matrices are used to promote the desorption and ionization of biomolecules from the tissue surface, however, these types of matrices have a number of limitations. Specifically, extensive fragmentation can interfere with the analysis of lipids, peptides and pharmaceuticals in the low mass region ($m/z < 500$), and organic matrices tend to form large crystals upon drying which can limit imaging resolution and repeatability. NanoComposix is developing a new matrix that utilizes gold nanoparticles to efficiently ionize biomolecules from tissue samples. This gold nanoparticle matrix has much lower background ion signal, has improved imaging resolution, and specifically ionizes molecules not observed using traditional organic matrices. MALDI-IMS will be used to validate optimized nanoparticle formulations and application methods using hepatic and neuronal tissue slices.

The broader impacts of this research are the potential for profound affects on the scientific communities understanding of disease, capabilities for early disease diagnosis, and our ability to find new drug targets. Information on the content and spatial distribution of biomarkers in tissue will accelerate the development of "personalized medicine" where drugs can be selected based on individual patient characteristics. The current organic matrices used for MALDI-IMS are limited and there is an immediate need for new matrices with unique specificity and sensitivity towards biomarkers that are not observed using standard matrices.

Nanohmics, Inc.

Phase II Award No.: 0724423

Award Amount: $482,526.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Program Director: Gregory T. Baxter

Sector: Devices & Instruments

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

As the knowledge of our genetic code expands and our ability to isolate, manipulate, and interpret genetic expression increases, so too must instrumentation to handle the vast possibilities in this emerging field. Funded by the NSF Small Business Innovation Research (SBIR) program, Nanohmics, Inc. is currently developing the Infrarray SNAPTM (Simple Nucleic Acid Profiler) platform to fulfill this unmet need in the performance of array-based genetic analysis/diagnostics. Presently, instrumentation to perform genetic exploratory studies and multiplex genetic diagnostics is costly and is only maintained at the "facility" level with user's vying for time or outsourcing routine array-based testing. Nanohmics' goal is to implement a detection method that will enable the development of a compact, low-cost array analysis platform that can be used by the individual researcher. The Infrarray SNAPTM will put the power of custom array design and analysis into the hands of individual researchers and ultimately be used to perform rapid medicinal genetic diagnostics. Rapid, compact multiplex genetic diagnostics in the medicinal setting will provide physicians with a powerful tool for assessing the health needs and future health issues of patients.

This innovation originated from early work efforts performed under an Air Force SBIR #FA8650-05-M-1893 where the upconverting phosphors were first introduced as near-IR sensitive pixels in a color filter mosaic. Nanohmics recognized the potential of the phosphors in diagnostics applications. Combined with the phosphors, Nanohmics developed a process for inclusion of the phosphors labels along with an imaging device and custom microarray to develop the Infrarray SNAP concept which is currently being developed under NSF Phase II grant 0724423.

Nanopharma Technologies, Inc.

Phase II Award No.: 0620572
Phase IIB Award No.: 0848810
Award Amount: $632,951.00
Start Date: 08/01/2006
End Date: 07/31/2009

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Sector: Nanotechnology

STTR Phase II: Antibacterially-Active Nanoparticles

The Turos laboratory at University of South Florida has developed a protocol for synthesizing polyacrylate nanoparticle emulsions for delivery of pharmaceutical compounds as a potential means to improve their efficacy, stability, biodistribution or specificity, particularly in the microbial infection area. Under an NSF-funded project, his laboratory and Nanopharma Technologies, Inc. has further investigated these nano-antiobitics which deliver the drug molecule into the bacterial cell by what appears to be an unusual mechanism. As such, the nanoparticles insulate incorporated drugs from the external aqueous environment, and thus can protect even sensitive antibiotics from enzymatic damage that causes drug resistance. Consequently, these nanoparticle antibiotics (nanobiotics) could provide a way for treating infections caused by methicillin-resistant Staphylococcus aureus (MRSA), a dangerous pathogen responsible for 19,000 deaths each year in the United States, and rejuvenate the clinical activity of old antibiotics like penicillin. NSF is supporting the Turos-Nanopharma studies on this nanoparticle technology as a means to treat skin and systemic infections caused by MRSA bacteria. This could be one of the first applications of nanotechnology for treatment and prevention of life-threatening diseases caused by microbial drug resistance.

The study was to conjugate or encapsulate penicillin to novel, patent-pending nanoparticles prepared by a modified emulsion polymerization technology. Thus penicillin can be protected from drug-destroying exudates of antibiotic-resistant microorganisms such as methicillin-resistant Staph aureus (MRSA). Through the project, penicillin-nanoparticle conjugates (NanoPenicillin) as well as penicillin-encapsulated within nanoparticles but not conjugated were prepared and tested against mouse models. These nanoparticle-penicillin solutions are being considered as an injectable drug for the "Critical Care" market, as well as a topical application in order to mitigate MRSA growth starting from skin surface abrasions.

Newton Photonics, Inc.

Phase II Award No.: 0822746

Award Amount: $477,497.00
Start Date: 11/15/2008
End Date: 10/31/2010

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Program Director: Cynthia A. Znati

Sector: Devices & Instruments

SBIR Phase II: Novel sensor for non-invasive blood glucose monitoring

This SBIR Phase II project will demonstrate a promising method for continuous noninvasive glucose monitoring based on an innovative optical sensing technology. To date no organization has been successful in producing an FDA-approved non-invasive glucometer, i.e. one that provides a level of sensitivity and selectivity equivalent to the current self-test method (deposition of a blood droplet on a test strip). The primary difficulty in building an accurate instrument has been the reliable discrimination of the weak glucose signature from interfering effects inherent in live human tissue. Newton Photonics (NP) has developed a new approach based on optical coherence tomography (OCT). Researchers have previously demonstrated that OCT could detect a person's glucose level. Unfortunately, the considerable influence of physiological effects, especially those of cell size, tissue hydration and tissue non-uniformity, have limited the practical application of this modality. NP integrates OCT sensing with thermal modulation of the skin and new noise reduction techniques to overcome this critical deficiency. In Phase I, NP demonstrated the principles of operation in experiments using phantoms and ex-vivo tissue. In Phase-II NP will upgrade the system for human testing and conduct pre-clinical trials.

NP's non-invasive glucose monitor will improve the lives of millions of individuals whose health depends on the external control of their glucose levels. The NP monitor provides continuous data output. It maintains its measurement accuracy without the frequent calibration required by commercially available subcutaneous probes. These capabilities will enable convenient, pain-free operation. Two groups of users will benefit from this technology: a) hospitals will improve the health and longevity of intensive care patients while simultaneously reducing the cost of healthcare. Approximately 20 million intensive care unit (ICU) patients per year frequently suffer hyperglycemia as a result of major surgery or illness. A 2001 landmark medical study demonstrated that tight glycemic control of ICU patients leads directly to reduced hospital stay duration and also provides a 3-8% decrease in first year post-hospitalization death rate. b) Self-testing diabetics will have a convenient, painless way to more frequently monitor their glucose level and thus control it more accurately. Diabetes is a chronic disease with no cure. The direct cost of treating diabetes and its complications in the US was $92 billion in 2002, approximately 10% of the entire annual cost of the US healthcare system.

Nextech Materials Ltd.

Phase II Award No.: 0848877

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Program Director: Cynthia A. Znati

Sector: Energy

SBIR Phase II: Catalyst for Biomass Gasification Processes

This Small Business Innovation Research Phase II project focuses on improving efficiency and reducing cost associated with the production of energy, liquid fuels, and value-added chemicals from gasified biomass. Unlike most other sources of biofuels, gasification would not directly compete with food sources since virtually any organic matter can be used as the feedstock. Examples of feedstocks include agricultural residue, wood chips, and municipal waste. However, biomass gasification is currently a capital intensive process because of the difficulty with producing a clean syngas (free of tars and pollutants) for use in downstream turbines or chemical production steps. Tar removal is necessary to protect down-stream equipment in the process. Within this project, NexTech will develop and commercialize a novel catalytic monolith capable of reforming tars into a useful product, syngas, improving system efficiency. This will be done by first optimizing the processing steps required to produce the monolith, then verifying the monolith performance in independent testing. The end product will provide gasifier users with a simpler and less expensive method for tar removal than currently used approaches.
The production of energy and liquid fuels from biomass will have a number of beneficial societal impacts. The gasification process is carbon neutral, since it uses CO2 that was captured from plants; therefore, biomass gasification will replace energy production from fossil fuels, thus reducing greenhouse gas emissions. Unlike fuel crops, biomass is a waste product that has no use for human consumption, so the technology does not compete with food sources. Further, using biomass as a source of energy will reduce the dependence of our nation on foreign sources of energy.

The technology being developed could have application to a wide range of other catalytic reactions as well, including lean burn diesel engine exhaust treatment, hydrocarbon reforming and gas-to-liquid processes. From a scientific standpoint, the technology being developed in this project is unique from traditional catalysts, and the basic principles could be applied to a wide range of applications. Additionally, the work being carried out during this project will improve understanding of catalyst deactivation from sulfur poisoning and carbon formation. Overall, the project will contribute novel results to the body of literature in catalysis and materials development.

Novomer LLC

Phase II Award No.: 0620438
Phase IIB Award No.: 0840816
Award Amount: $1,000,000.00
Start Date: 09/01/2006
End Date: 08/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: Novel Polycarbonate Synthesis

As uncertainty continues growing around the cost and availability of petroleum based raw materials for producing chemicals and plastics, there are increasing activities focused on the search for alternative feedstocks. While the majority of these efforts are aimed at using biologically-derived alternatives, the industry adoption rate and long-term viability of these alternatives are questionable, particularly if the source of the raw material is a food-based product. Novomer looks to exploit traditional chemical processes to incorporate alternative feedstocks to generate both existing and new chemicals, polymers and resins.
The goal of this NSF SBIR award is to commercialize a process for the production of plastics and resins that use CO2 as a raw material. Even though carbon dioxide is a non-flammable, non-toxic and inexpensive raw material, there are few industrial chemical processes that use it. Through an exclusive license with Cornell University, Novomer has access to a family of catalysts that incorporate CO2 into materials that could be used in applications ranging from consumer packaging to metal coatings.

This project is based on research that was originally conducted at Cornell University in the lab of Prof. Geoffrey Coates. The NSF has sponsored this research with grants CHE-9875261, CHE-0243605 and CHE-0809778. The original research focused on catalyst discovery and was performed on the 10 – 20 mL scale. Novomer has focused on the improving the catalysts and exploring the commercial viability of these reactions and has conducted pilot scale manufacturing campaigns with toll manufacturing partners.

One Cell Systems, Inc.

Phase II Award No.: 0724876

Award Amount: $512,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Devices & Instruments

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

Oligo Fluorescence in situ hybridization (Oligo-FISH), a new strategy for enumerating chromosomes in interphase nuclei with 5 minutes hybridization.

FISH ODN probes' short length permits rapid hybridization (5 minutes), a significant advantage for time critical procedures such as enumeration of chromosomes in interphase nuclei for oncology or preimplantation genetic applications. The entire FISH procedure including analysis takes only 1 hour.

Design: 10-20 ODN for Chr. X, 15, 17 and 20 a-satellite repeats and for Chr. Y alpha 3 repeat were designed, 5' end labeled, and tested individually on human metaphases. Only ODNs exhibiting signal specific for the target region were selected for each Chr. cocktail. For each Chr., ODNs were mixed together and hybridized on human cells and signal to noise ratio (S/N), sensitivity and specificity were assessed. Only probes exhibiting S/N >2 and sensitivity and specificity $>98\%$ were included in each Chr. specific cocktail. Next, we selected 5 fluors that could be simultaneously assessed using epifluorescence. To rank fluor intensity, Chr. Y probe was labeled with all 5 fluors, and S/N was assessed. S/N obtained for each probe labeled with A568, was inversely matched with the fluor ranking. Finally, all the probes were mixed together, and varying hybridization times were tested until the shortest time giving the same S/N was found.
Results: We designed specific ODNs for 5 Chr. After probes were labeled with the 5 fluors and combined, all probes exhibited S/N >2. The shortest hybridization time was determined at 5min permitting results in 1 hour.

We have been performing research for applications in the FISH arena for more than 5 years. Efforts include development of assays for microscopy and digital imaging as well as flow cytomery. We have developed alternative probe labeling strategies methods and instrumentation to improve sample processing in research and clinical applications.

OnTo Technologies

Phase II Award No.: 0750552

Award Amount: $512,000.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Recycling Advanced Batteries

What is the fate of the billions of batteries made for computers, cameras, cellular telephones, power tools and perhaps your future ride? Such advanced batteries, which are products of the Nano and Mirco Age, if sent for recycling, are either buried, melted, or dissolved using technology reminiscent of the Bronze Age. The resulting material is not suitable for battery use, which is not really recycling batteries. The technical mismatch could fatally limit the growth of nationally critical technologies such as energy storage and plug-in hybrid vehicles. To address this vital issue, the National Science Foundation supported OnTo's novel way to recycle advanced batteries. The impact of this technology is foundational for the next generation's significant environmental challenge: service of energy storage and energy conversion devices. This project bridges the battery-reliant industries requirements for low-cost, environmentally friendly materials. The developed recycling process will be the basis for jobs fundamental to the future portable electronics and electrified vehicle markets.

The use of green chemical processing for recycling modern materials produces a second generation suitable for use in batteries. Consider lithium cobalt oxide, which is the standard battery-cathode used for notebook computers and cellular telephones. Material recovered from exhausted packs was successfully restored to pristine character. Fractured material with degraded performance of 107 mA g-1 was restored to perform with theoretical capability of 140 mA g-1. The cost of restoration of recycled material is a fraction of that to synthesize the material from pure ingredients. Even the electrolyte was recycled and reconditioned for battery use, which is impossible with current methods. The project may produce the most economical advanced battery by using scrap material and novel recycling technology. These results are welcomed by industry; RSR Technologies, Inc. is the commercialization partner for the project and poised to provide advanced battery recycling for consumer products and electric vehicles.

The advanced battery recycling innovation is related to basic research performed in the laboratory of Dr. John B. Kerr at Lawrence Berkeley National Laboratory as part of the Advanced Technology Development Program, which was a multi-national laboratory/ industrial cooperation to develop diagnostic techniques for understanding capacity fade in lithium-ion batteries for hybrid electric vehicles and funded through The Assistant Secretary for Efficiency and Renewable Energy, Office of Advanced Automotive Technologies, U.S. Department of Energy, under contract no. DEAC03-76SF00098. The technology is currently in commercialization development under a contract with RSR Technologies, Inc.

Oragenics Corporation

Phase II Award No.: 0749884

Award Amount: $500,000.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: Lantibiotic Synthesis Using Differentially Protected Orthogonal Lanthionines

The need for new antibiotics grows steadily as bacteria that cause serious infections become increasingly resistant to the antibiotics currently in use. Last year, over 100,000 people died in the U.S. from infections caused by drug resistant bacteria, and many more suffered extended hospital stays, unnecessary pain and high costs to bring their infections under control. Lantibiotics are a large class of antibiotics that have been known for over 80 years, but have never been tested for their ability to treat infectious diseases because of insurmountable difficulties in either production or purification. ONI Biopharma has created a novel, proprietary chemical approach called DPOLT to synthesize lantibiotics. In October 2008, ONI BioPharma publically announced that it had successfully synthesized an analog of its lead antibiotic, MU1140, using DPOLT. This is the first report ever of a cost effective method for producing a member of the lantibiotic family. The Company has retained Almac Sciences, a leading contract manufacturer, to refine and scale-up GMP production of synthetic MU1140 to achieve sufficient quantities for it to be fully tested for regulatory approval as a new drug. MU1140 has the potential to treat a wide variety of infections, including those caused by MRSA (methicillin resistant Staphylococcus aureus) and other drug resistant Gram positive bacteria. Preliminary studies also indicate that MU1140 may be the first new antibiotic in 35 years for the treatment of tuberculosis. In addition to MU1140, DPOLT will allow us to synthesize all 50 of the known lantibiotics for the treatment of infectious diseases. In effect, DPOLT should provide a much needed pipeline of antibiotics at a time when they are most needed.

Production of a small, heat stable antibiotic by a particular strain of an oral bacterium was first described by ONI's Chief Scientific Officer, Jeffrey D. Hillman, in 1984. Early efforts to produce sufficient MU1140 to enable its characterization failed due to lack of significant production and difficulties with purification of the molecule. As new genetic and molecular tools became available, they were adapted to help solve these problems, and a scheme was designed that attempted semisynthetic production of MU1140. This work was sponsored by NSF Phase I SBIR (Grant No. 0419205; July 1, 2004-December 31, 2004). While this method ultimately proved unsatisfactory, our knowledge gained during that period led us to the DPOLT innovation, which has been supported by NSF SBIR Phase I and Phase II grants (Grant No. 0749884) and has proven to be extremely successful.

Phasiks Inc.

Phase II Award No.: 0848967

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Devices & Instruments

SBIR Phase II: Themally-Actuated Microfluidic Systems

This Small Business Innovation Research (SBIR) Phase II project will develop a new technology to satisfy the need for reliable and inexpensive ultifunctional fluid handling and control in microfluidic devices. Building on the Phase I results, which demonstrated the fundamental concepts of thermal actuation of microfluidics, the goals of the Phase II program are to demonstrate, develop, and optimize thermal actuation techniques for all useful microfluidic fluid handling functions, and to demonstrate the ability to combine the various functions into an integrated device. To achieve these goals, methods will be developed for fabricating, operating, evaluating, and optimizing devices demonstrating each function of interest in a realistic application setting. The end result will be a complete microfluidic tool box that can be applied to supply fluid handling and control functions to a variety of customers for implementation in commercial microfluidic devices.

The broader impacts of this research are in the areas of biomedical and biopharmaceutical research, and clinical diagnostics. Successful completion of this Phase II program would result in development of a set of thermally-actuated functional elements enabling a less complex and more cost-effective biomedical microfluidic device; the "lab-on-a-chip" system. The potential commercial value is significant. The increasing complexity of molecular diagnostic tests and the pressure to provide cost-effective, reliable, and repeatable point-of-care assays will continue to increase the demand for such systems. Societal impact of such a technology will include substantial cost reduction, more accurate and consistent results, and improved health care resulting from more rapid and specific treatment.

PolyNew Incorporated

Phase II Award No.: 0822999

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Materials

SBIR Phase II: BP 1 - Microwaveable Bioplastic Packaging

This Phase II SBIR research develops innovative nanotechnology to allow the use of bioplastics for food packaging. Polylactic acid (PLA) is an environmentally beneficial bioplastic made from renewable resources; however, the properties of PLA are limited. This makes it unsuited for use in microwaveable food packaging. In Phase I, university expertise resulting from earlier NSF funding was used to formulate a bioplastic with suitable properties, including cost. In Phase II, a viable manufacturing route towards food packing trays will be demonstrated at the pilot plant level working in close collaboration with a large industrial manufacturing partner.

The broader impacts of this Phase II SBIR research will be manifold. The new bioplastics are quantitatively more environmentally benign that petroplastics. Bioplastics are made form renewable resources and therefore simultaneously help decrease dependence on foreign oil while providing environmental benefits. Using a domestic biomass resource provides a competitive advantage against low labor cost manufacturers like China helping to stem job losses in the plastics industries. Presently, polystyrene is largely used for tray applications and foamed with 3-5 weight percent hydrocarbons. PLA can be foamed with carbon dioxide so the new technology has the additional benefit of displacing at least 1 million pounds per year of the pollutant volatile organic carbons (VOCs).

Prediction Sciences, LLC

Phase II Award No.: 0750452

Award Amount: $481,960.00
Start Date: 06/01/2008
End Date: 05/31/2010

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Sector: Biotechnology

SBIR Phase II: Multi-Marker Prognostic Test for Breast Cancer Outcome

This Small Bbusiness Innovation Research (SBIR) Phase II project aims to continue the validation of a set of markers for predicting recurrence and guiding the selection of treatment in stage I-III breast cancer patients. Upon removal of their primary stage I-III operable tumors, breast cancer patients must decide whether or not to receive adjuvant therapy such as chemotherapy, or hormone therapy. Currently, the physician and patient can arrive at the decision by relying on several published guidelines whose accuracy is limited by the fact that they are based on general clinicopathologic data such as tumor size and grade. Thus the majority of patients are recommended to receive adjuvant therapy, although only a small fraction of them benefit from it.

Availability of a set of reliable markers that can predict recurrence of tumors would allow tailoring of adjuvant therapy for each patient and is thus likely to reduce the chances of under-treatment and over-treatment. As such, it would be of great benefit to cancer patients, as well as to oncologists.

Protelix Inc.

Phase II Award No.: 0848867

Award Amount: $499,825.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Biotechnology

SBIR Phase II: Bioinformatics knowledge-based, universal library design for a non-immunoglobulin, protein-scaffold

This Small Business Innovation Research Phase II project seeks to fully establish ProtElix' scaffold-based human fibronectin libraries (14th fibronectin type III module of Human Fibronectin) as platform technology to discover novel antibody-mimics drug candidates for a wide range of therapeutic applications. The social and commercial implications of this discovery may include developing second generation protein drug antagonists which are less expensive, more efficacious and safer than current monoclonal antibody-based drugs. Overall, this Phase II Project will be divided in two stages: a research plan during which different binding and stability optimization strategies will be executed. Moreover, ProtElix technology will be tested with several protein targets (CD20, EGFR, VEGFR2, VLA-4) in order to fully assess the universality of the platform itself. The second stage of the project will be focused upon drug development activities. Lead candidates will undergo full kinetic characterization in vitro and in vivo and will be tested for PK/PD in small animal models. By the completion of phase II, a comprehensive discovery platform for proprietary human 14FN3-based antibody mimics libraries will be fully developed and the "drugability" of lead candidates assessed.

The application of protein scaffold to develop new therapeutics is becoming an area of great commercial potential with high social implications as it relates to lower the cost and increase the accessibility of therapy to several life-threatening diseases. In particular the use of antibody-mimics to selectively block therapeutically important protein targets could be the key to overcome the clinical limitations and potential toxicity and lack of efficacy of current antibody-based therapeutics. The flexible format of ProtElix scaffold platform technology together with its proprietary mutagenesis technology for producing "intelligent" library diversity will provide an attractive alternative to pharmaceutical and biotech companies for the discovery and development of next-generation biotherapeutics. In addition, the intrinsic characteristics of the Fibronectin Type III domain (i.e. small size, no disulfide bonds) would lead to cheaper cost of manufacturing and potentially more effective and safe drugs (higher tissue penetration and faster clearance) compared to immunoglobulin-based antibodies. If successful, this project will take the potential applications of scaffold-based therapeutics to a higher level than first generation antibodies, including cancer, autoimmune diseases, cardiovascular and infectious diseases.

Renewable Alternatives, LLC

Phase II Award No.: 0750470

Award Amount: $500,000.00
Start Date: 04/15/2008
End Date: 03/31/2010

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Sector: Materials

SBIR Phase II: Fire-Retardant Phase Change Materials from Fats and Oils

This research is focused on developing materials that can be safely incorporated into buildings and clothing in order to moderate the preferred ambient temperatures of humans. Current technology exists now, but is limited to its use because of its flammability. This work has reduced the flammability of these temperature moderating devices. Phase Change Materials (PCMs) are used for thermal energy storage and management. They can be used to buffer wide temperature swings. PCMs liquefy and solidify at specific temperatures. During the process of liquefying and solidifying PCM's absorb, store, and release large amounts of energy. The energy involved in these phase changes is referred to as latent heat. PCM's recharge as the ambient temperature fluctuates, making them ideal for a multitude of everyday applications. Previously used PCMs were derived from paraffins, a petroleum based product. Renewable Alternatives has developed a line of renewable phase change materials. These PCMs are made from vegetable oil and animal fat sources. They have higher latent heats, target more temperatures, are made from renewable resources and cost less than the line of petroleum derived PCMs. One of the best uses for PCMs is in the clothing market and the building construction market. However, safety is extremely important in these market applications, especially safety from flammable materials. Unfortunately, paraffin PCMs and the Renewable Alternative's PCMs are both flammable. Therefore, PCM use has been limited in these markets. This SBIR grant has been focused on creating PCMs that are not flammable. Various approaches have been taken to reduce the flammability to the PCMs. We have successfully changed the chemical structures of the PCM itself and we have added flame retardant compounds to the PCM. Each of these approaches has been successful. Renewable Alternative is now taking this successful laboratory research from bench scale to commercialization.

Renewable Alternatives completed a Phase II USDA-SBIR (award number 2003-33610-14177) on converting fats and oils into phase change materials. Commercialization began during the last year of the Phase II SBIR. Customers overwhelmingly requested a PCM that was also flame retardant. Dr. Sutterlin who is the PI on this project was also a post doctorial researcher on a USDA-NRI grant(Project Number MOR-2005-02692) that investigated other flame retardant materials. Some of that knowledge is being used in this project.

Ridge Diagnostics, Inc.

Phase II Award No.: 0848665

Award Amount: $464,304.00
Start Date: 04/15/2009
End Date: 03/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Molecular Interaction Measurement System: A Label-free Detection Platform.

This Small Business Innovation Research (SBIR) Phase II project is to build upon the feasibility of using MIMS technology to determine the presence and measure the concentration of multiple protein biomarkers (specifically autoantibodies) within a single sample. In order to achieve our primary objective in Phase II, PHB proposes to produce a new highly-sensitive and stable MIMS system prototype for clinical use. We will develop a prototype disposable, reliable, easy to use biochip cassette with limited potential for biohazard exposure. To reduce the need for off-chip processing, PHB will implement a cartridge- based fluidic channel to remove blood cells. We will develop specific attachment strategies for antibodies and/or F(ab)2 fragments of antibodies that enable the efficient capture of antigens to be used as targets for autoantibodies. This will eventually lead to the development of reverse capture arrays for identification of autoantigens against which autoAb expression may be used to differentiate between normal and disease states. We will optimize the protein printing methodology, and blocking protocols to enable the optical interference detection system to provide reproducible results in molecular binding reactions on a multiplicity of nanostructured protein chips. We will evaluate the performance of the optimized substrate and platform in real-time with a representative set of antibody targets. Our initial focus will be a panel consisting of Thyroperoxidase antibody, TSH receptor antibodies and thyroglobulin antibodies. These tests can potentially be used to diagnose an autoimmune thyroid disease and to separate it from other forms of thyroiditis.

The broader impacts of this research are to develop the Molecular Interaction Measurement System (MIMS) which has the potential to measure multiple analyte types (protein, RNA, DNA etc.) in real-time. MIMS uses optical interference to measure the changes in thickness, resulting from binding of a ligand to a macromolecule attached to the surface of a detector chip. The array format of the MIMS assay permits simultaneous detection of the binding of multiple analytes. One application of interest and immediate clinical value is in the detection of autoantibodies which target host tissue and mediate autoimmune diseases. MIMS can enable specific detection without having to tag (e.g. with radioisotope or fluorescence) a patients sample: resulting in more accurate and cost effective diagnoses In addition, the finding that patients with cancer produce autoantibodies against antigens in their tumors suggests that such autoantibodies could have both diagnostic and prognostic value. Commercially, MIMS can be a tool to easily, rapidly and cost effectively screen a large number of patients with different types and stages of cancer and other diseases providing value to clinicians, to patients and the clinical research community.

Semprus Bioscience Corporation

Phase II Award No.: 0822959

Award Amount: $499,923.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Permanent Attachment of Antimicrobial Peptides to Central Venous Catheters.

This SBIR Phase II project continues SteriCoat's development of a permanent antimicrobial coating for use on central venous catheters. Current leaching antimicrobial technology does not possess the duration of efficacy required to protect these devices over the lifetime of implantation, especially for peripherally inserted central lines (PICCs). Research during this Phase II project will focus on the integration of proprietary polymer technology with tethered antimicrobial peptide (AmP) technology developed in Phase I to maximize the efficacy and bioavailability of the immobilized AmPs in vivo. Work will also be performed to ensure the manufacturability of SteriCoat's coating technology, including prototype production. After transitioning this formulation to the intra- and extraluminal surfaces of a polyurethane tube, efficacy and biocompatibility will be demonstrated both in vitro and in vivo. By the end of this Phase II project, SteriCoat will have an antimicrobial CVC model with efficacy proven in vivo using the models designed by industry thought leaders and will be ready for scale-up and manufacturing.

This SBIR Phase II project addresses the hospital infections afflicting 1.7 million patients and killing 99,000 in the US annually, the majority of which are associated with medical devices. Existing slow-release antimicrobial coatings are insufficient in addressing device infection. They have a limited lifespan and concerns over drug resistance and toxicity because the drug gets distributed in the bloodstream. SteriCoat is developing a permanent coating using antimicrobial peptides (AmPs) to prevent bacterial colonization of central venous catheters (CVCs), a $350M market. The goal of this project is to deliver a polyurethane-based antimicrobial CVC model which incorporates a surface functionalization with AmPs and to test the ability of this approach in resisting bacterial colonization. By the end of this phase II project, SteriCoat will have verified in vivo efficacy of prototype catheters and be positioned to begin GLP studies for FDA product approval. In addition, achievement of the technical objectives of this Phase II will open up avenues for additional investigation in the field of bioactive ligand presentation as the developed technology could lend to the efficacy of many biomaterial applications in addition to antimicrobials.

SFC Fluidics, LLC

Phase II Award No.: 0750328

Award Amount: $500,000.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Program Director: Gregory T. Baxter

Sector: Devices & Instruments

SBIR Phase II: Automated Analysis of Body Fluid Chemistry Using MHD-Based Microfluidics

This project is focused on automated assessment of patient metabolic health status from a finger-prick sample of blood and initially targeted to meet need for improved preconception care outlined by the CDC in the Healthy People 2000. Prospective markets and impact will be extended to include inexpensive screening for pernicious anemia, renal disease, and cardiovascular health. This point-of-care device with disposable bio-assay chips will provide an opportunity for customized, immediate diagnosis and medical intervention. All components needed for automated analysis of the pertinent biomarkers are fully contained on the sealed bio-assay chip – including reagents, pumps, mixers, valves, and detectors. An untrained operator need only add a finger-prick drop of blood, press a button, and wait several minutes for the results. This unique integration of assay steps on a single sealed chip is made possible using SFC Fluidics' mPump® technology. This non-mechanical pumping technology is uniquely suited for such applications and provides an elegant, inexpensive, customizable fluidic system which enables the movement of reagents along programmable pathways, stirring of liquids, valving of reagents, and all steps needed to realize the fully automated, on-chip assay for determination of metabolic health status.

The fundamental physics behind this technology resides in discovery of the Lorentz force, at the end of the 19th century. The Lorentz force is the total force exerted on charged particles by magnetic and electrical fields. It is debated whether the Dutch physicist, Hendrik Antoon Lorentz, actually discovered the effect first or if the discoverer was James Clerk Maxwell, a Scottish mathematician and theoretical physicist. Although the Lorentz force has been known for some time, application of magnetohydrodynamics (MHD, movement of fluids by the Lorentz force) came much later and microfluidic MHD is a recent technological advancement. Key innovations in MHD microfluidics are centered on several key inventors: Professor Abraham Lee (University of California at Irvine), Professor Ingrid Fritsch (University of Arkansas), and Professor Haim Bau (University of Pennsylvania). Licenses to the key patents from these institutions, together with internal intellectual property, affords SFC Fluidics a unique position to exploit this technology.

SFC Fluidics, LLC

Phase II Award No.: 0822723

Award Amount: $499,923.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Devices & Instruments

STTR Phase II: Magnetohydrodynamic-based Circular Liquid Chromatography

This STTR Phase II research project develops a circular chemical separation system on a small (~1 inch x 1 inch) chip. This chip and the associated instrument will separate complex mixtures for biological, chemical, medical, and industrial applications. Based on magnetohydrodynamic (MHD)-driven liquid flow, liquid chromatographic (LC) separations will be accomplished in a circular, closed-loop format. Typically, LC separations require a sample containing multiple analytes to flow in a single direction along a fixed-length, linear column with detection performed after the analytes elute from the column. In the circular LC system, miniaturization is possible because samples are instead circulated around a closed-loop chromatographic column thus, the effective column length is not limited to small chip dimensions. Very few methods can provide the mobile-phase pumping in a closed-loop that is required for practical application of circular LC. The MHD-based circular LC system envisioned will be small, portable, and designed for laboratory as well as field use. The sealed LC chip will contain the stationary phase, mobile phase, and all in situ MHD pumps needed to conduct the separation of complex samples. This prototype LC instrument will be designed and fabricated with a built-in fluorescence detector for monitoring analyte separation directly on the chromatographic column.

The broader impacts of this research are highlighted by the ability of the proposed circular separation system to miniaturize a valuable analytical tool, liquid chromatography (LC). Samples of interest include human blood serum, saliva, and urine, with component analytes of interest that are equally diverse (e.g. proteins, pharmaceuticals, and small molecular biomarkers). Many analytes in these complex mixtures have similar properties and cannot be separated and analyzed using a very short chromatographic column, which has limited the miniaturization of this important analytical tool. This limitation is overcome using circular LC, where the effective column length is not limited by the small chip sizes that are essential for portable LC instrumentation. SFC Fluidics' core technology makes possible the miniaturized, closed-loop pumping required for implementation. This method has broad implications for the portable LC systems for field deployment or point-of-care applications. The market opportunity is expected to be significant, particularly when considering that applicability extends beyond the traditional instrumentation market into the worldwide point-of-care diagnostics market.

Silatronix, Inc.

Phase II Award No.: 0724469

Award Amount: $511,245.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Energy

SBIR Phase II: Integration of Nanostructured Electrodes with Organosilicon Electrolytes for High Energy-Density Supercapacitors

Energy storage is a crucial problem as our country moves toward alternative sources of energy. Batteries and capacitors are able to store energy, but the current generation of energy storage devices have a number of shortcomings that limit their application, especially in transportation. Lithium-ion batteries and electrochemical double-layer capacitors (EDLCs) currently use flammable compounds (electrolytes) to carry current. The current generation of device also uses materials that boil at comparatively low temperature, thereby making it difficult to integrate them into applications such as hybrid automotive vehicles. We have developed novel silicon-based electrolytes and have constructed prototype electrochemical double-layer capacitors using organosilicon compounds. Organosilicon compounds have low flammability and low toxicity, making the ideally suited toward commercial applications in consumer products. By choosing the right combination of organosilicon compound and a lithium-containing salt, we have a successfully fabricated electrochemical double-layer capacitors that can withstand applied voltages as large as 5 V. Current efforts are underway to optimize the processing conditions, to extend the lifetime and performance, and to test properties at higher temperatures. Initial experiments were also conducted on the performance of organsilicon electrolytes for lithium-ion battery applications. The impact of our work is that it will enable and extend the applications energy storage devices.. Since organosilicon electrolytes have very low flammability compared with conventional electrolytes, their application in capacitors and batteries will enhance the safety of these devices.

This research originated in an ATP (Advanced Technology Program) program involving Prof. West's group at the University of Wisconsin, Argonne National Laboratory, and Quallion LLC, a medical device company. The goal was to develop ultra-safe, long-life batteries for medical implants. After the conclusion of the ATP Program ended, West initiated efforts to continue development; that lead to formation of start-up known as Polyron Materials, which received an SBIR Phase I grant, Award #0610741. Polyron was re-organized last year and became Silatronix. Silatronix coupled the expertise of West with that of Robert Hamers (CTO of Silatronix) to facilitate both synthesis of new compounds and development of electrical energy storage devices based on these compounds.

Sol-Gel Solutions, LLC

Phase II Award No.: 0750442

Award Amount: $502,423.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Manufacturing Processes

STTR Phase II: Ultraviolet Activated Chelation (UVAC) for the Recovery of Hg from Industrial Wastewater

In the U.S. approximately 5 to 10% of women of child-bearing age are estimated to exceed federal mercury (Hg) exposure guidelines due to dietary intake of Hg-contaminated fish. This exposure can impair neurological development, particularly in fetuses and during early childhood. Emissions of mercury from a number of industries must be significantly reduced in order to protect human health and the environment, and thus effective and economical technologies must be developed and commercialized. We have developed a novel and economical UV-promoted method, UVAC, which can remove Hg from variable industrial wastewaters to concentrations below 12 ppt. Technologies that can achieve such low Hg levels regardless of changing wastewater characteristics are currently lacking. Although a number of sorbents have been developed that claim to achieve low Hg levels, they are expensive and must be recovered and disposed of as hazardous waste. The UVAC technology is robust, simple to operate, requires minimal maintenance, and generates minimal waste. We have successfully completed bench-scale studies resulting in Hg concentrations as low as below detection (less than 0.5 ppt), and have determined the design parameters for a pilot-scale system to treat up to 50 GPM of Hg-laden wastewater at a US chlor-alkali facility. The reactor system has been fabricated and will soon be installed for an extensive study in preparation for commercialization of the technology.

The UVAC technology originated during the evaluation of the STC (silica-titania composites) technology developed by Dr. David Mazyck and colleagues at the University of Florida. Sol-gel Solutions, LLC licensed the STC technology for commercialization in the chlor-alkali industry. In the midst of feasibility studies for the STC technology, we discovered that the UVAC process was much simpler in operation and thus would result in a more economical commercial application.

Southeast TechInventures

Phase II Award No.: 0848968

Award Amount: $499,829.00
Start Date: 04/01/2009
End Date: 03/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Microglassification: Dehydration Process for Protein Preservation

This Small Business Innovation Research (SBIR) Phase II project will advance the recent discovery of an ambient temperature dehydration method "Microglassification" that is designed to more efficiently stabilize biomolecules for preservation. Lyophilization is the current process of choice, but it has major disadvantages including high capital cost of equipment, high energy costs, and long process time. Furthermore, with the advent of new protein therapeutics, diagnostics, vaccines, such expensive and environment-sensitive biomolecules can be irreversibly impacted due to the stresses of the freezing and the drying process and may never reach the market due to insufficient stability or even degradation that makes them antigenic and toxic in the body. Incorporation of Microglassification to produce a dry formulation of a biomolecule leads to following benefits: reduction in operation costs, production time savings, increased yield and purity, increased long-term stability, and reduced capital equipment costs.

The broader impacts of this research are not limited to broader temperature tolerances for the microglassified products facilitating storage and transport of sensitive biologics throughout the US, and also to developing countries. But also this research furthers the fundamental understanding of water removal from a protein (how molecular layers of water of hydration influence protein activity), the structural changes that might occur in the protein, and the protein interactions with its surrounding environment. It is expected that Microglassification will provide the needed stability to enable a biotechnological advance to reach the market, and, more importantly, reach the patient.

Stellar Biotechnologies, Inc.

Phase II Award No.: 0848952

Award Amount: $461,566.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Program Director: Gregory T. Baxter

Sector: Biotechnology

SBIR Phase II: Megathura crenulata Post Larval Culture - Bottleneck for a Valuable Medical Resource

This Small Business Innovation Research (SBIR) Phase II project will develop methods for the control of larval settlement, metamorphosis and postlarval growth of Megathura crenulata (keyhole limpet) to support the production of commercial quantities of Keyhole Limpet Hemocyanin (KLH), a unique and medically valuable marine natural product. Unlike many other prospective medical products from marine organisms, KLH is already in extensive use in over 20 KLH-based therapeutic vaccine trials. Phase I research successfully identified a critical "cue" for settlement of M. crenulata larvae and demonstrated the feasibility of achieving the long-term commercial objectives of this research. Phase II studies will translate the results from Phase I studies into prototype designs for testing and optimization of systems, diets and aquaculture methods for cultivation of the age-specific developmental phases, from metamorphosis to fully developed adults for KLH production.

The broader impacts of this research are; 1) The elucidation of the underlying biochemical factors that promote settlement, metamorphosis and early postlarval survival of this carnivorous gastropod thus adding significantly to the body of scientific knowledge in this field and improving the potential for cultivation of other commercially important species with biomedical potential; 2) Providing sustainable commercial supplies of KLH for new, life-saving therapeutic vaccines for cancer, arthritis, hypertension, and other debilitating diseases, without continued dependence on the limited and threatened fishery, and; 3) Providing regulators and resource managers the opportunity to formulate management policies to protect the wild population without imposing limitations on KLH or the important KLH-based vaccines under development.

Stem Cell Products Inc.

Phase II Award No.: 0823027

Award Amount: $500,000.00
Start Date: 10/01/2008
End Date: 09/30/2010

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Sector: Biotechnology

SBIR Phase II: Automated culture and differentiation of human Embryonic Stem Cells

This SBIR Phase II research is focused on methods to utilize blood precursor cells derived from human embryonic stem (HES) cells. The project uses a new defined differentiation system which allows automation and scale-up production of this important cells. There is a significant demand for these cells from research and drug discovery. Increased availability and batch-to-batch reproducibility of HES cell-derived blood cells, resulting from the defined genetic background of the starting material and this standardized, automated culture system, make this technology invaluable model systems for basic research and drug development. Based on the automated pilot system for handling and scale-up production of HES cells developed in phase I of this SBIR project we will transfer our current culturing protocols into robust automated production procedures to provide a reproducible quality of CD34 positive cells.

The broader impacts of this research will be improving the process of drug discovery and development and in the long term by providing revolutionary new applications for medical treatment to improve public health. Nearly 98% of a multi-million dollar stem cell market is currently consumed by blood and immune system treatments. We anticipate that the proposed research will lead to the faster integration of HES cell biology into biomedical research. It will help to provide a variety of other blood cell types in quantities required for basic research, drug development, high throughput screening, biochemical characterization and potential medical treatment of blood related disease.

Super Pulse

Phase II Award No.: 0750056

Award Amount: $505,999.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Room Temperature Medical Waste Treatment

Super Pulse has developed a plasma driven free radical source that produces air streams with sterilizing properties. The air stream contains various oxidative radicals that effectively sterilize and decontaminate sensitive surfaces. During the NSF Phase II project we will develop a novel, reliable, affordable, technology for effective decontamination/sterilization of medical waste. The technology is based on an air/gas sterilant. The technique allows for sterilizing a wide range of materials and surfaces at low-temperature and with low energy requirements. This technology is thus very suitable for the development of a decontamination/sterilization device for medical and dental offices/clinics. The proposed medical waste decontamination technology will not leave any chemical residue and will be very low maintenance and simple in operation. The medical waste treatment device will not produce any toxic or harmful effluents or odors. So far there is no effective room temperature technology available for dry medical waste treatment.

According to the Environmental Protection Agency hospitals and clinics in the United States generate up to one million tons of medical waste, and as much as 15% of it poses a potential infection hazard. New emerging decontamination technologies are in demand, especially those which do not produce harmful byproducts. Our technology is environmentally friendly and should be relatively easy to market. The proposed free radical method is a reliable, flexible, low maintenance, cost-effective, and extremely efficient decontamination method. It can be utilized in both small portable and large decontamination units. We will develop a small, portable unit capable of decontaminating medical waste at the point of creation. This way there is no necessity to transport contaminated waste to central decontamination unit, which maybe located far away. Transport of medical waste within the health facility or to other processing facilities is risky and costly because of liability and specialized transportation that is required. The current high cost of disposal leads to the possibility that untreated waste may be dumped illegally. Super Pulse's technology addresses both the safety and financial burdens of medical waste diposal.

The use of free radicals in medical applications is a result of many years of experimental effort by the PI supported by grants from private Industry, Cornell University, DoD and NSF. It started during the development of a microwave lamp starter, where plasma generation was the primary object. This later lead to the application of plasma discharges to driving of chemical reactions and the development of the free radical source.

Sustainable Innovations, LLC

Phase II Award No.: 0848366

Award Amount: $499,617.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Energy

SBIR Phase II: Development of Hydrogen/Halogen Fuel Cell Technology for Renewables Based Energy Storage

This Small Business Innovation Research Phase II project will develop the underlying technology behind a highly efficient energy storage system that can provide reliable, dispatchable power from intermittent renewable energy sources such as wind and solar. This technology is based on a novel hydrogen/chlorine chemistry embodied in a regenerative fuel cell architecture that can address MW-scale applications. This project will develop a better scientific understanding of important technological barriers to commercial implementation of this technology including developing an insight into parametric behavior through both experimentation and modeling, improving reactant mass transport at the chlorine electrode, and eliminating parasitic shunt currents in multi-cell module architectures. Sustainable Innovations, LLC, will work with Harvard University to develop an 8-cell, laboratory scale electrochemical module having a round-trip efficiency of over 80% with design features that optimize mass transport and reduce shunt currents and will evaluate the performance of this module through a series of parametric and durability tests. This research will culminate in the development and demonstration of a 100-Watt integrated system and the development of a 135 kW system concept that will serve as a critical building block for future commercialization efforts.

Concern about the increasing level of greenhouse gases is intensifying the global interest in better ways to harness renewables such as solar, wind, and hydroelectric power. Renewable power applications have experienced significant growth as a result of this belief and also technological advancements that have reduced their cost and increased their efficiency. Utility privatization and deregulation have opened the market for innovative power technologies, and some consumers have elected to use renewables even when they are more expensive than grid power. But renewables can't always generate power on demand because they depend upon favorable natural conditions, such as the presence of sunlight or wind. The development of cost effective, efficient energy storage systems that could create dispatchable power from inherently intermittent renewables may enable the widespread use of these technologies. Various technologies, particularly batteries, have been implemented for applications requiring energy storage, but conventional batteries have significant efficiency, cycle life and life cycle cost limitations which reduce the overall cost effectiveness of renewable installations. New technologies, such as hydrogen/halogen regenerative fuel cells with improved efficiency, cycle life and cost are needed to add value and utility to intermittent renewables creating technical and economic drivers for widespread commercial deployment and global electrification.

Synkera Technologies Inc.

Phase II Award No.: 0548757
Phase IIB Award No.: 0828371
Award Amount: $922,292.00
Start Date: 03/15/2006
End Date: 02/28/2010

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Sector: Materials

SBIR Phase II: High Flux Metal-Ceramic Hydrogen Separation Membranes

Production of pure hydrogen is essential to the realization of the "hydrogen economy," one in which hydrogen will be utilized as a clean, renewable energy carrier; eliminate or reduce the dependence on fossil fuels; improve utilization of natural resources; and reduce the generation of greenhouse gases. Besides its potential as an energy source, hydrogen is a versatile chemical with a wide range of commercial uses, particularly in the oil and gas industry. A crucial step in economical hydrogen production is separating it from other gases. Drawbacks of the current separation processes (high capital and operating costs; low productivity; size, weight and energy consumption; narrow range of operating conditions; reliability) limits both the utility and the cost-competitiveness of many hydrogen-based processes and applications.

Synkera Technologies Inc. is developing novel nanocomposite membranes for hydrogen separation that target breakthrough performance and reliability in a broad range of operating conditions and offer significant cost savings at the system level. These benefits, enabled by membrane composition and architecture engineered at the nanoscale, provide significant competitive advantages for many point-of-use hydrogen separation and purification applications, from portable fuel cell and hydrogen refueling stations to semiconductor foundries and oil refineries. With support from the NSF SBIR program, Synkera developed laboratory prototypes with significant performance enhancements and cost savings potential over competing technologies. Excellent reliability was achieved in thermal and pressure cycling without loss of performance. Based on this success, Synkera secured critical partnerships in two key markets, fuel cell power systems and distributed hydrogen purification. Consequently, our current effort under Phase IIB funding are directed towards further development to meet application requirements and scaling the technology to produce system-specific membrane prototypes for field-testing.

These novel membranes are based on Synkera's nano- & micro-fabrication technology platform. Using this platform for creating hydrogen purification membranes was first demonstrated under Phase I SBIR funding from DOE (DE-FG-02-04ER84086) and NSF (DMI-0420147) in 2004-2005. The follow-up development under a NSF Phase II grant was critical in maturing the technology and achieving performance and scale-up milestones that resulted in significant interest and support from the fuel cell and petrochemical industry. The membrane prototypes are currently being developed for integration and validation in application-specific separation systems for these markets, for potential product launch in 2009.

Synkera Technologies Inc.

Phase II Award No.: 0724408

Award Amount: $487,677.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Catalytic Nanochannel Reactor Arrays for Fuel Reforming

Fuel cells are a viable alternative for generating clean energy, with the variety of applications ranging from battery replacement to portable power and transportation to stationary power for buildings and distributed generation. However, significant technical and economic barriers keep fuel cells from reaching the broad market. In particular, PEM fuel cells (~50% of the overall market), pose a critical need for high-performance, cost-effective and reliable hydrogen generation by reforming available fuels (e.g., alcohols, natural gas, propane). These demands are exacerbated by the weight and size constrains of portable PEM power systems (0.1 – 1kW), which represent a large market segment.

In this NSF SBIR project, Synkera addresses the challenges of increasing performance and reliability, reducing weight and volume, minimizing power usage, and lowering cost by developing lightweight compact catalytic reactors for fuel reforming and other applications using novel nanochannel array reactor architecture. Generating hydrogen from methanol using these reactors with performance exceeding that of conventional reactors was demonstrated. Under Phase II funding, Synkera is now developing and validating operational prototypes of these reactors. Together with one of the leading developers of PEM fuel cell power systems, we are targeting new designs for fuel processing systems, where reforming and separation processes are tightly integrated, delivering significant cost savings, increasing power output and improving reliability.

These novel reactors are based on Synkera's nano- & micro-fabrication technology platform. Using this platform for methanol reforming was first demonstrated under Phase I SBIR funding from NSF (OII-0611291) in 2006. The current development under a NSF Phase II grant is critical in achieving technology milestones and producing operational prototypes for performance and cost validation in portable fuel cell systems.

TauTheta Instruments LLC

Phase II Award No.: 0750508

Award Amount: $495,224.00
Start Date: 04/15/2008
End Date: 03/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Vertical Perifusion System for Cell Culture and Monitoring

Metabolic problems associated with impaired insulin secretion of pancreatic beta cells are thought to be linked with various health issues facing society at large. Issues such as the obesity epidemic and early onset diabetes are topics of great interest not only to the general public, but to researchers attempting to unlock the causes of these problems. TauTheta's Vertical Perfusion Chamber (VPC) is the result of an ongoing collaboration between TauTheta LLC and Professor Ian Sweet of the University of Washington's Division of Metabolism, Endocrinology and Nutrition. The VPC will allow precise, controlled and continuous measurement of oxygen consumption in pancreatic islet cells, along with metabolic studies of various cell cultures. TauTheta has developed a non-consumptive, oxygen optical fluorimeter measurement system that, used in conjunction with a novel "pig trough" perfusion system will allow fast, simple and sterile setup and measurement of cell metabolism. We hope such a system will make cell metabolism research a simple and inexpensive proposition to researchers in a university setting, along with private industry and government labs. Early prototypes of the VPC faced issues with gas bubble formation in the perfusion chamber, which would kill the cells under study. It also required a complex O2 metering method involving an artificial lung. Couple these issues with a relatively inefficient cell loading procedure and temperature regulation, and you have a system that while providing wonderful data, was difficult to set up and use. The second generation VPC addresses these issues by making use of a pre-equilibrated media and simple, modular setup and loading. Bubble formation is eliminated, while temperature and O2 saturation is precisely controlled. Flow rate through the VPC is precisely controlled via peristaltic pump, with research into nL/min pumping rates using alternative pumping methods. Preliminary studies show great promise in addressing all issues with previous generation VPC systems. We hope that the unique design of the VPC "Pig Trough" system will greatly simplify the study of pancreatic islet metabolism, and help researchers gain a deeper understanding of various metabolic disorders.

This work represents ongoing development and innovation related to conceptual design and prototype fabrication outlined in NSF Award Number 0611015, SBIR Phase I: Vertical Perfusion System for Cell Culture and Monitoring. Preliminary Phase I work was based on the integration of TauTheta's Multi-Frequency Phase Fluorimeter (MFPF), which represents a leap in sensitivity and ease of use in a turnkey optical O2 fluorimeter. Prior work on the use of a Vertical Perfusion Chamber (VPC) for studying the metabolic processes of pancreatic islet cells was carried out by Dr. Ian Sweet of the University of Washington, and included a early design of a single channel VPC, utilizing a single outflow optical channel and a "push pump" method of flowing media. Early design in the Phase I research included increased sensitivity for in-situ O2 measurements in multiple inflow/outflow channels, along with simplifying the loading/assembly aspects of the Vertical Perfusion Chamber (VPC). We found that there were inherent problems related to bubble formation in the VPC chambers which could kill or damage cell cultures. The incorporation of a lung O2 diffuser alleviated many of these issues, but detracted from the simplicity of operation and compromised sterility due to assembly difficulty. Current work centers on simplifying the loading and assembly of the VPC, primarily by removing the lung, and instead using a simplified "pig trough" system, which makes use of pre-equilibrated media that is sucked upwards rather than pushed upwards via a peristaltic or syringe pump. Such a design, while lacking the ability to vary the O2 saturation rapidly and in real time, virtually eliminates the possibility of bubble formation, along with allowing for more sterile conditions, ease of injecting media into the flow chamber, and allows for increase in scale to accommodate as many flow channels as the researcher wishes. Improvement in TauTheta's MFPF systems can currently deliver 0.1 part per million O2 sensitivity, with prototypes developed capable of ~2 part per billion sensitivity. Delivery of a four (4) chamber, eight (8) channel VPC system is expected by April 09, with incremental upgrades expected through the remainder of the SBIR Phase II contract.

Tetramer Technologies, LLC

Phase II Award No.: 0521976
Phase IIB Award No.: 0753713
Award Amount: $1,023,993.00
Start Date: 09/01/2005
End Date: 08/31/2009

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Sector: Materials

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

Tetramer Technologies is working with Elevance Renewable Sciences to take renewable soybean oils and changing the molecular architecture so that they can replace the equivalent products derived from petroleum sources. In the past soybean oil has been investigated as a feedstock for creating materials; however, Tetramer and Elevance are making use of the Nobel prize winning technology of self metathesis to alter the molecular structures in ways which were previously unavailable. In just one year of research over 60 new compounds have been synthesized and are being evaluated from commercial applications. These materials show higher viscosities and melt points than most traditional soy-based waxes.

The importance of these new natural oil derived materials is obvious in terms of developing green technologies which also lessen the US dependence on foreign oil. However, the products developed under this NSF funded program will also begin to supply the US market with wax products which have been steadily declining globally as older refineries which produced wax as a byproduct go offline and new more efficient refineries come on-line which produce lubricants instead of wax. Most importantly, unlike ethanol from corn the products developed from this commercial enterprise will compete with petroleum on their own with no federal subsidies.

This innovation began under NSF research funded to develop bio-based materials from waste racemic lactide which is produced as a byproduct in the synthesis of PLA. While the project was a technical success, securing a supply of the waste product became an issue when Dow and Cargill split up NatureWorks. During this time we also began to have discussion with Cargill on developing other new biorenewable materials. This led to the inclusion of the metathesis technology which Cargill was developing with Materia. Finally, Materia, Cargill, and TPG formed a joint venture, Elevance Renewable Sciences, to develop biorenewable chemicals based on the metathesis technology. Elevance is working with Tetramer in a joint develop role under the Phase IIB program to create new materials based on natural oils. The lactide work is still of great interest; however, the supply of racemic lactide is still an issue as Teijin is now working with Cargill. We will continue to pursue this research.

The Shepherd Color Company

Phase II Award No.: 0750194

Award Amount: $500,000.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Materials

STTR Phase II: Durable Functional Coloring of Fiber Reinforced Thermoplastic Structural Composites for High Strength Material Applications

Attractively colored high-strength molded plastic composite parts are an energy-saving alternative to their metal and painted metal counterparts. The development of glass-reinforced thermoplastic composite structural materials with enhanced thermal efficiency, attractive coloring, and greater weather resistance, are a great benefit to a number of consumer markets. The availability of colored composite materials that are processable using low-cost flow molding technologies allow for production of complex parts and assemblies that are made via an entirely integrated in a single-step process. Molded, high strength, glass-reinforced plastics have been on the market for some time now. However, coloring these materials has always been a problem. Most pigments are decomposed under the aggressive molding conditions. Using higher performance pigmentation leads to degredation of the glass reinforcement fibers, nullifying the advantage of the fiber reinforcement. As a result composited were available but only in a limited and bland color range. As color is a very important feature of many end-use applications, it was not possible to use the versatile high strength composites in certain areas. By finding the right high performance pigmentation and processing conditions, nicely colored composite reinforce plastics parts can now be molded. This new flexibility allows for the preparation of colored molded high-strength composite parts with the additional properties of color, high solar reflectivity, and greater weather resistance. Combining these latter properties with the great strength of the composite material allows for a number of new uses for such composites.

This innovation has the potential to significantly impact a number of end use applications in particularly in the areas of transportation and construction. In the transportation area. Heavy metal parts needed for their strength can now be replaced by lighter equal or higher strength composites. Making a molded, colored composite part all in one step eliminates not only weight savings for greater fuel efficiency in vehicles, but also eliminates a finish painting step and the environmental impact that results from that activity. Examples of transportation applications include body panels, underbody floors, roof substructure, etc.
In the construction area, using high performance pigmentation allows for making molded composite parts with better colorfastness, weather resistance and greater solar heat reflectivity. Such high strength, high durability parts can be used in any number of commercial and residential applications where attractive coloring along with exterior durability and strength are needed.

This innovation is supported by a Phase I grant to demonstrate the utility of making highly colored fiber reinforced thermoplastic composite materials. Work on the prior study and the present is being done in conjunction with the University of Alabama at Birmingham. Prototype parts have been successfully produced at the National Composites Center in Ohio.

United Environment & Energy, LLC

Phase II Award No.: 0848605

Award Amount: $499,989.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Manufacturing Processes

SBIR Phase II: Heterogeneous Catalytic System for Biodiesel Production from Alaska Fish Oil

This Small Business Innovation Research (SBIR) Phase II project concerns an innovative high throughput, high efficiency, and low cost heterogeneous catalytic fixed-bed technology for biodiesel production from Alaska fish oil. Around 200 remote Alaskan villages have energy costs of three to five times the national average. Alaskan fisheries are suffering from high diesel fuel cost. Converting the low-value fish oil to biodiesel is an attractive solution. However, the commercially available homogeneous alkali-catalyzed biodiesel production process does not work well for fish oil. The objectives of this Phase II project are to scale-up the fixed-bed reactor, produce prototype reactors, conduct field testing in Alaska, and prepare for commercial production.

The broader impacts of this research are as follows: the success of this project will create a value-added and profitable market for fish oil, reduce damage to the marine environment, and provide Alaska with a renewable fuel that will in turn reduce diesel emissions and fuel costs for remote communities and fisheries. The fixed-bed reactor can be a mobile unit for small fish oil production entities or can be easily scaled up for potential customers that produce a large quantity of fish oil. In addition to fish oil, this reactor can be used to process vegetable oil and yellow grease and can be applied to other biodiesel production plants in the U.S. The success of this new technology will bring a revolutionary change to the traditional biodiesel production process.

Xradia

Phase II Award No.: 0750353

Award Amount: $499,393.00
Start Date: 02/15/2008
End Date: 01/31/2010

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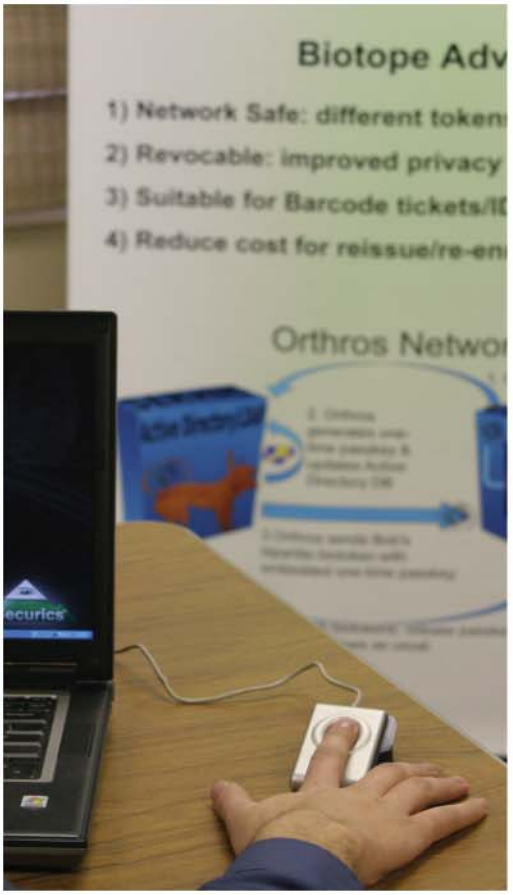
Sector: Devices & Instruments

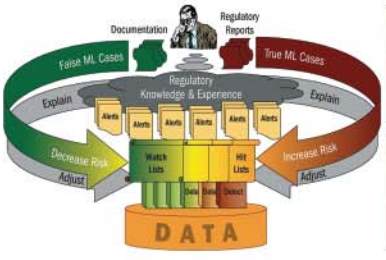
SBIR Phase II: High-Throughput In-Situ Crystallography Screening System

This SBIR Phase II project aims to develop a high-throughput in-situ crystallography screening system to fully automate the crystal growth process – an increasingly important capability for structural genomics, proteomics, and rational drug design. Its key enabling technology is Xradia's x-ray focusing optics with 100 to 1,000 times better resolution than those used in existing crystallography systems. This high-resolution optics is ideally matched to high-brightness micro-focus x-ray sources to produce a compact diffraction system with higher flux density, finer focus spot, and much lower initial and maintenance cost. These unique characteristics increase screening system's throughput while reducing its cost with three approaches: automation that replaces the currently labor-intensive crystal selection process; miniaturization that reduce both the reagents consumption and crystal growth time by several orders of magnitude; and parallelization that allows many experiments to be performed in a massively parallel fashion. Incorporating this technology in the protein crystallography work flow will substantially reduce the time and cost needed for structure determination.

This innovation represents the convergence of x-ray focusing technology and the significant increase of crystallography technique in biomedical research. The last two decades saw tremendous improvement of x-ray focusing optics, initially at several universities and national laboratories in Europe and US and then at Xradia, Inc. To date, x-ray lenses have demonstrated highest focusing resolution across all electromagnetic spectrum and high enouch efficiency for microscopy and nano-probe applications. The viability of x-ray lenses for crystallography applications was first demonstrated under a grant from NIH (R43 GM069230-01) to investigate its use in structure determination machines. After analyzing data collected during this project, we have identified the ideal application for this x-ray optics is high-speed in-situe screening of small crystals during their growth phase, where the advantage of the optics technology can be fully realized to greatly improve the overall throughput and reduce the cost of the structure solution pipeline.



Education Applications (EA)



Advanced Science & Automation Corp

Phase II Award No.: 0848966

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Education

SBIR Phase II: Virtual Learning Environment for University Physics

This Small Business Innovation Research (SBIR) Phase II project proposes the development of a web-based collaborative Virtual Learning Environment for teaching freshman university physics, called the Virtual Physics Lab (VPL). The VPL will deliver an individualized self-paced learning experience using high-end multimedia lectures, and interactive virtual-reality simulations. The multimedia lectures are delivered using a synchronized multimodal combination of both highlighted text and speech that is delivered by near-photorealistic intelligent animated virtual instructors. The multimedia lectures include interactive Flash animations, movies, and 2D/3D animated illustrations. The VPL's interactive simulations are delivered in a video-game-like 3D virtual environment using physics-based models to simulate physics concepts such as pendulums, impact, buoyancy, magnetism etc. The VPL is highly interactive and uses pre-topic, in-topic, and post-topic questions to keep students engaged and to assess whether or not students need further training in any given subject. The VPL also includes collaborative/competitive mini 3D computer games that use relevant physics principles to increase the students' interest about the material being taught, and to add entertainment and competitive dimensions to the learning experience. The VPL's interactivity and the visually stimulating instruction will result in faster assimilation, deeper understanding, and higher memory retention by the students than traditional text-book/classroom learning.

The VPL has the potential to radically change the way physics is taught. Due to the current exponential rate of increase in human scientific and technical knowledge, there is a need for students to assimilate more knowledge at a faster rate. Current classroom and text-book instruction delivery methods cannot satisfy this need due to a variety of reasons, including, delivery of the lecture in non-engaging and minimally interactive way, use of antiquated static graphical illustrations, variability of teacher skill, lack of one-on-one teacher attention, and variability of student learning styles and speeds. The VPL will help overcome those limitations. Particularly, it will enhance the quality, accessibility, and speed of learning. It will enhance the student experimentation, creativity and problem-solving capability. Freshman university physics was chosen because it is one of the essential foundations for training high-caliber engineers and scientists who will ensure the continued leadership of the US in developing new technologies and in conducting cutting-edge scientific research. The US market for the proposed learning tool is estimated at 500,000 licenses per year. A larger market exists worldwide in English language speaking countries, and for future versions of the VPL that will be translated into other languages.

Agentsheets, Inc.

Phase II Award No.: 0848962

Award Amount: $465,612.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Education

SBIR Phase II: Scalable Game Design: Broadening Computer Science Participation with Low-Threshold, High-Ceiling Design Environments

This Small Business Innovation Research (SBIR) Phase II project will build a Scalable Game Design tool and curriculum, with the goal of increasing the participation of students in Computer Science (CS). K-12 computer education fails to attract the necessary number of students to CS - especially at the middle school level, where students make critical career decisions by judging their own aptitudes towards math and science. This is a serious problem because, despite the growing need for IT workers, enrollment in undergraduate CS programs is dropping at alarming rates. Scalable Game Design provides an ideal balance between motivational and academic concerns of CS. This approach is based on the existing Fluency with Information Technology framework recommended by the National Academies of Sciences and will be aligned with the emerging National IT education standards (ISTE NETS). This project will explore Scalable Game Design by building a low-threshold, high-ceiling design tool, called AgentCubes, featuring Incremental 3D modeling, animation, programming, and visualization. The project will incorporate the tool into a 3D Gamelet Design curriculum to provide an attractive route to the effective design, development, and deployment of an exceptionally large spectrum of games - ranging from simple 2D Frogger-like games to 3D Sims-type games.

The proposed technology has a high potential to increase the number of K-12 students interested in Computer Science (CS), which in turn should result in larger enrollments at the university level. Without stronger CS enrollments the US cannot maintain an internationally competitive IT workforce. A less programming-focused, more design-based IT curriculum is likely to increase the participation of women and minorities. Initial results from our feasibility study indicate that Incremental 3D approaches work across ethnicity and gender. The proposed 3-stage classroom integration strategy is based on a pipeline of required, elective, and transitional modules that introduce students to making simple games, move to more advanced games and computational science applications, and transition to traditional programming models. This strategy maximizes the exposure of public schools students in general, and women and minorities in particular, to computer science because all students will at least take the required one-week module. Furthermore, as a general end-user tool to create interactive 3D applications, the proposed technology will be useful beyond educational game design. Potential applications include computational science simulations, computational thinking tools and serious games with potential users such as university students, scientists, and engineers.

Agile Mind Inc.

Phase II Award No.: 0450380
Phase IIB Award No.: 0750254
Award Amount: $1,000,000.00
Start Date: 09/01/2005
End Date: 08/31/2009

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Education

SBIR Phase II: Enabling Pedagogical Choice and Cost-Efficiency in the Development of Web-based Curricula

Funded in part by the NSF, Agile Mind's online authoring and learning management systems (LMS) hand instructional designers effective and accessible development tools. Our innovative techniques and technologies support easy authoring and a broad range of pedagogical approaches, while preserving Agile Mind's existing class management, productivity tools, and content creation capabilities. This innovative authoring environment couples the Sharable Content Object Reference Model (SCORM) standard and associated XML with an easy-to-use graphical user interface, supporting authoring by both novice and expert authors and producers. These systems address a major problem in education: the consolidation of content development and dissemination in the hands of a small number of publishing conglomerates that leads to a lack of quality and diversity of choice. This issue is critical given the recommendations of national panels and organizations – such as the National Research Council – stressing the importance of linking theories and principles for understanding to the development of new technological and non-technological curriculum materials. Agile Mind's new authoring and learning management systems empower content providers to use these principled learning theories and pedagogical practices for creating new online curricula that support technology-mediated instruction. To date, these technologies have been used to create and deliver customized courses for educators in the states of New York and California. Experts in curriculum development, in collaboration with local state educators, have developed customized instructional materials tied to state and district learning goals.

Our innovation is based, in part, on the Sharable Content Object Reference Model (SCORM) – a collection of standards and specifications for web-based e-learning. Created in 2000 by the U.S. Department of Defense as part of the Advanced Distributed Learning (ADL) initiative, SCORM is now the de facto industry standard for web-based e-learning content. SCORM enables effective, reusable e-learning by defining how a Learning Management System (LMS) can be constructed so that content from one SCORM-compliant LMS can be used in another SCORM-compliant LMS. Content can then be created once and reused in multiple systems without requiring further changes. To date, there have been three released versions of SCORM (SCORM 1.1, SCORM 1.2 and SCORM 2004); Agile Mind uses the most current version of the standard.

Agile Mind Inc.

Phase II Award No.: 0620380
Phase IIB Award No.: 0836609
Award Amount: $1,000,000.00
Start Date: 08/01/2006
End Date: 07/31/2010

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Sector: Education

SBIR Phase II: Providing Tools for Richer eLearning Assessment

Funded in part by the NSF, Agile Mind gives K-12 educators tools to create and administer assessments. Educators choose from challenging puzzle-like questions that are designed to increase intellectual challenge and interactivity for the student, while incorporating distractor analysis that assigns meaning to various student responses. There are distractor analyses for alternate correct, partially correct, and incorrect answers. Key innovations of this work include (a) the inclusion of varied and game-like learning interactions in a system designed to allow dynamic test construction by educators, (b) the capability to define answer analyses for stored question items with potentially complex student responses, and (c) the capability to represent question items in a form in which Agile Mind developers and strategic authoring partners can use actual test-taker data to improve the assessment corpus. These technologies will allow educators to move beyond online testing based solely on multiple-choice, single-answer questions that studies have shown are un-motivating for many students. If tests and other forms of assessment can be made more intrinsically interesting, they can serve students now not typically well represented in multiple-choice tests. Delivering effective and motivating instructional content assumes we can present learning interactions that appeal to our target learners. By developing our capability to improve the quality and interactivity of eLearning tools dramatically, to increase what learners can experience, and to improve the kinds of feedback educators can get on test taker response, it is possible to make a significant contribution to exploratory learning. Agile Mind's assessment tools and technologies are currently being used in nine states by students and teachers to support low- and medium-stakes formative assessment.

The innovation is related to e-learning technologies developed by Adele Goldberg, a distinguished computer scientist with more than 25 years of experience in technology invention and development. In her capacity as Agile Mind's chief technologist for four years, Adele played a leading role in the design and engineering of Agile Mind's puzzle-like assessments and interactions. These assessments and interactions use Zope and other open-source technologies.

ArchieMD, Inc

Phase II Award No.: 0750352

Award Amount: $493,537.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Education

SBIR Phase II: 3D Human Functional Anatomy for Middle and High School Education

For this SBIR project, ArchieMD is creating an interactive, inquiry-based simulation toolkit (in accordance with National Science Education Standards (NSES) [2]) that enables students to explore the human anatomy and physiology in an exciting new way. The Project will include 3-D animations, with physiologically correct graphics, for use with classroom lectures or self-paced learning. Furthermore the development includes an immersive environment that allows the user to explore the anatomy and function of the human body. For example, if the student wants to understand the breathing process, the student will be able to enter the body as oxygen, be absorbed by the alveoli in the lungs, bound to hemoglobin in the blood, and circulated throughout the body. The student will have to make choices that apply their knowledge of the body to progress through the environment.

This innovation is related to SBIR Grant # IIP-0750352 done in conjuction with ArchieMD, Inc. with funding from NSF.

Avencia Incorporated

Phase II Award No.: 0750507

Award Amount: $467,805.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Algorithms and Visualization Techniques for the Detection of Geographic Aberrations in Crime (GIS)

HunchLab is a geographic prioritization and alerting system that uses spatial statistics to identify changes in geographic patterns of a specific classification of events. It is capable of sifting through large amounts of location-based events and identifying areas in which recent events demonstrate statistically significant changes. The prototype software was originally developed with an NSF Phase I SBIR grant. The prototype demonstrated a compelling application for crime analysis, fraud detection, public health and general business use. The Phase II SBIR grant is focused on refining the application's interface and building additional functionality including; alternate workflows for different user types, expanding the alert infrastructure, and building text mining capabilities. The initial market for HunchLab is law enforcement at all levels of government with secondary markets in public health and fraud detection. Many law enforcement agencies are engaged with crime analysis and mapping. These efforts are frequently part of a 'CompStat' process aimed at performance management through use of statistics and maps. HunchLab is targeted at providing social value by enabling law enforcement agencies to more quickly detect, be notified and respond to changing spatial patterns in crime. The basic statistics were developed in a prototype developed in collaboration with the Philadelphia Police Department. The SBIR project is aimed at extending this prototype to create a useful commercial product that can be applied not only to this initial law enforcement domain but also to applications involving syndromic surveillance and fraud detection.

The application was originally funded by a National Science Foundation (NSF) Phase I Small Business Innovation Research (SBIR) grant (SBIR IIP-0637589) in 2006. The work completed in Phase I proved the feasibility of generating a hunch in a simple and straightforward fashion and then processing that hunch through the hypergeometric algorithm to check the validity of the hunch. When the hunch was proven valid, subscribed users were notified via email. The prototype was reviewed by twelve domain experts and their feedback was incorporated into the Phase II Work Plan. Avencia received NSF Phase II SBIR funding in April 2008. In the first 8 months of the project has focused its efforts in three primary areas, role based functionality, extending the flexibility of the hunch definition/creation process and extending the core functionality of the application.

bdDisplays, LLC

Phase II Award No.: 0822965

Award Amount: $492,628.00
Start Date: 09/01/2008
End Date: 08/31/2010

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Sector: Devices & Instruments

STTR Phase II: High Resolution, High Brightness Display for Virtual Reality

This Small Business Technology Transfer (STTR) Phase II research project focuses on new GaAs-based, low voltage technology for high definition head mounted displays (HMDs), suitable for advanced applications in immersive virtual reality and 3-D imaging. Applications for this technology include battery powered augmented reality HMDs, full color, high resolution HMDs with 3-D imaging potential, and low cost, low voltage indicators and backlights for battery powered electronics. Displays derived from this GaAs technology have superior color gamut, high brightness, resolution and efficiency compared to other approaches. The results obtained from the STTR Phase I project indicate that low cost HMD-based optical systems can be designed using these high resolution microdisplay chips at supply voltages as low as 1.5 volts. Compared to display systems based on GaN LED and OLED technology which require voltages of up to 4 volts, this technology presents a path for continued advancement to 3-D imaging systems that could reach the resolution of the human eye.

This technology should impact low cost HMDs displaying low-information content data such as maps, text or line graphics that require long battery life for markets that include first responders, factory and inventory workers, and consumer appliances. The technology can be advanced to much higher resolution microdisplays and improved optics for the high-information content marketplace such as immersive virtual reality for education, medical imaging and surgery, games and videos. Commercial emphasis will be placed on the low voltage operation for battery compatibility, a key advantage for augmented reality HMDs; and one which may lead to fundamental changes in battery powered electronics having indicator lights and/or displays.

Blue Reference

Phase II Award No.: 0750063

Award Amount: $511,771.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Software Platform for Quality-by-Design Implementation

Recent findings on the interplay of pharmaceutical manufacturing and the Food and Drug Administration (FDA) reveals that the pharmaceutical industry is wasting more than $50 billion a year in manufacturing costs—costs that could be better applied to lower prices or increased research and development. The FDA has openly acknowledged that compliance prescriptions have had the unintended side effect of discouraging manufacturers from embracing new technologies and process improvements. In response, the FDA has instituted sweeping changes that are transforming research, development and manufacturing process engineering organizations. Central to these changes is the overarching Quality-by-Design (QbD) paradigm, a risk-based approach aimed at building quality into the process and shifting from "quality by testing" to "quality by design." To implement QbD, the FDA suggests that modeling and simulation must play an increasingly important role in science-based manufacturing and QbD workers will need an accessible modeling and simulation tools devoid of extraneous functions, designed to help them get their jobs done. General purpose tools simply won't do. In response to this need, Blue Reference has initiated a project, entitled Inference the QbD project, directed at development of a comprehensive software solution for the implementation of QbD practices in pharmaceutical R&D and manufacturing. The Inference for QbD project, described on the website at www.InferenceForQbD.com, encompasses a number of novel elements including the following:

- it employs the patent-pending Inference platform developed by Blue Reference;
- users access it through the easy-to-use and familiar user interface of Microsoft Office; and
- it is being development within the context of a consortium of pharmaceutical companies, who provide guidance on requirements and who test prototypes in production settings.

This innovation is related to the research on application of experimental design and information extraction at IntelliChem (acquired by Symyx Technologies) funded under SBIR grants from NIH and NSF (2000-2004). Results of those efforts were incorporated into development of an Electronic Laboratory Notebook for Pharmaceutical R&D. The commercial software product was successfully deployed for replacement of paper notebooks at one-half of the top 15 global pharmaceutical companies.

CameronSound, LLC

Phase II Award No.: 0822743

Award Amount: $500,000.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Devices & Instruments

SBIR Phase II: (IT-B5) Feasibility to run novel voice interface on a low-power microcontroller

This Small Business Innovation Research (SBIR) Phase II research project will implement a miniature information management system that is suitable to the access requirements for visually impaired users. Current information technologies for the visually impaired are slow and difficult to operate while holding a white cane or guide dog. Visually impaired people will benefit greatly from a hands-free/eyes-free information system that is much faster to operate and easier to access. The project will develop a voice-operated personal digital assistant (PDA), called Vivian, which performs 10 times faster than Braille PDAs. The outcome of the Phase I study demonstrated the feasibility of real-time speech processing algorithms on integrated microcontrollers without hardware floating-point arithmetic. The outcome of this Phase II project is anticipated to result in a wearable device similar to a state of the art media player with 10X faster processing and 10X smaller in size.

With more than 160 million visually impaired people worldwide, 10 million in the US alone, the proposed research is a critical step towards a device that will address their mobile information management needs significantly better than current alternatives. Moreover, this device should impact mobile information management for sighted people. The results of usability trials with sighted users speaking multiple languages conducted during the Phase I project, indicate that the outcomes of a powerful and fast alternative human computer interface to graphical user interfaces for sighted and visually impaired users. Additionally, this voice technology is suitable for integration into mobile appliances such as mobile phones for which over 300 million were sold in 2007.

Centar

Phase II Award No.: 0848285

Award Amount: $499,555.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

SBIR Phase II: A New Class of Fast Fourier Transforms

This Small Business Innovation Research (SBIR) Phase II project is directed at development of a high performance, programmable fast Fourier transform (FFT) circuit for use in embedded signal processing integrated circuits. Over the last 40 years the technology for executing parallel FFT implementations has remained relatively unchanged, being based essentially on different permutations of the signal flow graph and mappings thereof. Performance improvements are now largely achieved by shrinking circuit geometries according to Moore's Law. Because of the limits imposed by physics of integrated circuit fabrication, it is expected that continued improvement in signal processing will only be achieved with more efficient algorithmic implementations in combination with advanced integrated circuit technologies. This proposal focusses on a radically different architecture for parallel FFT circuits based on a new matrix formulation of the discrete Fourier transform (DFT) to achieve exactly this goal. The specific advantages of this new formulation include: 1) logic and memory resource requirements are reduced; 2) less power is consumed; 3) significant added functionality is accrued; and 4) design, test, and maintenance efforts are diminished because the circuits are simple, locally connected and structured.

The outcomes of this project is a commercial quality FFT circuit based on the feasibility prototypes developed during SBIR Phase I. The DFT sub-system is a critical and important component of large number of real-time communications, radar, medical, acoustics, navigation, surveillance, remote sensing, and robotic inspection applications and is arguably the most prominent of all signal processing algorithms. Consequently, the availability of more functional, efficient, and higher performance FFTs will significantly improve the efficacy of a host of electronic products. The benefits of this new FFT technology would be best suited to mobile wireless devices, the largest and fastest growing market for electronic products, because future 4G wireless protocols will be based on orthogonal frequency division multiplexing, which is a scheme that makes use of the FFT. Consequently, most wireless devices of the future will use embedded FFT circuitry. However, the computational demands to support 4G communication requirements will increase by a factor of ~10 compared to today's wireless mobile devices. Therefore, more efficient integrated circuit implementations of FFTs will be required to continue to keep the cost and power usage of mobile appliances low.

Cilk Arts, Inc

Phase II Award No.: 0822896

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Cilk++

This Small Business Innovation Research (SBIR) Phase II research project aims to develop software technology to enable C++ programmers to easily program multicore chips produced by the leading processor hardware vendors. Physical limits are driving chipmakers to produce chips containing multiple processor cores, but existing methods for programming multicore chips are error-prone and difficult to use. The potential outcomes of this research project will enable C++ programmers to easily parallelize applications to run on multicore processors without restructuring their legacy applications. Cilk++ is a simple set of language extensions to C++, which, together with a powerful runtime platform, allows multicore processors to be programmed easily. Market research shows that global variables pose a major barrier to parallelizing legacy code. This research project seeks to understand the linguistics, implementation, and applicability of hypervariables, a new construct designed to solve data-race problems created by parallel accesses to global variables. The results of the project include software implementations of hyper-variables in the context of Cilk++, including modifications to the Cilk++ language, compiler, tools and runtime platform. Additionally, the project will produce engineering design documents, user documentation, and training and educational materials, and will evaluate this technology in customer applications.

In 2008, the leading processor manufacturers will ship over 100 million processors, with forecasts for over 75 percent of such processors be multicore. On the software side, the C++ programming language has become the standard langauge for developing applications that run on uniprocessor-based platforms. Although C++ programmers number well over 3 million, most lack the specialized training to use create correct, high-performing parallel programs. This research project will allow ordinary developers to multicore-enable legacy code and bring new multicore applications to market, thereby fulfilling the potential of multicore technology to help users of computers and personal appliances be more productive and to take advantage of the increased performance of computers in as diverse areas as health care, shopping, scientific advancement, entertainment, financial planning, and more. This research will advance the understanding of how multicore computers can be programmed effectively. The lessons of Cilk++, and the innovation of hypervariables in particular, will generalize to other programming languages, such as Java, C#, and Fortran. The educational and training materials will educate software engineers in parallel programming and expose them generally to the subtle issues of concurrency.

Digital Assembly LLC

Phase II Award No.: 0822980

Award Amount: $559,525.00
Start Date: 09/01/2008
End Date: 08/31/2010

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Sector: Enterprise Software Applications

STTR Phase II: Next Generation Digital Data Recovery System

This Small Business Technology Transfer (STTR) Phase II research project proposes to research and bring to market the next generation digital data recovery techniques. The problem of restoring lost data from a damaged digital device arises routinely in digital forensics and data recovery. In many advanced cases of digital storage failure currently available file recovery techniques based on disk storage information fail. During the Phase I of this project a software framework was developed for file carving. Using this framework a software library and a user interface to carve fragmented files from a disk image, called Adroit was implemented. Adroit currently supports carving of JPEG fles, structured documents (such as HTML, source code, plain-text fles, etc.), and Microsoft office documents. In tests conducted, Adroit recovers more files than tools currently available in the market. Furthermore, the validation and user interface component built into Adroit excels at allowing the user to guide the technology to recover more data with much less effort. The problem of recovery of information from bits and pieces of digital data, in the absence of storage meta-information to tie the pieces together, is equivalent to the problem of having hundreds/thousands of jigsaw puzzles mixed into together. The challenge of identifying if a piece of data belongs to a specific file or file type is daunting. The preliminary research conducted in Phase I has demonstrated the viability of developing domain specific techniques to identify the type of data fragments and the use of file type specific algorithms to reconstruct files.

The broad impact of this technology and its commercialization are: 1) it will change the nature of the data recovery market and make possible unprecedented recovery of data in a variety of situations; 2) it will save countless users the agony of losing valuable data. Be it important data that is needed for a company's survival or an emotionally valuable photograph of a proud parent or child; 3) it will provide law enforcement officials with an increased ability to gather evidence and prosecute their cases more effectively; 4) it will provide counter-terrorism experts the ability to glean crucial evidence that they may have otherwise missed.

Exprentis, Inc.

Phase II Award No.: 0750461

Award Amount: $500,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Enterprise Software Applications

STTR Phase II: Disciple Technologies for Development, Utilization, and Maintenance of Regulatory Knowledge Bases

Exprentis, Inc is using the novel Disciple Technologies to fulfill its mission of bringing to market a new line of specialized Regulatory Knowledge Base products and services that help financial services firm meet the regulatory imperative of protecting our financial system from the illicit activities of money launderers, fraudsters, market abusers, insider trading, and terrorist financiers. The new products are to help financial services firms improve the ability to manage risk and improve the effectiveness, efficiency and return on investment of their compliance and risk management systems. The Disciple Technologies developed at George Mason University use mixed-initiative multistrategy apprenticeship machine learning methods to build knowledge bases allowing the subject matter expert to teach the software agent their reasoning strategies by using natural language. This approach allows bypass the inefficiencies of traditional software development and maintenance technologies by developing products that support more natural expression of subject matter expertise and allow shared knowledge between a human expert and a learning apprentice system.

The Regulatory Knowledge Bases are tailored to classes of compliance problems within the financial services space, such as broker or trading compliance, or anti-money laundering. They include a complex regulatory ontology specific to the financial services industry and rule bases that reflect the latest regulations and best practices that govern analysis of alerts and compliance cases. The Regulatory Knowledge Base products will be sold in various formats and standards so they can be directly deployed on various commercial off-the-shelf reasoning engines. The impact of the recent global financial crisis is predicted to be a lasting one, resulting in a variety of fundamental changes in the financial services sector – from a change of philosophy on credit and investment risk management to a host of new government regulations. The new products developed by Exprentis are well positioned to take on the challenge of adapting to the coming changes in the regulations of the financial services industry.

Exprentis develops the Regulatory Knowledge Bases products in cooperation with the Learning Agents Center at George Mason University. The Disciple Technologies, invented and championed by Prof. Tecuci, have been developed through several Federal Government projects and have been applied to solve complex military and intelligence problems. Exprentis has extensive experience in developing and commercializing advanced systems that support the regulatory compliance and risk management needs of financial services firms.

HyPerspectives, Inc.

Phase II Award No.: 0750514

Award Amount: $491,180.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Enterprise Software Applications

SBIR Phase II: FireScape: A Platform for On-Demand, Browser-Based Incident Command

HyPerspectives is developing a web-based mapping and visualization application, FIRESCAPE™, for end-users in wildland fire management communities. The ability to quickly and efficiently collect, analyze, and share geospatial data (in particular, time-sensitive environmental data) across the World Wide Web is the cornerstone value proposition for the FIRESCAPE™ product. These combined abilities provide a critical and as-yet-unavailable tool for the fire management community, directly improving real-time fire modeling and strategic fire-fighting, helping save lives and property, resulting in a more informed public, and creating a new agency decision support system. We are partnering with Cisco Systems, Inc. to finalize the design of our network architecture, focusing on fire manager feedback and current system deficiencies. HyPerspectives and Cisco Systems are planning and leading demonstrations introducing the ruggedized networking components and satellite communications options, Cisco's incident management software integrated with cell phones, IP phones, push-to-talk radios, and meteorological sensors, and HyPerspectives' browser-based application for data visualization to customize our system to meet fire management needs. FIRESCAPE™ will ultimately provide end-users access to a complete team of expert analysts and engineers to gather, merge, and analyze fire-related data products through satellite communications networking. Our experts will then consolidate and simplify all the available data into custom, real-time data reports with geospatial context and deliver it to end-users to expedite high-level decision making.

FIRESCAPE™ has both economic and humanistic benefits in that confinement strategies decided-on and applied during the early stages of fires can significantly reduce the cost of fire suppression by several millions of dollars. This increased information will also allow decisions to be made that keep firefighters as safe as possible. The FIRESCAPE™ solution and web browser interface is a flexible architecture, based on open standards therefore the solution is agile, dynamically configurable, and interoperable holding significant value for applications such as natural disasters, pandemics, global monitoring, or homeland security. The overlay and visualization of data through FIRESCAPE™ will provide analyses of critical importance for decision and policy makers, as well as regular citizens, all seeking the best geospatial information possible and in a form they can use.

The innovation is related to basic research at HyPerspectives under a SBIR Phase I grant from NSF. The project builds on several awards to HyPerspectives from agencies such as the Air Force Research Lab, Naval Research Lab, and the US Department of Agriculture, to map vegetation condition, fire fuels, and forest parameters from remotely sensed data.

iBiometrics, Inc.

Phase II Award No.: 0848740

Award Amount: $499,956.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Enterprise Software Applications

STTR Phase II: Dynamic Passphrase Voice Security System

This Small Business Technology Transfer (STTR) Phase II project focuses on the research and development of a novel voice authentication security system which combines speech verification with speaker verification. As a basis for authentication, the proposed system generates a one-time pass-phrase which users are challenged to respond to immediately. Following the challenge, the dual verification engine verifies that the response is the required pass-phrase and that it is associated with the person articulating the pass-phrase. The proposed system addresses the vulnerabilities of previous voice authentication systems associated with 'ear shot' surfing, eavesdropping and theft. The proposal offers a solution for identity theft threats where personal information cannot be said aloud and further addresses password systems limitations. The proposed project will develop and construct a system which expands the voice capabilities to include a wider selection of users, channels and types of speech. The system will expand pass-phrase generation to support large customers and its passphrase 'topic selection' privacy feature. Additionally, the system will automatically enroll users over multiple calls overcoming previous limitations due to inadequate speech across channels.

The outcomes of the proposed project include secure authentication through speech via the widely growing number of speech recognition applications, voice channels and converged platforms. As more individuals use their voice on a variety of devices and networks such as VoIP or cellular, real-time, speech applications will benefit from the proposed method. The proposed speech security system method may also be the choice for those with visual or other applicable handicaps. Because of the continuous rise of security breaches and related identity theft, the outcomes of this project should significantly impact society by providing a robust security option for speech-enabled user interfaces.

Information in Place, Inc.

Phase II Award No.: 0823411

Award Amount: $495,885.00
Start Date: 11/01/2008
End Date: 10/31/2010

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Sector: Education

SBIR Phase II: Developing a Commercial Video Game for Tweens to Support Complex Systems Thinking

This Small Business Innovation Research (SBIR) Phase II research project will support middle school students in learning STEM concepts and problem solving through the use of a problem-based curriculum and video game with embedded scaffolds (e.g., guidance, tools, resources). The project will focus on the design, development, and testing of the usability, feasibility, and implementation of the Virtual Astronaut Learning Platform (VALP), an immersive, problem-based video game approach to improving STEM learning outcomes. The three-part model will combine the latest in learning sciences research and design with the best in commercial game play, and includes a new serious game-learning methodology - Mission Based Learning; a new game genre, First Person Explorer; and an approach - STEaM, which integrates creativity into STEM activities. The research will include iterative design and rapid prototype testing in school settings during Year 1 and a full-scale quasi-experimental design field test in Year 2. Additionally, the research will examine learning gains related to STEM concepts and problem solving approaches, changes in attitudes towards STEM-related careers, and changes in student self-efficacy related to science inquiry and technology; and will help to advance knowledge related to effective educational game design and implementation.

The Virtual Astronaut Learning Platform will result in a commercial quality 3D game environment that supports single player and collaborative multi-player learning activities. VALP is a collection of game-based STEM learning environments that will be sold as a supplement to existing curriculum and textbooks, thus enhancing the availability of engaging and effective STEM learning activities for students. VALP learning activities are being mapped to national STEM standards and will include a teacher's guide to ensure appropriate integration into the larger STEM curriculum. Set 50 years in the future and based on realistic future science and technology capabilities, VALP will enable students to see how space will be explored in their lifetime, and how STEM content provides them with the knowledge and tools they need to solve real problems in space. Findings from the design process as well as from the learning outcomes research will add to the growing body of research related to effective embedded scaffolding techniques, problem-based learning approaches, and STEM learning and game-based learning approaches for diverse populations.

Innovative Scheduling Systems, Inc.

Phase II Award No.: 0548666
Phase IIB Award No.: 0814123
Award Amount: $936,000.00
Start Date: 01/01/2006
End Date: 12/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: A Decision Support System for the Train Schedule Design Problem

Train scheduling is the most important part of a railroad's operating plan that enables efficient movement of railcars. Determining a railroad's operating plan comprises of two steps: determining a blocking plan and then determining a train schedule. Through another SBIR project to the company, NSF has funded the development of a decision support system to determine the optimal blocking plan. Through this project, we have developed a decision support system for determining the train schedule; thus complementing the previous effort and automating the operating plan development process. Designing a railroad's operating plan is a very complex decision 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 our software product, a large freight railroad can obtain a new operating plan within two weeks using two-three employees and can typically save over $50 million annually in operating costs. 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 and constraints. We have developed decomposition-based 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 have been packaged into a web-based decision support system with friendly and attractive graphical user interfaces (including maps) which allow sufficient user control. This software is currently being deployed at BNSF Railway (the second largest railroad in USA), and is being used to improve the train schedule at CSX Transportation (the third largest railroad in USA).

This research builds upon and extends the research funded by the National Science Foundation academic grants to the PI at the University of Florida - DMI-9900087 and DMI-0085682, and the SBIR Phase II Grant: IIP 0450504. We used this research as a starting point for the research conducted through this grant.

Integre Technical Publishing Company, Inc.

Phase II Award No.: 0750520

Award Amount: $499,920.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Education

SBIR Phase II: Adaptive Authoring for Compound XML Documents: Collaboration Tools and eLearning Content Creation for STEM

E-learning, social networking, and collaborative authoring are transforming how the world learns, interacts, and shares information. In spite of technological advances, however, these phenomena have had little benefit for the mathematical and scientific communities we rely on to develop those technologies. Why is this? Because communication technologies that are now everywhere---instant messaging, wikis, and blogs, for example---do not support the language of mathematics: the symbols and notation that many of us struggled to learn in school, but that is an essential part of communicating concepts in math and science. Just imagine how quickly science and technology would advance, and how learning math and science would change, if all of the world's scientific and technical knowledge were as readily accessible as Wikipedia or Google Maps on a cell phone!

Integre, a small company in Albuquerque, New Mexico, hopes to change all of that. Integre is creating a rich internet application, or RIA, in which you can share live, interactive math as easily as finding the nearest fast-food restaurant. What is unique about Integre's application is that you can add "intelligence" to the math: you can graph and compute like you would on a calculator, but you can also animate it or have it show you how to solve a problem. And because it's an RIA, you can do the math just about anywhere: on your desktop, in a browser, and some day soon maybe even on your cell phone. Imagine how different math class would have been if the math was alive! . . . if your math homework problems talked back to you, explaining what to do next or why your answer was wrong.

The earliest origins for this project date back to efforts at IBM Research in the late 1990s to develop a web-based interface for Axiom, a computer algebra system, using "semantic TeX" markup. That work evolved into techexplorer, a browser plug-in for rendering math using TeX markup. The work on techexplorer and semantic markup for mathematics informed much of IBM's early development of XML, including MathML. Integre acquired techexplorer from IBM in 2003, and continued development of web-based math support with a particular focus on user interactions for education. This work was funded in part by NSF grant DUE 0333694, and eventually led to the development of MathEX, a web-deliverable and highly customizable equation editor that simultaneously supports both Content and Presentation MathML. The current research is an effort to extend the MathEX editing framework from MathML to XML more generally, while retaining its focus on dynamic mathematical content.

Interactive Flow Studies LLC

Phase II Award No.: 0844891

Award Amount: $485,163.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Education

SBIR Phase II: Educational Particle Image Velocimetry Suites

This Small Business Innovation Research (SBIR) Phase II project is to develop a low cost educational Particle Image Velocimetry (ePIV) suite including both hardware and software for fluid science and engineering education at university undergraduate and graduate school levels. The proposed PIV is the state of the art technology in fluid flow research that enables visual and quantitative analysis of the flow field. Industrial/research level PIV system usually costs over $100,000. The high cost and safety considerations - because of the use of high power Class IV lasers - prohibit adaptation of PIV systems in the US higher education system. Current PIV systems typically use two pulse lasers with 50 mJ/pulse energy and 5 nanossecond pulse duration. This translates to a total power of 10 mega Watts if it was a continuous laser. In summary, although it is very challenging to develop a PIV system that works with only a single 15 milliwatt continuous laser and a regular CCD camera, the Phase I outcomes indicate that it is feasible. The project will create learning materials by developing software as a virtual teaching assistant for the education process, where the students can develop enhanced understanding of fluid flow by interactive experiments through a computer terminal in the classroom. Hence, the software will be an instrument that can be used in diverse educational settings because of its effectiveness as an education tool, high-tech appeal, compact size, low cost and safety.

Fluid mechanics is a highly visual subject. During the teaching process one must take full advantage of this fact. ePIV gives the opportunity to achieve this to its full extent making this technology easily accessible. The educational suite will provide faculty the latest technology as a teaching tool at a very affordable price, allowing them to acquire new knowledge and skills and to revise their curricula and teaching practices. The low cost of ePIV will allow schools with very limited budgets to use and teach the state of the art technology to their students. The project envisions bringing this new technology from technical colleges to BS, MS and Ph.D. granting institutions. Due to its simplicity of operation, low cost and being highly visual, the ePIV technology can even be used at museums, science centers and similar institutions to develop exhibits in science and engineering. This tool can also be used to promote fluid mechanics and science in general even to non-science and non-engineering students.

Norconnect Inc.

Phase II Award No.: 0848523

Award Amount: $472,564.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Biosensor device for recordation of handwriting

This Small Business Innovation Research (SBIR) Phase II Project proposes the construction of a biosensor device prototype that will produce text from electromyographic (EMG) signals recorded from hand muscles. This biosensor device will enable the user to enter text into a computer or a mobile device without the need of special paper, pen, or other devices to track the pen. Recent advances in various technologies have made it practical to develop the EMG detection and analysis techniques suitable for character recognition. Taking advantage of advances in electrophysiology, pattern recognition, signal processing, and computer engineering, this project proposes to develop a practical system to decipher the EMG signals generated by biosensors mounted in the digital glove. The project will use the test bed system that was developed during Phase I project and helped to prove the concept. The knowledge of hand EMG patterns of various characters that were gained during Phase I will be used in the development of hardware device. The development will be conducted in the areas of Data Collection, Data Representation (preparation), and Data Analysis. The improvements are expected in all three areas, due to the use of more advanced electrodes, data processing filters, and the application of Neural Networks algorithms.

The proposed approach will remove several limitations faced by current technology and should provide a more durable, flexible, accurate, and user friendly product that can be easily adapted to different users for taking notes, or writing SMS messages for cell phones. The technology will significantly impact the condition of Carpal Tunnel Syndrome, a common occupational illness being reported among typists. EMG-based fingerless glove can also be used as alternative communication device by disabled people who are not able to talk, or who have hearing problems. The resulting product has many applications in education, medicine, tele-robotics, and can be used by mobile workers. As a wearable computer device, this product will help to improve users' image and self esteem. This research project will contribute to the better understanding of muscle interactions. Finally, the handwriting application that will be developed, can become a test bed for analyzing and comparing various pattern recognition algorithms, including traditional statistical algorithms and neural networks, for example Self Organizing Maps (SOM), State Vector Machine (SVM), or Time Lagged Recurrent Networks (TLRN). These algorithms already have numerous applications in various fields.

OptTek Systems, Inc.

Phase II Award No.: 0750045

Award Amount: $439,646.00
Start Date: 04/15/2008
End Date: 03/31/2010

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Sector: Education

SBIR Phase II: OptDiverse: Innovative Technology to Enhance Workforce Diversity, Capabilities, and Performance

OptTek Systems, Inc. is developing a software product designed to support strategic workforce optimization. The product fills the gap in existing software to help organizations identify optimal portfolios of investments to achieve desired workforce composition. The software is structured to integrate with organizational objectives such as financial goals, productivity goals, diversity goals, and human resources goals (including recruitment, talent management, employee engagement, and retention). Important new strategic functionality is provided for current human resource and business planning applications by simulating and optimizing the workforce over the employment life cycle from recruiting to retirement. Analytics provided by the software spans a variety of processes including hiring, onboarding, talent management, performance management, compliance, and professional development.

Under an innovative research and development award from the National Science Foundation we are developing a prototype of the software. The software simulates and optimizes program investments to obtain workforce readiness and diversity goals for an organization's workforce. The resulting optimized investment portfolio takes account of how investment decisions affect the retention and recruitment behavior of individuals with different demographic attributes. The decision support and planning software accounts for realistic constraints including budgets, relationships between decisions, time frames, and government regulations. Based on the performance outcomes for each period simulated, optimal portfolios of investment decisions are generated to maximize readiness and diversity for given budget requirements. OptTek expects a working prototype to be ready no later than 2010.

This project is an application of our optimization technology integrated with sophisticated simulation modeling. It continues the groundbreaking work in complex optimization algorithm development pioneered by Dr. Glover starting in the 1980's.

Product Innovation and Engineering, LLC

Phase II Award No.: 0822739

Award Amount: $532,000.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Manufacturing Processes

STTR Phase II: A Multi-Axis Planning System (MAPS) for Direct Fabrication Processes

This Small Business Technology Transfer (STTR) Phase II research project focuses on the development of an innovative Multi-Axis Planning System (MAPS), for layered manufacturing processes. By enabling current direct metal deposition systems to fully control and utilize multi-axis capability to make complex parts, MAPS will enable fully-automated process planning for multi-axis layered manufacturing processes to directly control metal deposition machines used in automated fabrication. The building of complicated shapes without support structures is a major challenge for current direct metal deposition processes. This proposed Phase II research will continue to research and develop the 'centroidal axis' algorithm in multi-axis slicing, with an emphasis on completeness and robustness for complicated shapes such as geometry with multiple loops and internal structures. This algorithm will allow manufacturing systems to handle parts with multiple loop features. Additional features to be developed under this Phase II project include a deposition visibility map for efficient computation on the collision-free slicing/deposition sequence in a multi-axis scenario, and a '3-D layer' toolpath generation which will provide an alternative turning algorithm for the deposition process.

The proposed project will impact the manufacturing industry by incorporating fully-automated multi-axis control capability into the rapid manufacturing industry to produce fully functional metal parts with complicated shapes. This capability will lead to dramatic reductions in lead time and manufacturing costs for high-value, low-volume components with high performance material. Assuming the outcomes are successful, the project will several segments such as aerospace, military, motor sports, automotive, industrial machinery, medicine, dentistry, and consumer products.

Quantum Simulations Incorporated

Phase II Award No.: 0822696

Award Amount: $500,000.00
Start Date: 07/15/2008
End Date: 06/30/2010

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Sector: Education

SBIR Phase II: Artificial Intelligence Tutoring and Assessment for Teacher Development

This Small Business Innovation Research (SBIR) Phase II research project focuses on bringing the power and benefits of artificial intelligence tutoring technology to the arena of teacher professional development (PD). The proposed innovation is a teacher professional development system built on the principles of artificial intelligence, and delivered via the Internet. Similar to a flight simulator, this technology will offer a realistic but benign opportunity to test and expand a teacher's preparedness through practice with realistic classroom situations. A key objective is the creation of a classroom simulator which incorporates a virtual master teacher, to help teachers deepen their content understanding, learn to respond to student questions more effectively, practice proven pedagogical techniques for improving student understanding and conduct self-monitoring and assessment before getting in front of a live class.

An increasing number of schools are forced to rely on new or out-of-field teachers to fill the gap for teaching science and mathematics, often resulting in a substantial decline in quality, depth and individual attention students receive. Because of the well-documented problems of teachers teaching out of their content areas, and low-performing schools having greater percentages of lesser-qualified teachers, states have established stronger criteria for in-service teachers and newly qualifying pre-service teachers. Middle and high school science and mathematics are the areas where most out-of-area teaching is occurring. In the National Center for Education Statistics (NCES) report, 'The Condition of Education', a key finding is that high school students in high-poverty, high-minority schools were more often taught science, mathematics and English courses by out-of-field teachers than their peers in low-poverty, low-minority schools. This research is expected to impact these issues and in addition address the goals of the American Competitiveness Initiative and the requirements for highly qualified teachers identified in the 'No Child Left Behind' initiative.

RoadNarrows LLC

Phase II Award No.: 0848762

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Robotics & Assistive Technologies

STTR Phase II: General Robot Controller for Legged Mobile Robots with Integrated Open Source Software

This Small Business Technolgy Transfer (STTR) Phase II project focuses on the development of a generalized processing and sensor pack complete with open-source software and curricula for using legged robots as an educational platform for Science, Technology, Engineering, and Mathematics (STEM) courses. The innovation of this proposal is a middleware product called SkewZone Brain and Sensor Pack. This Brain Pack which consists of processing boards, plug-in sensors, wireless communication, software interfaces and mechanical hardware for attachment to commercially available legged robots, serves as a value-added layer between the low-level operations of a robot platform and the high-level software. Educators will be able to migrate their Brain Pack from one robot to another, allowing software, curriculum, and hardware reuseability. The Brain Pack provides sufficient sensory feedback to close the loop on the mechanical control of the legged platform. Higher-level cognitive algorithms, such as path-planning, vision, and behavior-based systems, can be easily developed or reused. The distinctive features and challenges of legged robots provide unique opportunities for high-school and college curricula in numerous STEM topics. Robots are currently used in a variety of classes. However, current educational robot platforms are dominated by wheeled robots; legged robots with a biological basis are almost absent. Robots, which have sufficient on-board processing power, sensors, a wireless interface, and open-source software, are necessary for building curricula that meet educational standards and for interesting research assignments.

Saltire Software Inc.

Phase II Award No.: 0750028

Award Amount: $527,500.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Education

SBIR Phase II: A Standards-Based High School Symbolic Geometry System

Most of the mathematics we teach in high schools and the early college years can be done by computers, and increasingly by pocket calculators. We can fight this by not allowing the use of technology in the mathematics class, or we can embrace it. Embracing the technology will imply a tectonic shift in mathematics education away from teaching methods and manipulation to teaching modeling and problem solving. In the freshman or sophomore year in high school students use dynamic geometry software (DGS), and in the freshman or sophomore year in college they use Computer Algebra Systems (CAS). In between there is a gap. We are developing software which automatically creates algebraic models of sketched geometry. The software bridges the gap between geometry and algebra, between high school technology and college technology, and helps the student learn the sophisticated art of mathematical modeling. Real life problems in areas as diverse as telescope optics, farm irrigation, mechanical engineering design, computer graphics are simply modeled geometrically. Our software can convert the geometrical models into algebraic ones, which can be solved using the techniques which are currently taught in high schools, and which in the future may be left to computer algebra systems. Two dimensional geometry is hard enough, three dimensional geometry introduces further problems both to the user interface (how do you sketch in 3D?), and to the algebra (the expressions rapidly become complicated). Teenage midshipmen in the 18th century Royal Navy would learn spherical trigonometry on the heaving deck of a three masted man of war. The mathematics was hard and learned by rote, but its relevance was beyond dispute. Perhaps we can reclaim some of the relevance and some of the mathematics (without the rote learning) for the teenagers of today using our new software.

The initial symbolic geometry research was carried out in 1987 in Tektronix Computer Research Labs. Further work at Saltire Software was funded by an NSF SBIR grant in 1994-96. The 1996 prototype had two problems: 1. it relied on an external algebra system, and thus could not be a standalone product and 2. it was too slow. In 2004, an old prototype was ported onto a new computer, and the performance problem had been solved by hardware speed and memory size enhancements. By 2006 we had developed our first symbolic geometry product: Geometry Expressions. The current work creates a symbolic geometry based tool for high school education, and extends the technology from 2 to 3 dimensions and from Euclidean to differential geometry.

SeaFire Micros, Inc.

Phase II Award No.: 0822744

Award Amount: $488,128.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Enterprise Software Applications

STTR Phase II: Splintered Topologically Close-Packed (TCP) Offload Engine for Grid Computing and Bandwith-Delay Product (BWDP)

This Small Business Technology Transfer (STTR) Phase II research project addresses the challenges of networks with extreme bandwidth delay products. Bulk data transfer over such networks used by national research laboratories and aerospace companies need to be provided with the endpoint resources required to ensure high performance in a cost effective manner. The outcomes of this project attempts to provide compatibility with present and future versions of GridFTP. The project addresses these challenges through the use of a novel offload engine. During the Phase I project, the feasibility of deriving and simulating the offload engine architecture, firmware, and creation of intellectual property (IP) for low-cost, high-performance field programmable gate array (FPGA) subsystems was completed.

Successful results from this research will significantly advance the state of the art for off-load engines used in grid computing. Immediate applications include accommodating the e-Science community's need for scalable 10-100 Gbps off-load engines, while supporting present and future versions of GridFTP. Other applications include the use of our ultra high-speed offload engines for grid and cluster computing, utilizing our open source firmware. The FPGA code resulting from this project has the potential to be used as intellectual property that could then be marketed to off-load engine manufacturers. These IP cores would accrue cost-effective savings for existing engine firms and would accelerate products to the market.

Securics Incorporated

Phase II Award No.: 0750485

Award Amount: $479,685.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Enterprise Software Applications

STTR Phase II: Improving Privacy and Security in Biometrics

Biometrics can provide secure access to facilities and sensitive data work areas, but they have been and will be used in other "lower security" applications. How well is biometric data collected at the DMV, theme park or local gym being protected? The trouble with biometric features as security tokens is that if they are compromised, they cannot be regenerated like a password or PIN number – they are effectively compromised forever. As the use of biometrics increases, compromises will also increase, thus decreasing their security value. At Securics, we have developed the Biotope secure revocable biotoken to solve this dilemma. In essence, the Biotope revocable biotoken is a transformation of the original biometric data that can be matched in encoded space. These biotokens are unique, and can be revoked and re-issued at will. This technology has been shown to be resilient to common attacks, and to have competitive matching accuracy. No other technology is this domain (both academic and commercial) has been able to provide high levels of security and performance. The societal and industrial impact of this technology is significant – the privacy and security of biometric data can be maintained by organizations charged with providing services in diverse areas, including network authetntication, physical access control, time and attendance, and data-at-rest applications.

Biotope technology was developed by Dr. Terrance Boult, with important early experiments performed by Dr. Boult and his team at the University of Colorado at Colorado Springs' Vision and Security Technology (VAST) Lab. The initial development was funded by the El Pomar Chair of Innovation and Security. Securics, Inc. spun-off in 2004 with Founder funding for (IR&D). Further funding before the current NSF Phase II has included University of Colorado Proof-of-Concept Investment (2005), NSF Phase I (OII-0611283) (2006). Securics has an exclusive license from the University of Colorado for the biometrics technology developed by Dr. Boult and all their derivatives. The IP consists of six patent-pending technologies, including international filings for Biotope technology.

SimBiotic Software

Phase II Award No.: 0749862

Award Amount: $499,999.00
Start Date: 03/15/2008
End Date: 02/28/2010

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Sector: Education

SBIR Phase II: Online Chapter Marketplace for Biology Learning Materials

Students in college biology classes are usually given reading assignments each week to complement the lectures and labs. But the amount of long-term or conceptual learning which happens from these readings is relatively low. The SimUText system we are developing will let biology instructors assign reading assignments where students actively use the knowledge they've just learned to solve problems. In this way, students will learn the material more deeply, and at the same time learn to apply the material to solve problems. Students also receive instant feedback on how well they understand the material, as do teachers who can then adjust the content the present in lecture. Furthermore, because the material is digital, teachers will be able to tailor it to the particular needs of their class. All of this will be available to the students for an affordable price.

This innovation stems from the work we have done for many years on using simulations to teach in the laboratory portion of biology classes around the country. Our various simulation programs let students learn by doing conceptually realistic experiments in areas that are not usually accessible to 3-hour labs. Some of these programs were funded on NSF grants from the Division of Undergraduate Education and ITEST programs, including a grant for the development of the EvoBeaker program for teaching evolutionary biology and a subcontract on a grant for developing middle school environmental science software for the state of Maine (EcoBeaker: Maine Explorer). The technologies we developed previously on those and other projects designed for labs gave us a foundation from which we saw the possibilities for integrating simulations with text for at-home assignments.

Tertl Studios LLC

Phase II Award No.: 0750432

Award Amount: $532,000.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Education

SBIR Phase II: A Visual Language for Mathematical Model-Making

Even as the state of algebra education has been declared a crisis and its improvement a national priority, research is finding that children's ability to think and learn algebraically is much greater than is seen in school. There is an urgent need for learning tools and approaches that connect more directly to children's natural mathematical intelligence. This project is making that connection by enabling children to build visual mathematical models that help to ground students' intutions and highlight the power of mathematical ideas to understand, predict, and solve problems.

Phase II research objectives address: (i) underlying algorithmic support to achieve a concrete user interface (ii) filling out core functionality; (iii) classroom usability and curricular integration; and (iv) learning outcomes.

This project builds on prior work in the areas of early algebra learning (e.g. by J. Kaput, D. Carraher, J. P. Smith, and others), modeling in math and science (e.g. by R. Lehrer, L. Schauble) and of visual modeling tools for students (e.g. M. Resnick, E. Soloway).

Tertl Studios LLC

Phase II Award No.: 0848878

Award Amount: $500,000.00
Start Date: 04/01/2009
End Date: 03/31/2011

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Sector: Education

SBIR Phase II: An On-Ramp to Computational Fluency

This Small Business Innovative Research (SBIR) Phase II project continues development of a major improvement in the cost-benefit equation of learning computer programming. The approach integrates a new programming paradigm particularly suited to real-time, high-interactivity applications, with advances in program liveness and visualization, and game-based learning of essential concepts and skills. The strategy is to draw learners onward and upward through continued creative empowerment, while also facilitating more direct engagement with the core intellectual content of computer programming. The research objectives of this Phase II project address: 1) continued language development, 2) creativity toolset development, 3) development of learning games, 4) a learning environment architecture with an underlying model of learning pathways, and 5) evaluation activities including measurement of learning outcomes.

If successful, this Phase II project will lead to products that will engage over half a million learners in mastering fundamental computational topics and bending them to creative purposes, thereby addressing the following major national priorities:

- workforce preparation and technological fluency;
- rebuilding computer science enrollment and retention at the college level;
- alternative, hands-on pathways into algebra and mathematics for students who struggle with traditional instruction;
- cultivating technology-based creativity among young people.

The Learning Chameleon, Inc.

Phase II Award No.: 0822020

Award Amount: $399,370.00
Start Date: 11/15/2008
End Date: 10/31/2010

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Sector: Education

SBIR Phase II: A Value-based Approach for Quantifying Problem Solving Strategies

This Small Business Innovation Research (SBIR) Phase II research project will investigate methodologies required to scale and disseminate an online performance-based assessment system for quantifying the scientific problem solving skills of middle school students. This Phase II research will be based on the Phase I results which identified the technical, logistical and professional development challenges that influence the rapid calculation, aggregation and real-time, online, reporting of problem solving assessment data to diverse educational stakeholders. The research will first design and implement an Online Analytical Processing (OLAP) model for data analysis and reporting and incorporate these designs into a system scale-up plan to flexibly accommodate the 10-20 fold increase in users indicated by our commercialization plan. A central component of this development will be a data warehouse that will be instrumented allowing the analysis of how teachers access the performance data, which will be linked to a digital dashboard which will provide teachers with an easy, and highly visual access to multi-dimensional assessments of their students and comparison classrooms. Additionally, this information will be used to develop new forms of professional development to support teachers in the better use of the data available.

The impact of this extensible formative, summative and programmatic assessment system of learning will have broad relevance for helping teachers to teach, students to learn, and administrators to make informed data-driven decisions through the continual, and real-time formative evaluation of a student's problem solving progress, a dimension not frequently or rigorously assessed in today's classrooms, yet a critical component of 21st century skills. The outcomes of this project should have widespread utility at all levels of science education and should allow cumulative comparisons of problem solving across science domains, classrooms, teachers and school systems thus helping to re-think the ways scientific problem solving is systemically assessed and how the impact of teaching these skills becomes quantified.

The Virtual Reality Medical Center

Phase II Award No.: 0750551

Award Amount: $500,000.00
Start Date: 04/15/2008
End Date: 03/31/2010

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Sector: Education

STTR Phase II: Developing a Mixed Reality Rehabilitation System

Over the past ten years, researchers have used virtual reality (VR) as a useful tool in therapy for a wide variety of applications, including treatment for anxiety disorders and pain distraction. One of the newest and most exciting applications of VR is in the field of rehabilitation. Research in VR applications for stroke patients in particular have made considerable progress. Functional magnetic resonance imaging (fMRI) studies of VR used in conjunction with traditional physical therapy in stroke patients have resulted in neuroplastic changes in the brain and corresponding improvements in motor functions. Mixed Reality (MR) extends VR by blending the real and the virtual into a seamless landscape. Using virtual enhancements, overlays, and contexts, MR allows the real world to be converted into an altered reality without losing the benefits of the physical setting—touch, smell, hearing, taste, and visual contact with other humans. Wearing a specialized head-mounted display (HMD), a participant can see a virtual environment (VE) overlaid onto their view of the real world, thus creating an experience of mixed reality. The Phase I effort between VRMC and UCF MCL enabled the development of a new rehabilitation system, the Mixed Reality Rehabilitation System (MRRS) that will enable a stroke patient to receive rehabilitation therapy of the upper extremities both in the office and at home. The product is being refined and tested in Phase II, in which the objectives include improving the system's scenarios and hardware, adding mental practice and video capture of body movement, programming metrics into the system, integrating telerehabilitation capabilities into the system, ensuring the system's safety, and submitting the system for regulatory approval. The use of fMRI brain imaging will complement our comprehensive evaluation of objective measures of success and outcomes of this program. The impact of the project will be the ability for stroke or traumatic brain injury (TBI) patients to borrow or rent a take-home version of the system from telerehabilitation-enabled facilities to continue intensive rehabilitation on their own under the guidance of a therapist via the Internet.

With funding from the Office of Naval Research (ONR), VRMC is treating posttraumatic stress disorder (PTSD) in active duty members of the U.S. Armed Forces returning from Iraq and Afghanistan. This VR therapy combines realistic computer simulations with physiological monitoring, which allows the therapist to help guide the patient through gradual exposure and skill acquisition, has been 85% successful in controlled clinical trials. This program (contract # N00014-05-C-0136) is now entering its fourth year. VRMC has expanded the program to treat additional wounds of war, including both physical and cognitive disabilities following traumatic brain injury (TBI). Funding from the U.S. Air Force (contract # FA8650-07-M-6829) made possible the creation of a cognitive rehabilitation system that has undergone initial clinical trials. These programs are now being introduced in the Veterans Administration (VA) hospital system.

TravellingWave

Phase II Award No.: 0724271

Award Amount: $500,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Robust Speech-to-Text Messaging

TravellingWave technology addresses a very crucial need in the mobile industry: inputting text into mobile devices using Voice. The reason this is an important problem is that the competing text input methods (multi-tap, predictive text input, compressed keypads, etc.) are painful, slow and prone to error. Devices designed with mini-keyboards are bulky and difficult to use. Further, there is a limit to how small the key spacing can be compressed in the trade-off between design and usability. Speech-to-Text has been attempted several times by leading companies but has not been successful; given the complexity of the problem. In general, many speech-to-text applications have ended up being slower and less accurate than using a standard keypad. TravellingWave's unique approach is based on combining the finger/hand based inputs with Voice. Specifically, under a novel framework called "Predictive Speech-to-Text™", TravellingWave has developed an interface called "VoicePredict™", which boasts of being the world's 1st next generation multimodal mobile user experience. Using VoicePredict, a user speaks a word/phrase, types a letter or two, and the word/phrase appears on the mobile screen. This approach guarantees a near 100% task-completion-accurate system because the system automatically chooses between the keypad and voice inputs to generate "best of both worlds".

Under the NSF Phase II grant, TravellingWave is working on making its speech recognition highly robust; to background noises and speaking styles; using a unique signal processing approach is inspired by the way human auditory processing. Results demonstrate significant improvements over vanilla speech-to-text as well as standard text-prediction. VoicePredict's has the potential to lead to a new generation of keypad-less computing devices. Subsequently, this has the potential to impact areas including mobile messaging, mobile marketing, social networking, and benefit a broad spectrum of users including teenagers, executives, and the elderly and disabled.

This innovation is related to fundamental research conducted by the Dr Ashwin Rao for about 15 years in the area of "frequency localized temporal signal processing" inspired by the human auditory periphery. Subsequent experiences gained by Dr. Rao while at Bell-Labs and Dragon Systems in large vocabulary speech recognition has led to this overall technology called "predictive speech-to-text". VoicePredict is currently in trials with leading mobile phone manufacturers and wireless carriers.

TRX Systems Inc.

Phase II Award No.: 0750498

Award Amount: $512,000.00
Start Date: 02/01/2008
End Date: 01/31/2010

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Sector: Wireless Technologies

SBIR Phase II: TRX Sentinal First Responder Tracking System

TRX Systems, Inc. is developing a personnel tracking and location device that provides accurate 3-D position both inside (GPS denied) and outside. TRX's approach integrates innovative system design and signal processing techniques. In addition, TRX has developed innovative map generation software that will generate a floor plan if one is not readily available. Our target market is first responders. TRX's tracking system is capable of tracking a team of first responders at an incident site. No special instrumentation or preparation of the incident site is required; therefore system set-up time is on the order of seconds. Our 3-D solution is able to combine information from various MEMs and other sensors and information from pre-existing or from dynamically generated maps to produce refined location estimates. This information is integrated and presented on a map display that provides a level of situational awareness not previously available to incident commanders. In addition to overall superior incident management of resources, the TRX tracking system's precision location and health status information of deployed personnel offers a dramatic decrease in rescue time for distressed or downed firefighters.

The tracking system is comprised of three basic components: (i) a laptop command station and (ii) a small rugged tracking unit (about the size of a deck of cards) and (iii) a data radio that are worn by the first responder. The Command Station presents location and track information in a number of ways depending on the commander's preference. It includes a full geographical information system with satellite imagery, building outlines, and building floor plans (when available). The data radios form a mesh network that extends the coverage range of the system. The system supports many additional features, including the ability to provide automatic distress detection as well as manual 2-way alarming and the transmission of evacuation orders.

VCOM3D, Inc.

Phase II Award No.: 0620486
Phase IIB Award No.: 0849153
Award Amount: $968,075.00
Start Date: 09/01/2006
End Date: 08/31/2010

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Sector: Education

STTR Phase II: Lifelike Virtual Tutors to Support Authentic Learning

Under a Small Business Technology Transfer Research (STTR) grant from NSF, Vcom3D and TERC have completed initial development of an Authoring Tool that supports the creation of virtual, collaborative K-12 science activities in an interactive 3D world. A unique feature of these activities is the inclusion of virtual tutors that communicate in English, Spanish, or American Sign Language. These tutors can also interact realistically with their environments to perform scientific experiments as directed by students. Vcom3D and TERC have created virtual "Catching Sunshine" and "Marble Roll" activities that are being evaluated in over 10 classrooms at both mainstream schools and schools for the Deaf. Students will share and compare their data to test hypotheses and learn from each other's designs.

The Authoring Tool has been successfully commercialized and is being used not only to create K-12 science instruction, but also by a university medical school to research and train interactions between medical professionals and patients; and by the U.S. Government to train personnel how to appropriately interact with persons of different cultures in order to build rapport and conduct successful negotiations. As part of a Phase IIB extension, Vcom3D has extended the technology to create instructional content for mobile devices such as the Apple iPhone and touch-screen iPod.

The technical origin of this project dates back to the late 1990s, when the co-founders of Vcom3D developed and patented a methodology for character animation that was capable of rapidly creating intricate movements with sufficient detail and accuracy to represent American Sign Language (ASL). An NSF grant awarded in 1998 allowed the developers to add facial expression, which is also an important part of ASL. Starting in 2001, Vcom3D has collaborated with TERC, a non-profit educational research institute to create STEM instructional content for Deaf and Hard-of-Hearing children. In this most recent collaboration, Vcom3D and TERC are immersing these "Signing Avatar" characters into 3D virtual worlds in which they support collaboration between not only Deaf children, but with visual learners with many different abilities.

VCOM3D, Inc.

Phase II Award No.: 0823070

Award Amount: $509,484.00
Start Date: 12/15/2008
End Date: 11/30/2010

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Sector: Education

SBIR Phase II: Life-like, Expressive Avatars for the Instruction of Young Learners who are Deaf

This Small Business Innovation Research (SBIR) Phase II research project will develop a new authoring tool that will allow persons proficient in American Sign Language (ASL) to create animated stories and instructional material in ASL. The goals of this authoring tool are: 1) to support the creation of instructional materials that assist Deaf and Hard-of-Hearing (HH) students in the elementary and middle grades in learning to read; 2) to support the creation of animated ASL stories, including the full range of ASL grammar, that can be enjoyed by Deaf and Hard-of-Hearing students; and 3) to provide a tool that can be used by older students, at the secondary and university levels, to learn about the ASL by creating animated ASL passages. The project includes the development and testing of exemplary reading instruction for Deaf students reading at grade level K-6.

The research will result in improved, computer-based reading instruction for the 50,000+ K-12 Deaf/HH students in the U.S. whose first language is ASL, as well as students that are taking ASL courses. Currently, Deaf children are delayed in developing language skills, to the extent that the average reading level of a Deaf high school graduate is no greater than 4th grade. Since Deaf children have difficulty developing phonemic awareness, and are often isolated from contextual information available to hearing students, teaching reading to Deaf children requires the application of several unique methods that go far beyond simply translating English text. By providing educators and developers of educational software with products that allow them to develop personalized signing avatar tutors for Deaf children, this project will make possible the creation of instruction that is available 'anytime, anywhere' for assisting Deaf children in developing literacy skills.

Workplace Technologies Research Inc.

Phase II Award No.: 0548631
Phase IIB Award No.: 0832707
Award Amount: $1,002,388.00
Start Date: 04/01/2006
End Date: 03/31/2010

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Sector: Education

SBIR Phase II: Cognitive Agility Assessment Tool

The FutureView Profiler is a both an executive assessment instrument and a professional development tool with important differences from other products designed for the same purpose. The major innovation is that it does not rely on self report. The user trouble-shoots an actual business case using actual primary data (annual reports, 10k's, analysts reports, etc) His or her ability to spot problems and predict outcomes is directly measured against the known outcomes of an actual company. Secondly, the instrument scores the users on the six major dimensions of business acumen known to be required at the C-level. In other words, the user gets six scores and can thereby identify blind spots or areas of development even if – overall – he or she highly skilled. This guides coaching and staffing efforts. Lastly, the instrument profiles general cognitive agility, or the degree to which any "blind spots" are overcome as the user gets increasing amounts of information. Future versions of the instrument will also calculate the cost of having a "blind spot" or the advantage of foreseeing a problem, giving users valuable feedback on the costs and benefits of their current business acumen profile. Current research has also shown that the profiler can be a valuable learning tool. Using it repeatedly (with different cases) helps many users overcome chronic blind spots and learn how to identify red flags and potential problems in their early stages.

Originally the product was sold as a large instrument in booklet form (50 page). The current versions are available via the web, usable on-line with automated, instant reports and feedback. A much longer detailed report is available to professional coaches. There are also several versions available, varying by difficulty and industry type. However, most versions require only a lunch hour to complete.

This innovation is related to the basic research funded by grants from NSF and NASA on the impact of accelerated change in organizations. The FV Profiler was developed as a WTRI in-house tool in order to help set appropriate goals for clients and determine root cause blind spots in key decision makers. Development of this tool into a product began at the request of customers who wished to have it for their own employee recruitment, succession planning and professional development.

Workplace Technologies Research Inc.

Phase II Award No.: 0646275
Phase IIB Award No.:
0924326 (pending)
Award Amount: $532,000.00
Start Date: 02/15/2007
End Date: 01/31/2009

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Sector: Education

SBIR Phase II: Strategic Model for Manufacturing Organizations (DSMMO)

The FutureView Modeler is a high level Business Intelligence tool with some major differences from traditional BI tools. Most Business intelligence systems which model processes or finances do so in a more or less "local" way. In contrast, the Modeler tells the user what needs to be fixed in order for the company to achieve its maximum value proposition. Traditional BI tools model the benefits of doing things differently at the operational level or within a client's company and show the local benefits (e.g., improved output from a manufacturing cell) . The FutureView Modeler models a firm in the context of the marketplace as a whole and in comparison to its competitors. It compares the company with overall trends and "locates" it within its competitive space in terms of its overall performance. It then clusters the "high performers" within the firm's competitive space and mathematically derives an ideal model of "goodness" based on an analysis of how these high performing companies leverage resources that result in benefits. The ways that the company differs from the derived "ideal" performer -- e.g., R&D spending -- are then identified. The idea here is that not all problems are equally worth fixing. In general, fixing any problems in the areas significantly at variance with an "ideal" performer usually contributes the most to the company's total performance. The Modeler then shows the value – at the top line and the bottom line – of fixing that problem. In other words, it quantifies the value of the fix in the value proposition of the total firm. Traditional Business intelligence systems can then be used to drill down into these areas and improve processes, flow or operations. Therefore, while traditional BI tools work on specific issues, The Modeler tells the user what to work on for maximum benefit at the level of the firm's value.

This innovation is related to the basic research funded by grants from NSF and NASA on the impact of accelerated change in organizations. The Modeler was developed as a WTRI in-house tool in order to help set appropriate goals for clients and determine root cause inhibitors to company performance. Development of this tool into a product began at the request of customers who wished to have it for their own strategic planning.

Yantric, Inc.

Phase II Award No.: 0849004

Award Amount: $454,274.00
Start Date: 04/15/2009
End Date: 03/31/2011

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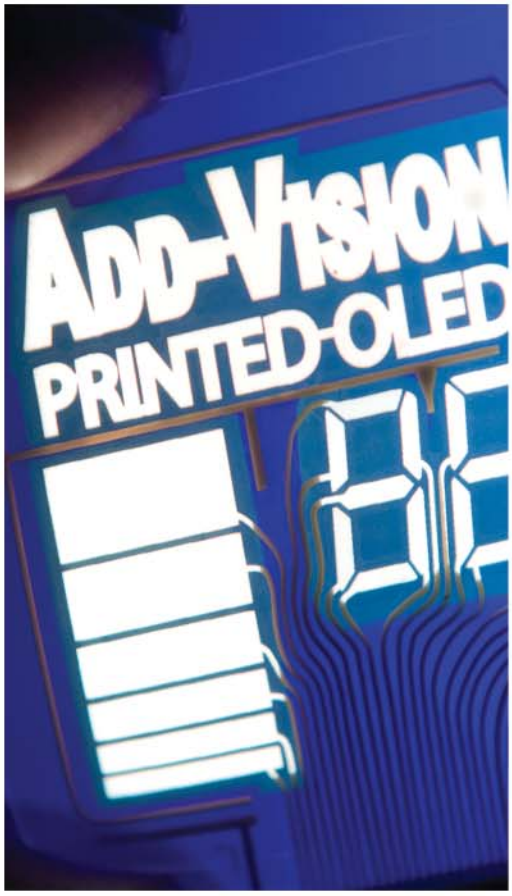
Sector: Robotics & Assistive Technologies

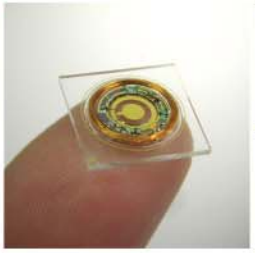
SBIR Phase II: Wearable Tactile Display System for Blind Individuals

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of a novel system for communication with computer through touch, particularly relevant to blind individuals. The system includes a newly developed Tactile Display Device (TDD) technology with miniature thermo-fluidic actuators that uniquely revolutionizes the way humans interact with different machines and systems using a wearable tactile display. The proposed new technology is a significant breakthrough as the concept of sensing touch actuation based on bubble formation and vapor pressure has a wide potential for miniaturization, embedding, flexibility, and wearable possibilities with amplitude and force of actuation not achieved by other means so far. The specific objectives of the project are to improve the actuator modules and the TDD developed during Phase I of the project, so that the technology can be brought to market.

The research will impact both the education and scientific segments of the market by addressing many challenges in application of bubble and vapor based motive power in miniature systems. Additionally, this outcomes of this work is expected to catalyze new avenues and variants discovered by the scientific community working in the areas of miniature actuators and systems, eventually leading to new innovations in Micro-Electro-Mechanical Systems (MEMS) and in nanosystems. The research has very high societal impact potential as it addresses the blind population market segment that is somewhat neglected by the larger corporations due to its relatively smaller size. The blind population is not benefiting fully by the latest trend in information decimation increasingly through internet and computer based mediums. As these medium are highly graphic and visual in nature, alternate and enhanced interfaces with computers that use touch to convey information will be of great service and importance in making the visually impaired population more informed and productive.



Information & Communications Technologies (ICT)



Add-vision, Incorporated

Phase II Award No.: 0724204

Award Amount: $497,242.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Program Director: Juan E. Figueroa

Sector: MEMS & Electro-Optics

SBIR Phase II: Ultra Low Cost, p-i-n OLED Lamps for Specialty Lighting

This project seeks to enable new, energy efficient lighting with an unconventional, low cost manufacturing approach. This approach is unique as it leverages state-of-the-art high efficiency polymers in combination with novel voltage-lowering chemistry to enable print manufacturing at much lower costs than other approaches. The conventional development path of mainstream OLEDs have led to impressive improvement in performance, but utilize device structures that require expensive and complex processing and encapsulation. This has led to high costs and has delayed commercialization of OLED products. Add-Vision's focus is on realizing the initial promise of P-OLED technology by developing a modified device structure, air-stable materials, and print-based manufacturing leading to ultra low cost OLEDs on flexible substrates. Currently, the research team is developing a low-cost, flexible P-OLED technology that is also sufficiently long lived, and efficient enough to ensure adoption into early-entry SSL. Add-Vision has been establishing technical and commercial feasibility through successful internal R&D and through securing commercial commitment from a high-level manufacturing partner to leverage Phase-II innovations. Phase-II work with white Light-Emitting Polymer (LEP) materials, formulations and print process development have led to (1) Improvement in white P-OLED operating lifetime from 100's of hours to 1000's of hours, (2) Demonstration of improved printing yields, (3) Improvements in power efficiency, (4) Formation of relationships with materials suppliers leading to access to a broader range of higher performance materials, and (5) Escalated commercial interest, licensing, capital investment and product development activities with electronic manufacturers. We have now exceeded 5,000 hours brightness lifetime in air-printed white OLEDs, well exceeding the entry level performance specifications. We are now focusing on voltage reduction, print and encapsulation process refinements and cost reduction to push this technology into commercialization.

This NSF project is opening up significant commercialization opportunities for OLED technology in entry SSL applications. Add-Vision is pursuing a $1B market for specialty lighting in mobile electronics. This technology will be made available for licensing, and since it exploits low cost and energy-minded manufacturing, it is expected to directly benefit some of the 30,000 U.S.-based printing companies, ensuring rapid roll-out and creating jobs. Finally, this Phase-II enhances the scientific understanding for similar emerging printable electronic technologies such as photovoltaics, where low cost manufacturing are paramount for commercial success.

The innovation is directly related to fundamental discoveries by Prof. Richard Friend's research team at the Cavendish Laboratory of Cambridge University, which created the first light-emitting diode using conducting conjugated polymers (P-OLED), (1989). Soon thereafter, another discovery by Dupont Displays (formerly UNIAX) of Santa Barbara led by Prof. Alan Heeger created the first doped P-OLED device structure that operated much like an electro-chemical cell (1994). Alan Heeger, Alan MacDiarmid, Hideki Shirakawa were awarded the Nobel Prize in Chemistry for their discovery and development of conducting polymers (2000). Add-Vision, a Scotts Valley, CA company, demonstrated the world's first fully-printed P-OLED device using a doped P-OLED device structure (2002). Under this NSF SBIR Phase I, Add-Vision successfully demonstrated the concept and feasibility of fully printed white polymer OLED technology (2006). Add-Vision awarded NSF SBIR Phase II grant to develop and commercialize a robust white P-OLED technology whose structure is entirely solution processable on plastic substrates and deposited by conventional printing equipment (2007). Add-Vision secured commercialization commitment for NSF-funded research in white printed P-OLED technology for keypad backlighting in mobile appliances (2008).

Adelphi Technology, Inc.

Phase II Award No.: 0724503

Award Amount: $500,000.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Efficient, High-Resolution Fast-Neutron Detector

New "eyes" have been developed to see inside high density materials with extremely energetic particles (fast neutrons!) that come from the interior of atomic nuclei. Adelphi has developed a new imaging camera, which uses fast-neutrons for radiographic imaging and inspection. Fast neutrons can easily penetrate high density materials such as steel and uranium, but are easily absorbed by hydrogen-rich materials (e.g. water, oil) embedded or circulating in metal structures or machinery such as automobile engines. This permits high contrast images between these two classes of materials (e.g. water and brass pipe, see Figure). This also allows the non-destructive inspection of pipes, vessels, and structural supports for cracks, corrosion and other defects, as well as the detection of contraband and explosives in luggage and large cargo containers. The Adelphi fast neutron imaging system consists of a transportable fast neutron generator and a neutron imaging camera. The fast neutron generator produces deuterium nuclei which are fused together at relatively low energies (e.g. 100 kV) to produce energetic neutrons (2.5 MeV). The neutron camera is comprised of a scintillator, a high gain light amplifier and an electronically cooled CCD camera. The scintillator converts the neutrons into visible photons that are imaged by the light amplifier and the CCD camera. This arrangement allows for the sensitive collection of imagines that have low fluxes of fast neutrons.

The Adelphi imaging system pedigree arises from the basic DOE supported research of fast neutron generators of Ka Ngo Leung, et. al. of Lawrence Berkeley National Laboratory and Adelphi Technology, Inc., and of the DOE supported fast neutron imaging detector work of James Hall as well as D. Ress, et. al. of Lawrence Livermore National Laboratory. The detector work was also strongly inspired by L. Disdier of CEA DAM in France with some support from DOE, and with supportive advice and help from Walter Siegmund of Sigma Optics in Pomfret Center, Connecticut, Chuck Hurlbut of ELJEN Technology of Sweetwater, Texas, and Mike Buchin of Stanford Photonics in Mountain View, CA. Many of the Sigma Optics capillary array customers, Stanford Photonics CCD camera customers and ELJEN Technology scintillator customers are funded by NSF, DOE, and NIH.

Advanced Powder Products, Inc.

Phase II Award No.: 0848712

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Devices & Instruments

STTR Phase II: A Lithographic Gelcasting Process using Nanoparticulates: An Enabling Technology for Mass Production of Microdevices with Nanoscale Features

This Small Business Technology Transfer (STTR) Phase II project will develop and commercialize a novel Lithographic Gelcasting (LGC) manufacturing process for microdevices that is amenable for economical volume production. Molds will be made using photolithography and filled with nanoparticulate materials. The resulting parts will then be sintered and the photoresist removed. The objectives of the proposed work are to develop the nanoparticulate casting process into a robust, repeatable, and high-yield manufacturing process for mass production, through the use of statistical process models that relate the manufacturing process parameters to desired outcomes, and determine the range of process capability and design space as it relates to manufacturing and design attributes such as feature size and geometry, achievable tolerances, process yield, and manufacturing costs. This effort will be conducted on known client/partner designs so that actual components will be produced for an end application while the process is being developed. The motivating application for this work is the fabrication of microsurgical instruments, a class of devices that is quite challenging from the perspective of feature size, material, and physical properties. The proposed manufacturing method will impact many types of devices and systems that will benefit from attractive material properties and mass production capability.

If successful the proposed manufacturing methods have the potential to impact surgical instruments used in procedures as disparate as laparoscopy and its endoscopic or transluminal variants, neurosurgery, robotic-assisted surgery, flexible endoscopy such as colonoscopy, ophthalmology including vitreoretinal surgery, transluminal vascular procedures, and biopsy. In 2004 surgical and medical instruments comprised an approximately $24 billion industry. Millions of minimally invasive surgical procedures are performed annually in the U.S., where individual disposable instruments typically cost $100 - $3,000. Other industries requiring three dimensional precision parts could also be impacted. Besides the commercial potential the success of this enterprise could impact the economy of the local community in Central Pennsylvania.

Alces Technology, Inc.

Phase II Award No.: 0620566
Phase IIB Award No.: 0849598
Award Amount: $929,204.00
Start Date: 09/15/2006
End Date: 08/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: High-Speed, Low-Cost Maskless Lithography

Alces is developing a tool which uses laser light and Alces' innovative light modulation chip to print micron sized patterns onto photoresist coated silicon wafers. This high resolution desktop laser "printer" allows researchers and manufacturers to cost effectively and quickly produce semiconductor and micro machined devices in silicon. Current methods are costly and time consuming for small production runs relying on custom print masks or single laser beam maskless approaches to silicon lithography. Alces' high speed – low cost maskless lithography tool promises substantial reduction in print time thanks to Alces' novel MEMS (Micro Electrical Mechanical System) based linear light modulator. This device, itself micro machined on silicon wafers allows a large number of individually controlled pixels to be generated from a single beam of laser light. Alces' maskless lithography tool uses this parallel pixel generation scheme to simultaneously "paint" hundreds to thousands of features on photoresist coated silicon wafers which dramatically reduces overall print times. This tool brings the promise of true rapid prototyping to researchers, engineers, and scientists engaged in medium feature size semiconductor and MEMS development.

Alces has successfully demonstrated feasibility during a Phase I NSF funded SBIR project and has since moved towards commercialization aided by a commercial partnership and NSF Phase II funding. The key emphasis in Phase II has been to successfully fabricate Alces MEMS devices in a commercial foundry (San Jose, CA). The Alces team is actively moving towards final commercialization steps on this project through process and final design optimization. Pending Phase IIB funding seeks to further demonstrate a robust, commercial manufacturing process including packaging and back end processing for the production of high pixel density MEMS modulators.

The Alces light engine was invented by Dr. David Bloom, founder/CEO of Alces Technology and former professor at Stanford University. In 1994, Dr. Bloom invented the first MEMS diffraction grating modulator at Stanford University and later founded Silicon Light Machines to commercialize the device for the display and print markets. The Alces light engine shares the same linear array architecture as the grating light modulators but uses polarization instead of diffraction to reduce the size, complexity and cost of the device. This project was first funded by NSF Phase I grant No. 0512972 in 2005.

ANTEOS, Inc.

Phase II Award No.: 0822652

Award Amount: $492,740.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: High-Efficiency Nanocomposite Photovoltaics and Solar Cells

This Small Business Innovation Research (SBIR) Phase II project is focused on development of an innovative technology for fabrication of high-efficiency thin film nanocomposite photovoltaic materials and solar cells taking advantage of the recently discovered effect of carrier multiplication in semiconductor nanocrystals. The proposed concept employs smart design of the solar cells providing fast and effective spatial separation of electrons and holes photo-generated in the nanocrystals. The proposed reach nanotechnology platform solves the challenging problem of electrical communications with nanoscale objects, such as nanocrystals, nanorods, nanowires, nanotubes, etc. It can be employed for development of many other nanocomposite optoelectronic devices having numerous commercial and military applications.

If successful the development of new generation of high-efficiency photovoltaic materials and solar cells based on the demonstrated technology will have broad impact on the entire solar energy industry resulting in considerable energy savings and environmental protection. The technology has great commercialization potential and niche market. The proposed all-inorganic, high-efficiency, thin film, flexible nanostructured photovoltaic materials and solar cells, which can operate in extreme environment conditions and offer significant mass and volume savings, are ideally suitable for numerous applications, including power generating residential rooftops, power supplies for utility grid, emergency signals and telephones, water pumps, activate switches, battery chargers, residential and commercial lighting, etc.

Barrett Technology Inc.

Phase II Award No.: 0646448
Phase IIB Award No.:
0920283 (pending)
Award Amount: $504,361.00
Start Date: 04/01/2007
End Date: 09/30/2009

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Sector: Robotics & Assistive Technologies

SBIR Phase II: Methodology for Applying Haptic Robotics to Agile Manufacturing

This SBIR Phase-II project addressed safety, user-interface, and performance challenges uncovered in Phase I while adapting a haptic WAM 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.

This SBIR addressed four areas of concern. First, it implemented a comprehensive safety analysis and redesign that goes well beyond Barrett's existing FMEA study. Second, it developed an innovative user interface that focuses on direct intuitive interaction. Third, it improved the underlying dynamic controls and haptic formations. Fourth, it validated the safety, performance, and intuitive feel with craftspeople.

This innovation is related to research from MIT performed by the PI under the direction of Dr. J. Kenneth Salisbury, Jr. (1986-8). The concept was to combine a telerobotic slave and master into a single ("haptic") device. Only 8 units were shipped through 2004. But in 2005, a breakthrough motor driver made this machine much more practical and 45 units have been shipped since then through Q4-08.

Barrett Technology Inc.

Phase II Award No.: 0823008

Award Amount: $500,000.00
Start Date: 11/01/2008
End Date: 10/31/2010

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Sector: Robotics & Assistive Technologies

SBIR Phase II: Low-Cost Ultra-Efficient 50-gm, 300-W Servoelectronics Module with Integral Sensors

This Small Business Innovation Research (SBIR) Phase-II research project aims to cut the manufacturing cost of an innovative power-efficient ultra-miniature, brushless-servo-electronics module from $1,000 to $100. The module integrates all rotor-position sensing, vector-based commutation, controls, and power supplies needed to drive high-performance brushless servomotors rated up to 300 W (Root Mean Square) and 2 KW (peak) into a single 50-gram module not much bigger than a bottle cap. The cost reduction relies on a set of innovations led by replacement of laser optics used for rotor-position sensing with an array of magnetic field sensors measuring a calibrated target magnet. Phase I demonstrated that well-placed shielding enables high precision and excellent commutation performance even in the proximity of stray fields produced by high switched currents and spinning rotor magnets located in the motor body only millimeters from the sensor array.

This servo-electronics module fits the definition of disruptive technology for entrenched players, such as Danaher/Kollmorgen, Siemens, Fanuc, and Yaskawa, while it will enable scores of original equipment manufacturers (OEMs) to improve the performance, compactness, power efficiency, and reliability of their machines at competitive prices. As machines become more intelligent through embedded processing and sensor fusion it will improve not only industrial productivity, but quality of life as society ages. While embedded processors and MEMS-based sensors have become tiny, highly effective, and affordable, similar improvements in servomotors have evolved more slowly. At fractional-horsepower levels the power electronics contribute significantly to total motor-system bulk and complexity. Providing smaller and more efficient servo-electronics will enable OEMs to increase the competitiveness of their products. Robots will become more agile with additional degrees of freedom and less mass to accelerate.

Blue Wave Semiconductors, Inc.

Phase II Award No.: 0823126

Award Amount: $477,624.00
Start Date: 11/01/2008
End Date: 10/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: Bright and Tunable UV Light Emitter from ZnMgO Nanocrystalline System

This Small Business Innovation Research Phase (SBIR) II project proposes to develop innovative compositionally tuned nanomaterials based oxide phosphor bright UV light emitting devices that have tunable optical UV light emission. This innovation is based on optical processes emerged in nanomaterials by absorption and emission through band gap engineered meta-stable but high quantum efficiency nanocrystalline, highly directed wires and nanocrystalline epitaxial films. This effort will demonstrate the optimization of nanostructural optical materials with high UV light emission efficiencies and proto-type device integrated with UV lamps.

If successful the outcome of this effort will facilitate applications including invisible UV ink for security applications, medical devices, biological analysis tools, ultraviolet-based secure communications, space sensors, mineral identification, UV curing, UV fluorescent inspection, UV disinfection/sterilization of water, and UV measurement which have market potentials over $500M by 2010. The next generation of UV light sources will enhance UV applications by, 1) Providing additional energy savings, and thus a lower cost of ownership, 2) Enhancing optical spectroscopy, and 3) Enhancing national security applications.

BlueRISC Labs

Phase II Award No.: 0750040

Award Amount: $496,682.00
Start Date: 02/01/2008
End Date: 01/31/2010

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Sector: Devices & Instruments

SBIR Phase II: EO: Security Microchip for Mobile Devices

This project targets the development of a hardware-based security platform for protecting security-sensitive applications and data in mobile phones. The platform enables effective security for financial applications, secures mobile enterprise computing and facilitates using phones as electronic wallets and as payment devices, and protects private information and other sensitive data. The Phase II project will enable fully developing the security platform. The proposed end product components are: (i) An ultra-lowpower security microchip called Trust-GUARD-M (TGM) with protection against security attacks including a unique compilation-driven instruction set obfuscation technology, built-in cryptographic acceleration support, and built-in secure persistent storage, (ii) mobile security firmware supporting the Trusted Platform Module (TPM) specification from the Trusted Computing Group (TCG) industry consortium, and (iii) necessary development tools including security-focused compiler. The TPM standard services include support for advanced data protection, multifactor authentication, password management, identity protection, secure VPN access, secure email and digital signature. Although still in the first year of the project's Phase II effort, considerable progress has been made towards the final goals of this project.

This project builds on considerable prior related work, including several pending patents. This prior work includes, but is not limited too, grants from NSF (DMI-0348966, DMI-0450165) relating to a compilation infrastructure as well as an ultra-low power microarchitecture.

Brainstorm Technology LLC

Phase II Award No.: 0724338

Award Amount: $500,000.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: Visualization Toolkit for 3D Photography

Dr. Zokai and his team at Brainstorm Technology LLC in NYC are developing a comprehensive 3D photography toolkit for importing the geometry of existing large-scale urban structures into the computer. The goal of this NSF-funded SBIR project is to minimize the effort of building models of high geometric and photometric accuracy that are suitable for efficient rendering, manipulation, and analysis. This work is in response to a new surge of interest in constructing approximate lightweight 3D models that are suitable for transmission and rendering on web-based applications such as Google Earth and Microsoft Virtual Earth. The photo-centric modeling tool being developed can build approximate lightweight 3D models directly from a collection of photographs of the scene. Indeed, photographs are treated as tracing paper upon which 2D shapes are defined by the user prior to extruding them into 3D models. The very photographs that serve as the basis for the models automatically serve as the texture elements for them as well, thereby facilitating photorealistic visualization. The goal of this work is to easily facilitate the reconstruction and visualization of detailed models of urban sites, i.e. digital cities. Commercial applications include architecture, urban/military planning, real estate, video game development and entertainment. The software will be made available as plug-ins for Google SketchUp in early 2009. SketchUp was selected for our work because it permits us to tap into its large user community and leverage its push-pull interface for model creation. We will consider other platforms such as Rhino and AutoCad in future work.

The roots of this innovation are derived from work conducted by Drs. Zokai and Dr. Wolberg conducted under a NIST ATP award between 2003 and 2006. We expect to launch the software in the form of plugins for Google SketchUp in Q1 09.

Bridger Photonics

Phase II Award No.: 0848972

Award Amount: $500,000.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Sensors

STTR Phase II: Compact, Low-cost Remote Sensing of Methamphetamine Labs

This Small Business Technology Transfer (STTR) Phase II project addresses an urgent law enforcement need for a sensitive, portable, low-cost, laser remote sensor to detect illicit methamphetamine (meth) production labs from a distance. The research objectives are to: 1. Refine, optimize, and package laser subsystem, 2. Design, construct, and optimize receiver subsystem, 3. Integrate laser and receiver subsystems onto compact breadboard and test, 4. Design and construct first-revision prototype. To accomplish these objectives, the team and Montana State University will optimize the performance of the critical high-energy, narrowband, mid-infrared pulsed laser system that was developed under the Phase I effort.

The laser subsystem will be miniaturized and packaged for use in the sensor and for direct sales to bootstrap the sensor commercialization. The receiver subsystem will be designed, constructed, and optimized for performance, size, weight, and cost. The laser and receiver subsystems will be integrated and the unit will be field-tested. The first revision prototype will then be designed and constructed, incorporating identified improvements and modifications, and law enforcement customer input. Meth use in our country has reached epidemic levels. It is considered the most addictive illicit drug, can be easily produced with widely available and inexpensive ingredients, and is rapidly becoming more popular with young adults. Almost 1/5 of 2003 federal sentences were meth related and the state of Illinois estimates a $2B/yr meth-related burden. In 2005, 65% of Montana?s young adults reported that meth is ?very or somewhat easy? to obtain. Meth?s abundance is often attributed to the fact that it is alarmingly easy to produce in makeshift clandestine labs (in homes, apartments, motels, storage facilities, etc). These labs also pose lethal hazards to law enforcement, first responders, and children inhabitants. Washington State reported that children are or have been at 35% of the lab sites. Although 2005 legislation restricting the sale of a key meth ingredient reduced the number of labs, there is now resurgence. Moreover, the labs are becoming increasingly difficult for drug enforcement to uncover as the producers become more sophisticated and mobile. Drug enforcement personnel on local, national, and international levels require the ability to detect meth labs rapidly and in widely varying locations and circumstances. If successful law the outcome of the project will enable enforcement personnel to have a higher success rate in detecting these meth manufacturing laboratories.

Bridgewave Communications Inc.

Phase II Award No.: 0620136
Phase IIB Award No.: 0847400
Award Amount: $1,090,000.00
Start Date: 08/15/2006
End Date: 07/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: Micro-Coax Manufacturability Study

BridgeWave Communications of Santa Clara, CA has created coaxial wires much like those that carry cable television signals, but they are the size of a human hair. The team at BridgeWave, led by Principal Investigator Sean Cahill, has created these next generation interconnects for electronics and demonstrated their groundbreaking performance. While electronics' complexity and speed have doubled about every 18-24 months for the last 40 years (an observation known as Moore's Law, after one of the founders of Intel Corporation), the means to connect these chips had remained relatively stagnant since the 1960's. In the last 10 years interconnect performance has been a major bottleneck in the electronics industry, hindering the cost/performance reductions and hence the pervasiveness of higher speed digital and RF products. Micro-coaxial interconnects fabricated by the NSF-funded team were independently tested by Motorola Embedded Systems, and shown to have excellent performance from 0 to beyond 120 GHz, or more than 4x better than any other known interconnect technology. This new capability has implications for defense, space, imaging, RF, automotive, medical, simulation, electronic test, and consumer marketplaces. Subsequent to revealing the work at select technical conferences (along with support partner, US based Kulicke and Soffa, the largest semiconductor packaging technology, equipment and materials supplier in the world), BridgeWave has signed technology disclosure agreements with several leading companies working on high-speed applications and is currently working with several to develop specific solutions.

Micro-coaxial interconnects were first developed at BridgeWave to eliminate costly machined rectangular waveguide "plumbing" in millimeter-wave communication systems. Once the coaxes were demonstrated, researchers realized that the greatest utility for the micro-coaxes would be to apply them to various electronic packaging applications in the mainstream of electronics. Phase I and II NSF funding since 2006 has allowed the development and implementation of these next generation packages.

Cerberex Technologies, Inc.

Phase II Award No.: 0823009

Award Amount: $500,000.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Wireless Technologies

SBIR Phase II: MEMS for Secure RFID Applications

This SBIR Phase II research project will demonstrate a working alpha prototype of a MEMS-based approach to security for RFID and other electronic security applications. MEMS resonators have very narrow bandwidths and high frequencies which vary from resonator to resonator. This natural frequency variation can be used to uniquely identify a resonator, and makes cloning a specific signal extremely difficult in essence creating a voiceprint. This approach to RFID security overcomes the drawbacks of encryption which include more complex and expensive tags and the need to manage encryption keys. MEMS resonators for RFID tags are unique, secure, cost effective, CMOS compatible, and fast to read, with low power requirements and low overhead. This research project will demonstrate in a real environment with material temperature swings, working vacuum encapsulated MEMS chips with attached antennas, a low-cost prototype reader with maximum 10cm read range, and reader and system software to extract MEMS response signals to compare with stored signals for chip identification.

This project will have broad impact on the security of identification of both people and goods. For example, the RFID tags used in the implementation of US passports were recently cloned which calls into question the security of those documents. Since MEMS resonators cannot be cloned, they can provide significant security assurance to economically validate a given passport. MEMS resonators can also be used to economically authenticate pharmaceuticals since counterfeit drugs are increasingly prevalent (the World Health Organization projects a $75 billion counterfeit market in 2010) and have caused deaths.

Chatterspike, Inc.

Phase II Award No.: 0848718

Award Amount: $500,000.00
Start Date: 04/01/2009
End Date: 03/31/2011

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Sector: Enterprise Software Applications

SBIR Phase II: Software to Aggregate, Correlate, Analyze and Trend data for Knowledge Management in Decision Making

This Small Business Innovation Research (SBIR) Phase II project addresses the challenges for entities seeking to derive reliable and actionable information from enormous quantities of online "chatter" (online content from a variety of sources such as blogs, industry-focused sites, and media-generated material). Phase II will focus on technical objectives that will enhance the quality and reliability of the information produced by the ChatterSpike concept researched in Phase I. These objectives fall into three categories: data cleansing, context analysis, and basic commercial readiness. Their achievement will require the design, development and implementation of novel, niche-focused algorithms that will enable the mining and evaluation of thousands of online sources and the production of data with quantifiable quality metrics relating to authority, reliability, influence, and sentiment. The resulting product will algorithmically determine and quantitatively measure and evaluate these parameters in real time as it mines online sources for data, validating its conclusions and re-validating them every time it performs a retrieval operation.

By focusing on specific industry niches, the technology produced will enable the production of automated, highly tailored, detailed reports with a high degree of quantitatively-confirmed reliability. This capability will result from the creation of novel algorithms designed to exploit cutting-edge theoretical approaches to extracting, validating, and evaluating information from a multiplicity of online sources. These reports will be superior to the manual reports produced by currently available technologies and approaches. In addition, if successful, the technology will have significant societal benefit. Companies will be able to react more quickly to meet consumer demands and to correct negative trends in consumer opinions. The technology will also be able to detect trends reliably at a very early stage; in some cases weeks or months before they become obvious and are detected by other methods.

Chiral Photonics, Inc.

Phase II Award No.: 0849010

Award Amount: $500,000.00
Start Date: 01/01/2009
End Date: 12/31/2010

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Sector: MEMS & Electro-Optics

STTR Phase II: Chiral Long Period Grating Fiber Sensors

This Small Business Technology Transfer (STTR) Phase II project will develop a novel optical fiber sensor of temperature, pressure, extension, axial twist and various environmental factors, including liquid level, in harsh environments. The optical fiber sensor will be free of electromagnetic interference and of the hazard of igniting combustible fuels and will be capable of remotely monitoring temperatures up to and beyond 750 °C and of tolerating high-radiation levels. Conventional long period gratings fiber (LPGs) formed by exposing photosensitive doped optical fibers to patterned ultraviolet illumination cannot operate in harsh environments because of the fragility of the imprinted periodic structure. In contrast, the glass fiber in the dual-twist chiral fiber sensor (CFS) need not be photosensitive and will be chosen for its robustness. The chiral long-period grating (CLPG) structure of the CFS will be created in a glass-forming process in which signal and scaffolding optical fibers are twisted together to form a helix in the signal fiber as the fibers pass through a miniature oven. Transmission dips due to coupling of the light between the core and surrounding glass cladding by the chiral grating and their shift with environmental factors will be measured and calculated using an increasingly sophisticated sequence of perturbation theories.

The CFS based on the dual-twist CLPG structure overcomes the disadvantages of the LPG and of the CFS based on twisting single birefringent fibers. If successful it is ideally suited for demanding applications such as found in nuclear reactors, outer space, and oil wells, as well as in medical diagnostics and treatment and in the automotive and aerospace industries. The CFS may therefore become a pervasive part of modern technology and everyday life which relies increasingly on sensing and automated decision making. By substantially raising the operation temperature of optical fiber sensors, substantial savings can be realized. Conventional power generators could run at higher temperatures where they are substantially more efficient and the recovery rate in oil reservoirs can be increased considerably. The use of high-temperature and radiation-resistant CFSs in nuclear power plants can make these facilities more efficient and safe. The enhanced range of conditions in which the CFS can function relative to conventional electrical and optical sensors will have an impact across the economy and will make the CFS a rapidly growing segment of the multi-billion dollar sensor market. The novel glass forming fabrication methods and computational approaches may find use in diverse fields including photonics, microfluidics and medical diagnostics.

Clados Management LLC

Phase II Award No.: 0750543

Award Amount: $512,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Enterprise Software Applications

STTR Phase II: Integrating Online Analytical Processing (OLAP) and Ontologies to Discover Inconsistencies in Expectations for Supply and Demand

How does a person create economic value through trading with others? Whether one trades stocks, microprocessors, or factories, one creates economic value by buying things whose supply would exceed demand, and by selling things whose demand would exceed supply. To do this, one must often anticipate such an imbalance between supply and demand far ahead of time, so that one can spend time developing the capability to rectify it, for example by developing the skills to design microprocessors, or by building a factory to produce microprocessors. To anticipate imbalances in future supply and demand, one must ask how they are created, and in turn one must ask what creates future supply and demand. The answer: Today's expectations drive the investments that create supply and demand in the future, and inconsistent expectations drive investments that create future imbalances. Since these expectations are described qualitatively in business stories, such as news articles and industry research reports, businesspeople rely more heavily on crunching stories than on crunching numbers, despite ongoing advances in quantitative analysis. And businesspeople continue to struggle with story crunching, which involves pulling expectations about related products and services from separate stories and compiling them to compare related expectations and discover inconsistencies.

In this STTR Project, Clados Management LLC and Stanford University have advanced the state-of-the-art in OLAP and ontology engineering to build Story CruncherTM software, which provides a structured note-taking environment that may help businesspeople compile more comparisons of related expectations, discover more supply and demand imbalances, allocate resources more effectively, and improve economic growth.

The Story CruncherTM software system enforces a comparison process developed and tested by Clados' founder over years in professional investment management and reinforces it with comparison infrastructure built upon Semantic Web ontology languages recently recommended for standardization by the World-Wide Web Consortium. For these languages, Stanford University has a history of research leadership in authoring methods, and Clados Management's Chief Technology Officer has a history of research leadership in computational reasoning methods.

Compass Innovations Inc.

Phase II Award No.: 0724453

Award Amount: $500,000.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Advanced MicroDisplay Engine for Full Windshield Transparent Display

We are developing a miniature and high speed laser vector scanner module based on MEMS micro-mirror technology. The scanner module is a key component of a laser vector display device which can be used for automobile windshield display system, miniature laser projector for laser marking, laser show and other devices which require very high laser scan speed. Conventional vector scanner (such as galvanometer) are too bulky and slow to meet demanding need of laser vector display system. Upon success, we will build a prototype device which include a 4 laser diodes, 4 micro-mirror scanners and 4 deformable micro-mirrors; all components are arranged in a 2x2 array configuration and packaged in a 1"x1"x1" cubic. Such device provides 4 times performance of a conventional laser vector scanner and minimal power consumption during operation (less than a few watts and can be battery-operated).

This device uses a 2-axis micro-mirror scanner chip which is developed by Mirrorcle Technologies Inc.(www.mirrorcletech.com) at Berkely, California. Feasibility of the full-windshield display (FWD) system was demonstrated by the principle investigator at Superimaging Inc. (www.superimaging.com) at Fremont, California. The new single-element deformable micro-mirror and the concept of this 2x2 arrayed multi-device package were developed by the PI at Compass Innovations Inc.

Creative Logic Entertainment

Phase II Award No.: 0724452

Award Amount: $493,457.00
Start Date: 11/15/2007
End Date: 10/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: User Oriented Character Animation Framework for Producing Believable Motions

3D computer generated character animation is more popular than ever before in movies, on television, and on the internet. 3D animation has the ability to captivate and engage an audience like no other medium. Unfortunately, the tools and techniques used to create 3D animation are currently limited to the realm of highly skilled animators and developers. We all learn to express ourselves through writing and verbal communication starting in elementary school. Why not extend the ability for anyone to express themselves through the art of 3D computer animation? This is the problem that Creative Logic Entertainment (CLE) is working to solve. CLE is developing an on-line animation system that is accessed through a standard web browser and enables general web users to design an animation by instructing the characters what they should do and how they should perform the actions using a rich collection of motion behaviors. All of the complicated technical issues related to animation are taken care of by the CLE system that allows the user to focus on telling a compelling story. The CLE solution utilizes a unique motion generation technology that allows the style and emotional characteristics of movements to be easily reused and retargeted resulting in an almost endless possibility of motions. The CLE animation system will allow un-trained and underrepresented groups the ability to express themselves through the art of 3D computer generated character animation that is currently the realm of highly skilled animators only. This unique system will also enable animation to be used for applications where it was not previously feasible due to ease-of-use and budgetary constraints opening up new commercial opportunities in video advertising, training, education, and entertainment. Finally, the innovation will greatly enhance the learning of children in the K-12 age range making complex problems in science and math easier to visualize.

The kernel of the idea behind the technical innovation is related to (but not part of) research conducted by the principal investigator, Adam Divelbiss, during is PhD program at Rensselaer, where he developed a path planning algorithm for wheeled vehicles. The first opportunity to develop and practice the idea came via a Phase I grant from NSF (#0611090). It is now under full development as part of this NSF SBIR Phase II program.

Cross Cut Media

Phase II Award No.: 0847999

Award Amount: $500,000.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Enterprise Software Applications

SBIR Phase II: Applying Latent Group Models to Web Publishing

This Small Business Innovation Research (SBIR) Phase II project will extend the work begun in Phase I to apply advances in knowledge discovery to bridge the gap between what is known about an Internet viewer and what is done with this knowledge to improve user experience and business outcomes. The effort will develop new algorithms to combine implicit and explicit taxonomies to build content networks. A live feedback loop that uses multivariate test results will be used to adjust and refine clusters of users in order to establish specific parameters which can subsequently be acted on. Online content publishers aggregate enormous volumes of data about their viewers from web logs, registration systems, third-party web analytics providers and ad-serving systems. Mostly these systems operate independently with a primary focus on describing what has happened. Through a deeper analysis, which will be enabled by the current effort, content providers will be able to use this data in more predictive ways. This in turn will allow content providers a more intelligent tool for serving higher-value content throughout the online experience. If successful, this will have implication for new rich media services and e-commerce.

Cyber Materials Solutions

Phase II Award No.: 0724382

Award Amount: $516,187.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Sensors

STTR Phase II: Novel Deposition Rate Sensors for Real-Time Thickness Control of Plasma Spray

The Flux Sentinel, developed during this STTR, is an advanced plume sensor for plasma spray that is able to quickly and easily measure the particle states that correlate directly to critical coating properties. Because it is highly sensitive to the properties of the final product, the Sentinel is the best available tool for monitoring and adjusting the production process to assure consistency. The Sentinel can be used as a process monitoring tool, improving productivity and yield or as a process development tool, helping engineers achieve the highest possible efficiency from the process. Both uses are critical for plasma spray, a high temperature process in which powders are simultaneously sprayed and melted to create high-value coatings for modifying the surface properties of critical components such as gas turbine blades or industrial bearings. Though a number of plume sensors have been developed in the past several years, they are limited by their inability to distinguish individual particles or by their slow data acquisition speed. Preliminary experiments at Boston University showed that the average quantities reported by most sensors (temperature, velocity, intensity) are insufficient for characterizing the final coating parameters (thickness, structure). The ability to distinguish sub-distributions, such as molten particles, was shown to be critical for predicting final coating characteristics. This project was proposed to develop sensors that provide operators the tools they need to maintain coating consistency and enable process engineers to engineer coating structure.

Plasma spray coatings span a variety of applications in a number of industries. They increase component life, provide thermal barriers, increase wear resistance, and create sealing surfaces for jet engines, industrial gas turbines, machinery, and automobiles. Increasing the reliability of coatings increases the reliability of end products and can potentially improve cost, lifespan, and energy efficiency. The Flux Sentinel provides the insight into the process that makes control and reliability improvement possible.

Problems were defined and initial concepts generated based on work performed under CMMI-0300484 grant to Boston University [NSF GOALI: Engineering Coating Microstructure Through Advanced Plasma Spray Processing: Fuel Cell and Thermal Barrier Applications]. Experiments using commercially available sensors, both in-house as well as with industry, demonstrated that a new sensor concept was required. Cyber Materials and Boston University partnered to commercialize academic sensor and control concepts, receiving STTR support from the NSF [Ph I: 0539622, Ph II: 0548726]. Over the course of this award, we have developed the hardware specification and software algorithms and achieved correlation with deposited mass of 92%. We began alpha testing the sensor early this year and will begin beta tests in the next month, focusing on large equipment vendors and spray shops.

Cyclos Semiconductor

Phase II Award No.: 0724361

Award Amount: $500,000.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Ultra-Low Power Microcontroller Design

This Cyclos Semiconductor, Inc., NSF Small Business Innovation Research (SBIR) Award project investigates charge-recovery design technologies for the realization of digital electronic chips with substantially reduced energy dissipation. By exploring novel design methodologies in the critical area of ultra-low-energy semiconductors, this project advances our understanding of fundamental engineering practices and helps maintain the position of the nation as the global leader in innovative semiconductors. Moreover, by exposing professional designers to novel design methodologies, it helps cultivate a world-class engineering workforce. During the first 18 months of the project, work focused on the design, fabrication, and testing of the first-ever commercial microcontroller chip to incorporate charge-recovery technology. The design was taped out in the summer of 2007, and 100%-functional silicon dies were successfully demonstrated in the spring and summer of 2008. Based on actual measurements of the running silicon, the Cyclos-designed charge-recovery chip dissipates 25%-35% less energy than a conventional chip without charge recovery. Attendees of the 2008 Design Automation Conference (DAC 2008) were able to view a live demonstration of the running chip, and recognized Cyclos with a Best of DAC 2008 Trendsetter Award.

The potential impact of this project is enormous for both society and industry. The successful demonstration of charge-recovery design methodologies will benefit every sector of high technology, by ushering in a new class of semiconductor chips with unprecedented levels of energy efficiency. In addition to contributing to global conservation and sustainability efforts, this new class of chips will potentially enable novel semiconductor applications, ubiquitous computing paradigms, and multiprocessor computer architectures, while enhancing our scientific and engineering knowledge. Moreover, it will provide a renewed impetus and competitive advantage to the US semiconductor industry.

The charge-recovery technologies commercialized by Cyclos are related to basic research conducted at the University of Michigan by Prof. Papaefthymiou and his Ph.D. students under grants from ARO and DARPA. Feasibility was originally demonstrated on proof-of-concept prototypes designed at the university. Providing the first-ever demonstration of charge-recovery technologies on a commercial microcontroller, Cyclos makes a pioneering contribution towards the commercial deployment of charge-recovery design technologies for next-generation semiconductor devices that achieve unprecedented levels of energy efficiency. It also enjoys a significant first-mover's advantage in bringing charge-recovery technology to the marketplace.

DeWitt Brothers Tool Company, Inc.

Phase II Award No.: 0724428

Award Amount: $498,650.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: Three-Dimensional Microscopy of Surfaces by Grazing Incidence Diffraction

A novel method of range finding by was invented by the Principal Investigator. The range finder exhibits a magnification feature that is useful for 3D microscopy. Unlike the most commonly available range finder for 3D surface measurement, triangulation, the new method is also a powerful magnifier. A holographic optical element (HOE) is used as the range finder's primary objective. Remarkably, when a HOE replaces a lens as the primary objective of a microscope, the field-of-view does not shrink as magnification increases. Instead, there is a trade-off with efficiency, that is to say, light transmission decreases as magnification increases. In many practical applications, particularly in machine vision, a laser provides adequate illumination for high magnification. Magnifications of 50 times have been demonstrated and 100 times magnification is possible. However, when lasers are used as a source of illumination, speckle patterns arise. Since the magnification is only in the third dimension, the speckle pattern can be removed by moving the target a very small distance in either of the two planar dimensions which are not magnified. We are building a tabletop motion controlled 3D microscope that can be used for industrial inspection. The desktop unit being made under this NSF SBIR Phase II grant is manufactured by a spinneret inspection company, Aspex, Inc., which will offer a 3D version of their product line, Spintrak®. (Spinnerets are very small extrusion holes used in the manufacture polymer plastic fibers.) The microscope's HOE can be embossed in polycarbonate and offered as a consumable part that can be replaced inexpensively after contamination. By way of comparison, existing 3D microscopes have non-replaceable lens primary objectives, and they also lack a wide field-of-view. Our microscope can be used inside solder paste stations where circuit boards are assembled, replacing 2D cameras that lack the pattern recognition assurance of 3D. In medical applications such as endoscopy, the technology can be used for dentistry, exploratory diagnosis and surgery.

The P.I., Thomas Ditto, invented the diffraction range finding method in 1984 and received a basic method patent in 1987. Under a 1995 NSF SBIR grant, the method was improved to include a feature that overcomes perspective foreshortening, and the improvement was embodied in a 3D scanner made under Phase II of the grant. The 3D camera was named "Sensor and Instrumentation SBIR Technology of the Year" in 1997 by the Technology Utilization Foundation. Privately funded research followed and led to a further improvement of the camera that magnified in 3D in the near-field. The improvement is now embodied in a 3D inspection microscope being developed under the present SBIR Phase II grant. The P.I. has also developed a closely related telescope embodiment under a Fellowship at the NASA Institute for Advanced Concepts in 2006-07. Diffraction range finding alters an assumption of optical imaging by using a diffraction grating as the primary objective of an imaging system. Unlike reflection and refraction, diffraction is essentially an off-axis process, and as a result imaging systems enjoy leverage at angles of grazing incidence and exodus from the grating. This method has led to a new class of microscopes and telescopes.

Dot Metrics Technologies, Inc.

Phase II Award No.: 0848759

Award Amount: $491,578.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Ultraviolet Germicidal Optical Flow Cell

This Small Innovation Research (SBIR) project will bring to market a low power, point of use (PoU) water disinfection system designed to retrofit into existing passive (non-germicidal) filtration systems. This project will use ultraviolet light emitting diodes (UV LEDs) along with a novel and proprietary flow cell design, resulting in PoU water disinfection. Current ultraviolet PoU water disinfection is accomplished using discharge lamps, which requires high voltage, ballasts, and a relatively large form factor. The use of UV LEDs instead of discharge lamps will allow the light sources to reside inside a smaller form factor, and to function at lower overall electrical power, without line voltage and ballasts. Furthermore, the proprietary optical design of the flow cell will improve upon conventional flow cells by maximizing the ultraviolet dose received by microorganisms in the water, and increasing their residence time in the flow cell.

Currently, there are no PoU systems employing UV LEDs as the germicidal source. If successful, the product developed under the phase II program will be the first of its kind and provide a point of entry for UV LEDs into the large PoU water sterilization market. The low power aspect and small form factor of the flow cell will make the system potentially suitable for battery operated field applications where line voltage is not available. Such applications may include military or medical field operations. Overall societal impact should be significant, particularly in markets outside the United States where there is increasing concern about water sterility.

Emcien, Inc.

Phase II Award No.: 0620269
Phase IIB Award No.: 0804520
Award Amount: $1,044,665.00
Start Date: 08/01/2006
End Date: 07/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Reducing Lead Time and Inventory by Using Optimized Product Configurations

Provide a paragraph or two (about 300 words) that provides background on the project, results of the project, the scientific uniqueness; and the project's impact (societal or industrial). Write the Highlight for a "lay audience"; title and lead-in sentence should engage the reader. Does anyone, except maybe a few artists, buy anything but a #2 pencil? For all practical purposes, an inventory of pencils can be described by a single number: a count of the #2 pencils. How different it is for most other products! An inventory of toothpaste might require 20 numbers to track all of the different SKUs. An inventory of shoes might take thousands. Products like cars and computers go beyond SKUs, because customers can order vast numbers of unique configurations. If a customer wants a pencil, and you have 100 pencils, then you can sell him one and reduce your inventory to 99. If a customer wants a red car with a V6 engine, leather seats, a DVD player, fog lights, a satellite radio, and chrome wheels you may not have one, even though you have 500 cars on your lot. Then you have to find him something that is "close enough", or you have to custom build one just for him.

The purpose of Emcien's project is provide manufacturers of configurable products with a tool that allows them to design their inventory. That means what specific configurations of their product should they build, and in what proportions. The goal is to have what the customers will be looking for. The relevant metric is match rate: what proportion of the customers find exactly what they are looking for, or something that is close enough? Building such a tool means being able to detect the patterns in how customers order the product. These patterns are hiding in the sales history, and they can be found by looking at how collections of options are chosen together. There must also be some measurable meaning to "close enough". How close are two different cars? Would a customer who wants one of them accept the other? With what probability? If we can answer these questions, we can compute optimal sets of configurations, in the sense that they could capture the most demand. Emcien's product allows manufacturers to simulate future demand, and figure out what specific configurations would be most successful in capturing that demand. This can mean smaller inventories, faster moving inventories, and more profit.

This line of research grew out of a project that the PI worked on as a faculty member at the Georgia Institute of Technology. This project was initiated by an automotive OEM and was concerned with the proliferation of wiring harnesses for the electrical devices in cars. The mathematical structure of this problem served as a paradigm for many of the problems associated with configurable manufactured products.

Emcien, Inc.

Phase II Award No.: 0723832

Award Amount: $497,763.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: Parts Forecasting for Configurable Products

Manufacturers today use variations on traditional MRP (Materials Requirements Planning) systems. Given a completely specified order, the MRP system can produce a BOM (Bill of Materials) that lists all of the necessary parts. The bag of parts that are required depends on the whole set of options in the order. For example, if both option A and option B are included, then a special connector is needed. In order to be ready to respond to customer demand, the manufacturer must order parts ahead of time according to a forecast. If there was a forecast consisting of completely specified orders, then the MRP could turn it into a parts forecast. Unfortunately, until now, there has been no way of producing such a completely specified forecast. The common practice has been to construct a few representative "phantom" configurations, estimate how many of each will be needed, and use that. For example, one phantom might include all options that appear on at least 30% of the orders. The result is too many of some parts and too few of others. A surplus means waste and obsolescence, a shortage means production interruptions and/or expensive freight expediting. Emcien has developed a way to produce the completely specified forecast. This may consist of thousands of unique configurations, each with its own volume. Each unit in the forecast has the set of options that would be ordered by a customer. Producing such a forecast means finding the patterns in how customers are ordering the product, and the trends in those patterns. These patterns are hiding in the sales history. They can be found by looking at how combinations of options are chosen together. The result is more accurate parts forecasts, less waste, and more profit.

This line of research grew out of a project that the PI worked on as a faculty member at the Georgia Institute of Technology. This project was initiated by an automotive OEM and was concerned with the proliferation of wiring harnesses for the electrical devices in cars. The mathematical structure of this problem served as a paradigm for many of the problems associated with configurable manufactured products.

Energid Technologies

Phase II Award No.: 0848925

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Robotics & Assistive Technologies

SBIR Phase II: Real-Time Roboting Grasping System

This Small Business Innovation Research (SBIR) Phase II research project will create an information-based robotic grasping framework to enable practical grasping of objects for any robotic manipulator and any robotic hand, or even multiple hands. Grasp algorithms are stored in an XML database organized in a tree structure that allows rapid access and uses intelligent caching for very large databases. When a new object is presented to the grasping system, best matches are found in the database and the corresponding algorithms are extrapolated to determine the best grasp for the new object. Shape, surface properties, and articulation are used for matching. The techniques support the grasping of moving objects that can be tracked with a vision-based system. For constructing the grasp database, human supervisors train new grasps by simply picking up objects and giving special cues. Collection devices, such as data gloves and machine vision systems, are used to collect the supervisor?s hand position and contact forces, and a learning module finds new grasps by coupling supervisory input with simulation-based optimization, using high-fidelity dynamic modeling. For optimization, control and configuration parameters (in end-effector space) are perturbed iteratively using nonlinear numerical optimization techniques. If successful the creation of a comprehensive grasping framework as proposed in this project will have broad impact to research, industry, and society. Traditional grasping systems require specialized coding for new tasks and new robots. The proposed system will facilitate specific instantiations of general grasping algorithms. Application to virtually any robot manipulator, any hand, and any object to be grasped will be possible. This unprecedented flexibility, coupled with advanced and innovative grasping algorithms will play a role in advancing general purpose robots (those that can do multiple tasks without reprogramming). Robots with the ability to grasp hold promise for industries with labor shortages. The agricultural industry, for instance, will use robotic grasping for harvesting. Grasping robots will work in dangerous environments. An example application is rescuing injured humans in dangerous situations. Next-generation robots will assist the disabled with intelligent manipulators that can open doors and pick up objects. Grasping robots will support manufacturing and warehouse businesses. The simulation capability that is part of this research will allow new grasping strategies to be tested safely in a virtual environment before being implemented and fielded.

Fetch Technologies

Phase II Award No.: 0548699
Phase IIB Award No.: 0803126
Award Amount: $999,936.00
Start Date: 02/01/2006
End Date: 01/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Unsupervised Extraction of Relational Data from the Web

The AutoFeed technology developed by Fetch Technologies in this NSF-funded SBIR Project enables the data on web sites to be automatically extracted and labeled. The approach is designed to harvest any type of semistructured data – i.e., from any web site where content is generated from an underlying structured database and displayed in HTML. The AutoFeed system can automatically discover the underlying structured data and extract it. The extracted data can then be used to create a web feed that third-party applications can easily ingest (via XML or database tables. The technology in this project is fundamentally important for AI applications where a wide variety of heuristics must be combined to produce results. The technology has been embedded in the Fetch Agent Platform, and is being used to develop vertical search products for news aggregation, media monitoring, retail monitoring, and background search. Licensees currently include some of the world's largest news organizations.

The innovation extends basic research on web data extraction originally funded by NSF and other agencies in the lab of Dr. Minton while he was a faculty member at USC (NSF grant 9610014). The technology was refined by Fetch with funding from an SBIR contract (NSF Grant 9960536) and commercialized. After the success of this first commercialization effort, Fetch developed the unsupervised learning method funded by this SBIR and raised additional matching funds for a Phase IIB.

Hevva LLC

Phase II Award No.: 0822889

Award Amount: $500,000.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: SaaS-Based Procurement and CRM Systems for Local Food Markets

This SBIR Phase II project will develop a new methodology for data interchange in the agricultural industry. GreenLeaf Market is developing application program interfaces to enable the automated transfer of data to enterprise resource planning systems through a representational state transfer interface interchangeable with a webservice. This platform automatically identifies and aggregates agricultural market information while enabling this information to be integrated into the purchaser's business systems.

If successfully commercialized, the application stands to significantly reduce post-harvest spoilage costs, now in the tens of billions of dollars for the United States. It will increase productivity for purchasers, assist the producer in identifying emerging markets, reduce the distance agricultural products must travel, boost the local economy, improve the food security of the US, and lower the overall cost of food by reducing the gap between supply and demand.

HMicro, Inc.

Phase II Award No.: 0848913

Award Amount: $500,000.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Wireless Technologies

SBIR Phase II: Wireless Healthcare Disposables

This Small Business Innovation Research (SBIR) Phase II research project will further validate a groundbreaking wireless semiconductor platform that enables disposable, body-worn, physiological monitoring wireless sensors (wireless disposables) for a wide range of applications in healthcare and other industries. The company's chips are combined with today's body sensors such as electrocardiogram (ECG), Saturation of Peripheral Oxygen (SpO2), and blood pressure, to produce wireless disposables for continuous monitoring. For mass deployment, wireless disposables must displace today's wired sensors, therefore must have equally low cost, similar reliability, and days of operating life for a single use. Conventional radios are too unreliable, too power hungry and cause high interference to meet this challenge. The company is creating a single chip solution by combining radio with sensor functions providing a gain of 50X over conventional radio based solutions in terms of low power, low cost and wire-like reliability.

Eliminating the wires connecting a person's body to a patient monitor long held as impossible to replace could be possible with the proposed solution. Healthcare markets, the initial focus of the company (dominated by hospital use), represent more than a $2B market in disposables. The wireless disposables will have a broad global impact by contributing to cost effective, high quality care in hospitals and other care settings. In hospitals, wireless disposables can eliminate reusable monitoring wires, products which have been demonstrated to carry drug resistant pathogens in up to 75% of cases. Wireless disposables are also aligned with a future vision of highly automated institutions that support a more natural workflow. Outside the hospital, wireless disposables allow remote and mobile monitoring of people with chronic diseases, enabling early interventions, an important goal in maintaining health and lowering costs. Wireless disposables will help solve the global healthcare crisis, with US costs over $1.5 trillion and rising rapidly as 78 million baby boomers near retirement.

Imaginestics LLC

Phase II Award No.: 0620233
Phase IIB Award No.: 0843998
Award Amount: $1,029,987.00
Start Date: 08/01/2006
End Date: 07/31/2012

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Sector: Enterprise Software Applications

SBIR Phase II: Supply Chain Optimization and Product Explorer

The aim of the SCOPE (Supply Chain Optimization and Product Explorer) project was to solve the problem of searching for information that is non-textual based, such as 2D drawings, 3D models, images or even a free hand sketch (doodle), type of information which is prevalent in the industrial sector and key communication source for exchanging specifications between a buyer and a supplier. The project let to the development of VizSeek, a unique shape based search engine and of a revolutionary online industrial community called VizSpace, where manufacturers can showcase their products and capabilities through 3D models, 2D Drawing, images, documents, and connect with customers, suppliers, distributors and partners to form communities based on common interest. VizSeek search engine is then utilized to index the information in VizSpace and enable users to easily find products and services, locate communities of interest and connect with partners. Since shape is the lowest common denominator for any product, the ability to use shape as a search criteria is a key breakthrough achieved in this project since it can enable participants in VizSpace to transcend the barriers of language, context and user biases faced by text based search engines. The development of the VizSeek shape search engine and the VizSpace platform enables buyers and sellers worldwide to connect at a level that is visual and enables exchange of information that is more explicit in nature promoting the ability to make critical decisions early. The ontology based infrastructure of VizSpace enables the buyers to be presented with communities and suppliers that match the requirements of their products and for the supplier the platform presents them with opportunities to join communities where there is a need for their products and services based on numerous criterions, shape being one key component.

The innovation is related to basic research on 3D shape search conducted in the PRECISE lab of Prof. Karthik Ramani. The research was funded through the ToolingNet project funded by the Indiana Economic Development Corporations, 21st Century Fund.

Imaging Systems Technology Inc.

Phase II Award No.: 0750267

Award Amount: $512,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: Fabrication of Luminescent Phosphor Plasma-sphere Arrays for Display Applications

Under this NSF Phase II project IST is developing color Plasma-spheres for use in large area flexible plasma displays. Plasma-sphere are hollow gas encapsulating shells. When a voltage is applied across the shell the gas ionizes. Ultra-violet emission form the ionized gas excites phosphor of the Plasma-sphere and causes it to glow. Under this SBIR, IST has demonstrated ultra bright red, blue, and green Plasma-spheres sufficient for very bright large area flexible displays.

This work was begun with a NSF SBIR grant in 2001 in which IST demonstrated that monochrome orange plasma spheres could be fabricated for use in a display. Since that time IST has had several grants form Ohio, NIST and NSF to refine materials and develop the necessary manufacturing process to make large displays possible.

Innovative Micro Technology

Phase II Award No.: 0750536

Award Amount: $511,945.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Dual Substrate MEMS switch

The usual approach for fabricating MEMS devices is surface machining, wherein the various layers of the device are deposited and patterned over a single substrate. In the dual substrate MEMS RF switch, the vias for the signal and electrostatic actuation plate are fabricated on a lower substrate, and the movable member and electrostatic upper plate for the switch is fabricated on an upper substrate. The switch is formed when the upper substrate and the lower substrate are bonded together. The movable member then forms a conductive path that connects the vias when the switch is closed. This compact architecture has numerous manufacturing and performance advantages over surface machined devices.

This innovation began with the movable portion formed as a cantilever, however, this architecture quickly revealed some shortcomings, especially the tendency of the end of the cantilever to short to the electrostatic plate underneath it. For this reason, we switched the design to a plate attached to the upper substrate by a plurality of leaf springs, which approaches the opposite substrate in a planar, parallel manner. Further design improvements planned include a multiplexed, SP4T switch which can be flip chip bonded to a printed circuit board.

Innovative Technology, Inc.

Phase II Award No.: 0724502

Award Amount: $480,255.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Wireless Technologies

SBIR Phase II: Fabrication of Conformal Antennas for Airborne SatCom Using Kinetic Metallization

Direct write of electrically conductive coatings onto various polymeric surfaces are limited to using conductive ink-jet or laser ablative technologies. Both of these methods basically use conductive materials in a solvent and epoxy matrix that must be cured or fused to deposit the adherent conductive elements onto dielectric surfaces. Techniques for Direct Write of metallic powders are now possible with an innovative technology called Kinetic Metallization (KM). This project has demonstrated that copper powders can be deposited on dielectric materials comprising Ultem thermal plastics and composites of fused silica and Teflon using Kinetic Metallization. Direct Write of electronic configurations and elements can be implemented on complex shaped surfaces using robotic manipulation of the KM spray gun and nozzle. Results of the project to date have been focused on demonstrating deposition of conductive elements onto various types of polymeric surfaces for conformal antenna applications. Measurements of the RF performance during development have been evaluated using microstrip transmission lines. Although the electrical conductivity of KM consolidated metallic copper powder is reduced compared to oxygen free copper foils, the results are encouraging for lower frequency (C-Band) antenna systems. Recently, the prospects of depositing electrically conductive Electromagnetic Interference (EMI) shielding onto polymeric surfaces has generated new interest in the direct write capability of Kinetic Metallization. Additionally, one antenna manufacturer, now participating in the project, has a need to Direct Write brazing alloys onto complex electronic enclosure structures for RF antenna packaging.

Toyon Research Corp. initiated this project in 2004 when Inovati teamed with them on an Air Force SBIR Ph I proposal to evaluate the feasibility of using Kinetic Metallization for Direct Write of conformal antenna structures. This proposal was not funded by the Air Force, but subsequently was submitted to NSF for Phase I funding starting in 2006. The research work has progressed through NSF Ph II SBIR funding starting in Sept. 2007. Currently we are working with ATK Aerospace and Boeing Military to launch initial products resulting from commercialization of the technology.

InPhase Technologies

Phase II Award No.: 0750506

Award Amount: $500,000.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: MEMS & Electro-Optics

STTR Phase II: Hybrid Integrated Optoelectronic Systems

Optical technologies today including data storage (e.g. DVDs) and circuitry (e.g. planar lightwave chips used in telecommunications) have followed the lead of the electronics industry and are thus two dimensional. However, it is obvious to anyone who has used a laser pointer that light naturally addresses 3D space. Use of this third dimension would enable TB holographic storage disks and Tb/s processing chips. The barriers to these goals have been the lack of an optical analog of electronic materials (e.g. silicon) and the associated materials processing (e.g. semiconductor lithography). This project is overcoming these barriers through the development of volume photopolymers and the associated hardware 3D data storage and circuitry. One of the critical challenges in the design and development of materials for 3D optical patterning has been achieving the required performance across a wide range of requirements. Parameters such as high dynamic range or contrast, high photosensitivity, dimensional stability, high optical quality, environmental robustness, read-out durability, and manufacturability are required to generate a fully functional and reliable imaging material. We have developed a novel class of photopolymer recording materials that addresses the challenges. The recording medium is based on the two-chemistry concept in which the first chemistry, a thermosetting polymer, independently forms the mechanically stable matrix or host for the second chemistry. The second chemistry comprises the photo-reactive components that are able to store a complex light pattern. Through the use of this two-chemistry strategy, it is feasible to balance several counteracting key parameters.

These self-developing, thick materials are ideal for 3D optical circuitry, however traditional 2D lithography is inappropriate. We have designed and fabricated a new form of scanning 3D lithographic exposure system that incorporates two scanning, sectioning microscopes operating in a photo-insensitive laser wavelength. These microscopes detect and automatically compensate for the tolerances of internal hybrids such as fibers and detectors, allowing us to fabricate complex hybrid circuits without any active, manual alignment. This material and lithography platform is capable of seamlessly hybridizing electronic, micro-mechanical, opto-electronic and optic devices on a single chip to implement complex 3D systems in an environmentally robust package. In addition, we are developing holographic data storage systems that can store from hundreds of gigabytes to terabytes of information on disks of the optical polymer. The systems will be part of a family of archival storage systems with the first offering, the 300r, storing 300 Gbytes per 130-mm-diameter disk with 160 Mbits/sec data transfer rate. Later generations will have capacities up to 1.6 Tbytes per disk, with data rates to 960 Mbits/s.

The innovations in holographic storage are related to development work supported under two Advanced Technology Program grants from the Department of Commerce and grants from the National GeoSpatial Agency. The lithographic techniques were created at CU through the support of major optics and electronics firms including JDS Uniphase and Intel.

Integrated Sensing Systems Incorporated

Phase II Award No.: 0724340

Award Amount: $500,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Wafer-Scale, Hermetic Packaging of Intelligent MEMS-Based Systems

This NSF-funded SBIR project aims to develop a novel packaging method for hermetic hybrid integration of MEMS (Micro-Electro-Mechanical Systems) and electronics. 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 method being developed under this grant will greatly simplify the packaging of MEMS and their associated electronics, providing a low-cost, robust, and easily manufacturable packaging platform that can be used for a variety of micromachined devices.

The main customers for this packaging technology are companies in the MEMS field with sensors that require direct media access (pressure sensors, temperature sensors, chemical sensors, gas sensors, etc.). In order to achieve optimum performance for such sensors, the sensing element needs to be in direct contact with the environment, and the associated electronics need to be positioned very close to the sensing element. In most cases however, these electronics need to be shielded from the environment in order to avoid damage or contamination. Examples are sensors for medical applications where the sensing element is in contact with the media (blood, urine, etc.), or chemical sensors used in a variety of chemical detection applications (safety, defense, biohazards, etc.). In general, any sensing system with either monolithic or hybrid electronics, that requires exposure of the sensing element to the environment will benefit from this proposed packaging technology. At the end of this project, ISSYS will offer customers two packaging platforms, one for wired sensors and the other for wireless sensors, which will meet the need for a low-cost, robust, manufacturable packaging solution.

ISSYS' main technology for fabrication of micromachined pressure and flow sensors is based on the Dissolved Wafer Process (DWP), which was originally developed at University of Michigan. Packaging technology for hybrid and hermetic integration of electronics and MEMS has been developed at ISSYS. Initial development of this packaging technology was supported through NSF SBIR Phase I funding and continued through this Phase II project.

Integrated Sensor Technologies, Inc.

Phase II Award No.: 0724090

Award Amount: $499,988.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Sensors

SBIR Phase II: Structurally Integrated Organic Light Emitting Device-Based Sensors for Dissolved Oxygen in Water

This NSF Small Business Innovation Research (SBIR) Phase II grant is enabling the development of a compact, low cost, novel photoluminescence (PL)-based sensor at Integrated Sensor Technologies, Inc. (ISTI). The sensor will monitor dissolved oxygen (DO) in wastewater treatment facilities. It will also be suitable for environmental applications such as monitoring DO in lakes, rivers, and coastal waters, for fish farms, and for the food and beverage industry. Its novelty is based on its excitation source, which is an organic light-emitting device (OLED) pixel array, and on the detection mode, which monitors the PL decay time of an oxygen-sensitive dye. The OLED array can be easily fabricated and structurally integrated with the sensor film in a uniquely simple geometry, to generate a compact module whose thickness is determined by that of the substrates (glass or plastic) on which these components are fabricated. That is, the thickness of the module is ~1-2 mm. The OLED array is flexible in design and size; currently two 2 × 2 mm2 pixels, separated by a ~2 mm gap, are utilized as the excitation source. A ~2 mm thick Si photodiode, located behind the OLED array, collects the PL passing through the gap between the pixels. Thus, the whole sensor probe is very compact. In advancing towards the goal of fabricating a prototype, the sensor module, the software to determine and the needed electronic circuitry are designed and fabricated to achieve a compact, sensitive, reliable, accurate, and robust monitor. The sensor measures the DO level by monitoring the related PL decay time of an oxygen-sensitive dye following an OLED excitation pulse. Since this is an intrinsic quantity, calibration under various conditions is only required following fabrication of the sensor film. Since the measurement of is performed after the end of the OLED pulse, no filters, optical fibers, mirrors, lens, or couplers are required to separate the PL from the exciting OLED light.

The project has an industrial impact, as it will result in a needed, compact and reliable low-cost sensor. It will also serve as the basis for advancing the OLED-based sensor platform for a wide range of applications. Eventually, it may lead to disposable, miniaturized sensors for multiple agents. This advance in instrumentation will build the nation's applied research infrastructure and contribute to establishing it as leader in science and engineering.

The innovation is related to initial basic research that led to a US patent, performed in the labs of J. Shinar at Iowa State University (ISU) and R. Kopelman at the University of Michigan. Basic research on the OLED-based sensing platform for various analytes continued at ISU by Joseph Shinar and Ruth Shinar under grants from NSF (0345189 and 0428220) and NASA.

IQ Engines, Inc.

Phase II Award No.: 0822713

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Mobile Visual Search Engine

This Small Business Innovation Research Phase II project will develop a biologically-inspired image search and recognition technology to provide rapid object information retrieval from a mobile phone camera. The end result is that potentially any object in the real world is now "clickable": a picture of an object provides a hyperlink to the Internet. The proposed system utilizes a new method for sparse, multi-scale image representation based on the monogenic signal, a 2D generalization of the analytic signal that is robust to image transformations.

By 2010, it is estimated that there will be over 1 billion mobile phones with cameras.The mobile phone is becoming an important connection between people and the digital world. The applications for mobile search technology are enormous and include national homeland security, product information retrieval (such as environmental ratings, pricing, or specifications), vision support for the blind, accessing object information for the disabled, and general purpose information retrieval including remote visual data analysis and inspection. Search technology has brought about many profound societal, educational and scientific benefits in the past decade. The proposed mobile image search technology will extend those benefits to a broader base of users and applications.

ISCA Technologies, Inc.

Phase II Award No.: 0823095

Award Amount: $448,148.00
Start Date: 12/15/2008
End Date: 11/30/2010

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Sector: Sensors

SBIR Phase II: Autonomous Sensor Network to Manage West Nile Virus Epidemics

This Small Business Innovation Research Phase II proposal seeks to develop an automated sensory system (AMSS) for gathering and processing of mosquitoes vectors of West-Nile-Virus-Fever (WNV). AMSS captures mosquitoes, macerates them with solvents, process the fluid using a sensory array, relays wirelessly the information to a centralized internet hub where data is hosted, managed, reports created and distributed. There are four main parts to the proposed AMSS: 1) Design and development of the robotic device that sucks and crushes the insect; 2) Design and development of the sensor array; 3) Development of methods to determine presence of WNV in the circulatory fluids of the insects; 4) Automated wireless system for transmitting data. The AMSS can also be decoupled from the mosquito-trap providing the user with a handheld-sensing-system to detect WNV in samples derived from vectors (e.g. mosquitoes) or hosts (e.g. humans, vertebrates in general). The proposed system can be potentially expanded for detecting other harmful pathogens and could be used by homeland security and public health agencies.

If successful detection of the WNV-pathogen at a very early stage of its occurrence is of significant benefit to public health agencies and may allow for diversion of future epidemics. Early detection is the only form of early epidemic prevention. This project describes a disruptive concept to fill an enormous gap in vector-management, which now lacks technologies for speedy and effective data collection. WNV-detection-instruments are slow, expensive, bulky, require human interference and laboratory conditions with plenty of consumables and energy, and not amenable to unattended autonomous operation. Current detection procedures invariably fail to detect introduced pathogens before disease or epidemics become widespread. Vector-control personnel and epidemiologists rely on manual time consuming mosquito- vector management methods that often come too late to prevent epidemics and require expensive remedial actions, such as blanket spraying of insecticides on entire regions. Such mosquito management is inefficient, ecologically harmful and conducive to pesticide resistance. The proposed AMSS system will have significant impact in the detection of WNV-pathogens market, evaluated at $500M/yr. This will foster preventative rather than crisis or partially effective, remedial control actions. Implications can be made that this vector and disease management may be useful for bio-detection in the homeland-security, health-care, agroenvironmental field and food-safety markets, evaluated at $1.3B/yr.

ISCA Technologies, Inc.

Phase II Award No.: 0725388

Award Amount: $639,336.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Sensors

SBIR Phase II: Sensory System for Autonomous Area-Wide Disease and Agriterror Detection and Reporting

Autonomous robotic devices protect growers from devastating invasive citrus diseases Enable the facile detection in the lab or in the field of Huanglongbing (HLB), or greening, a devastating disease of citrus plants. We are researching and developing the baseline technologies to enable the creation of smart traps that capture, count and identify psyllids vector of citrus greening, and determines if they are carrying the pathogen HLB. The autonomous SMART Trap devices use robotics to manipulate the samples and biofunctionalized micro bead sensory arrays to detect HLB. The data are wirelessly uploaded to the Moritor System, in the internet, where statistical and reporting tools reside. This system, once successfully developed and deployed, will help growers to predict potential HLB outbreaks from several months to over a year earlier than currently possible and thus allow of more effective control measures to defend against this devastating disease.

Smart traps and Moritor system developed with SBIR funding from NSF (Award ID: 0132164) and ATP funding from NIST/Department of Commerce (ATP Cooperative Agreement Number:70NANB2H3065) • Lawrence Livermore National Laboratory (LLNL) Biofunctionalized micro bead sensory arrays

K&A Wireless, LLC

Phase II Award No.: 0724500

Award Amount: $499,991.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Sensors

SBIR Phase II: CLEAR-View - A Cost Effective Thermal Imaging Sensor

In many video-based imaging applications the camera is mounted to a platform that is moving, such as in aerial, maritime or vehicular imaging applications. This introduces motion into the video that a viewer finds undesirable and hence would like removed, or stabilized. This can be accomplished mechanically, though mechanical stabilization systems are often times large and cost prohibitive. Alternatives to mechanical stabilization are electronic image processing strategies and are thus termed electronic video stabilization algorithms. Such algorithms attempt to estimate the motion path of the camera by using information from the imaged scene that is subsequently used to compensate for motion in the video. Though some algorithms exist, many are computationally intense and cannot be performed at real-time rates on videos with large image sizes. We have developed an image stabilization algorithm that can operate at a fraction of the time of conventional electronic stabilizers, putting our algorithm well within the domain of video frame rates. Additionally, our stabilizer can be applied to perform fast object tracking within a video sequence. Object tracking is another traditionally complicated area of image processing. When an object of interest is selected in a scene, such as the crate highlighted in Fig. 1.a, our algorithm is able to perform image stabilization while simultaneously tracking the box as it moves across the ocean. In this case the box is moving independently of the camera motion in addition to changing its size as it floats away. As seen in Fig. 1.b, the box is still being well-tracked by our real-time algorithm after 10 seconds have passed.

This non uniformity correction algorithm was research originated in the labs of Prof. Majeed M. Hayat and J. Scott Tyo at the University of New Mexico. The work was supported by NSF funding (awards to both HAYAT and TYO) as well as AFOSR and Army Research Office grants. Prof. Tyo still works with K&A Wireless, though he has moved on to the University of Arizona. The stabilization research was funded as part of a Phase I SBIR grant #0724500 from the NSF in 2006, with Phase 1B and Phase II initiated in the fall of 2007.

Locomatix, LLC

Phase II Award No.: 0822777

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Scalable Location Data Management

This Small Business Innovation Research Phase II project aims to design, implement, and test scalable methods for providing location-based services, with a special emphasis on mobile cell phone applications. Examples of such applications include continuous monitoring of static and dynamic geo-fences, building dynamic mobile social networks, and mobile e-commerce. The Phase II effort will develop methods to push the efficiency of the location-based computation techniques, and develop methods for more sophisticated features such as privacy management and mobile power management, which will be crucial for the wider adoption of location-based applications. Location data is currently generated by continually moving physical objects equipped with location-based sensors, such as GPS and Wi-Fi based tags. Data management methods for these datasets require dealing with high update rates, large volumes of historical location data, and location-based triggers that raise an alert when the location of a moving object meets certain criteria (for example, if an object is beyond a well-defined boundary). Existing methods for supporting applications that have these requirements are not scalable.

The broader merits of this project include the development of a technology that has a potentially large commercial value and addresses an emerging market need. For example, for the cell phone market, these location-based services are projected to grow from $464M in 2007 to over $11B by 2011. If successful, the potential impact in both consumer and enterprise markets for location-based services could be substantial.

Los Gatos Research Inc.

Phase II Award No.: 0724434

Award Amount: $493,460.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Sensors

SBIR Phase II: Automated Structural Health Monitoring Sensor

For real-time load and damage monitoring, only a few techniques are considered sufficiently technically mature for use in aircraft structures, the most promising being electrical strain gauges and piezo-electric transducer (PZT)-based sensing. However, real-time stress measurements and crack detection using embedded sensors on commercial aircraft has experienced limited success in the last decade due to several unresolved issues.

- For large and complex structures such as airframes, bridges, and ships, the sensor array has to cover a very large physical space. With the increase of sensing points and structure size, the amount of cabling, weight, power requirement, and cost for system hardware increases dramatically. For aircraft, this weight penalty can be severe.

- The large amount of cabling also leads to the increase of installation and maintenance costs, reduction in reliability, deterioration in measurement resolution,due to electromagnetic interference and increases of self-weight.

These limitations reduce the opportunity for practical implementation of many aerospace structural health monitoring applications and have resulted in limited commercial success. To overcome these limitations, the embedded sensors need to be light-weight, low-cost, and capable of operating in real-time. More importantly, the sensor interrogation system should have the multiplexing capability to significantly reduce the amount of monitoring instrumentation, cabling, and power required for a large number of sensing points.

Los Gatos Research has developed light-weight, low-cost, real-time, automated structural health monitoring systems with multiplexing sensor interrogation capability which meet these requirements for crack/corrosion detection and stress measurements of aircraft structures. The instrument combines optical waveguide and fiber 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. During Phase II, LGR successfully developed an automated, field-tested multi-channel BG-based SHM instrument. In the last few months, a number of LGR's commercialization partners, including Physical Acoustics Corporation, have validated the multi-channel SHM instrument capability for stress, acoustic wave, and acoustic emission measurements with comparable performance with standard stress and acousto-ultrasonic instrumentation. The final design will be flight qualified during the Phase III program, through additional tests and demonstrations on-board a commercial aircraft.

The innovation of the laser-based Bragg grating interrogation technique is related to the research development at LGR under grants from NASA and NSF. The feasibility of acoustic emission detection was originally demonstrated using both waveguide and fiber Brag Grating sensors. A laser frequency locking technique was later developed to provide robust, real-time interrogation method. Recently, using high-sensitivity Bragg grating sensors, real-time, simultaneous measurements of stress and detection of acoustic emission with wireless data transmission capability were demonstrated, and the BG sensors and interrogation instrument were integrated into an automated multi-channel Structural Health Monitoring system for product launch in Q4 09.

ManningRF, LLC

Phase II Award No.: 0822972

Award Amount: $500,000.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Robotics & Assistive Technologies

SBIR Phase II: Electronic Orientation and Navigation System for People with Visual Impairments

This Small Business Innovation Research Phase II research project will design, build and test a new type of orientation and navigation (O&N) system for people with visual impairments. While GPS-based solutions show promise in outdoor environments, there are currently no widespread O&N devices that are designed for use in indoor environments. This makes it difficult for people with visual impairments to navigate through indoor public spaces. The purpose of this research will be to complete development of a new type of radio frequency identification (RFID) system, in which intelligent, variable-range active RFID beacons are programmed with information about their locations and placed through indoor environments like schools, shopping malls and museums. This information will be accessible to people with visual impairments via a small RFID receiver worn on the user?s belt. Information will be conveyed to the user via a text-to-speech interface. Results from field testing have demonstrated that the device helps people with visual impairments to navigate through an unfamiliar environment. Phase II research will complete development of the communications protocols and interface techniques that give the system its unique capabilities for delivering speech-based information to people with visual impairments.

There are 10.4 million people with visual impairments in the U.S., and this research will lead to an inexpensive commercial product that will greatly enhance their ability to navigate in unfamiliar surroundings. The market for this technology includes those who will purchase the RFID receivers and the RFID beacons. This includes people with visual impairments, as well as the owners and tenants of public spaces, such as office buildings, schools, malls, museums and government facilities. Also, because of the simplicity of the interface, the system will be useful to Orientation and Mobility educators working with young children to develop spatial concepts.

Mersive Technologies, LLC

Phase II Award No.: 0750202

Award Amount: $499,999.00
Start Date: 03/01/2008
End Date: 10/31/2009

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Sector: Devices & Instruments

SBIR Phase II: The Media Fusion Project: A Distributed Architecture for Mega-Pixel Displays

There are over 11 trillion pixels (the smallest dot on a digital display) being created each year. Most indivduals are surrounded by these pixels as they work, sit in an airport, or even watch television at home. Despite this, way we interact with our computers and computational environments have changed very little in the past three decades. Microprocessors, communications technology, and information storage have all undergone amazing changes, yet the displays we used to visualize our data have remained stagnant. We are developing a software operating system that will revolutionize the way in which we use displays and, ultimately, will have impact on how we work, play, and interact.

We are building a software operating system that will tie pixels together into a seamless landscape that can be shared, managed, and reconfigured. This software-based approach to displays will allow us to be free of the decades-long standardization cycle that keeps displays small, fixed in form, and unchanging. For example, by simply placing three flat-panel HDTV monitors next to on another, users can access a display that is now three-times the resolution of a standard HDTV. The operating system will allow this virtual devices to be created and modified dynamically without regard to a set of video standards.
As part of the project, we will release a set of Application Programming Interfaces (APIs) that allow software applcatons to particpate in the pixel landscape without having to manage the complexity of the underlying array of displays. We expect that this software will be the key that unlocks the display infrastructure that surrounds us everyday.

MHI Consulting LLC

Phase II Award No.: 0822830

Award Amount: $499,989.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Wireless Technologies

SBIR Phase II: VLSI Clocking Using BDS Technology

This SBIR Phase II research project intends to demonstrate a unique circuit method for GHz clock distribution inside CMOS chips, which provides state-of-the-art performance and is modular, scalable, and reusable. The theoretical foundation of this technology is the Bi-Directional Signaling (BDS) principle implemented over on-chip transmission lines. The project covers the design, fabrication, and evaluation of a comprehensive test chip aimed at validating key aspects of this new method such as the practical accuracy of a long distribution system, the realization of inexpensive high-quality integrated transmission lines, and the design of low power high precision active circuits for local clock generation. If laboratory tests confirm the expected performance and features, this method will be the basis of a valuable new VLSI Very Large Scale Integration (VLSI) technology.

The demonstration of scalable and reusable circuit Intellectual Property (IP) for clock distribution will cause a major simplification in the VLSI design methodology with substantial benefits to the manufacturers of integrated circuits. The semiconductor industry will be able to produce faster processing, lower power, and lower cost VLSI components for systems such as computers and communication devices.

Micro Magnetics Inc.

Phase II Award No.: 0750584

Award Amount: $498,295.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Program Director: Muralidharan S. Nair

Sector: Sensors

SBIR Phase II: Picotesla Magnetic Sensor Using MgO-Based Magnetic Tunnel Junction Technology

This project focuses on the development of a compact, easy-to-use, two-axis magnetic sensing module based on the use of MgO-based magnetic tunnel junction (MTJ) sensor devices. The sensor module will be capable of detecting very tiny magnetic fields created by metal objects (vehicles, weapons, etc.) or by electrical currents (such as those found in operating circuitry or power lines). The sensor module will have a very accurate response and will be capable of measuring magnetic fields one million times smaller than the Earth's field. The sensor module will be about the size of a deck of cards, and will run on battery power; therefore, it will be easily integrated into a number of emerging market niches. The field sensitivity of the sensor module will be more than a factor of ten larger than any commercially-available thin film sensor, giving it a dominant technical edge for high-performance applications. The key to the sensor's performance is the cutting-edge technology of the magnetic tunnel junction, a device which has been the subject of intense study over the past several years. These devices have several important technical advantages over competing methods. Micro Magnetics is a recognized leader in the development of these devices and is one of a very few companies worldwide to have commercialized sensors based on this new paradigm. The successful realization of a scalable process for creating a relatively low-cost sensor with such a high level of sensitivity will have numerous benefits for various commercial, military, and medical applications. Magnetic sensors are found in many appliances, tools, and in all of today's automobiles. High-performance sensors, like the one we are developing, are used by the military to detect enemy vehicles and soldiers on the battlefield, and they are also being used by doctors to measure the tiny magnetic fields created by the human heart and brain.

Micro Magnetics' core technology of magnetic tunnel junction sensors had its origins in original research conducted in the Nanoscale Physics and Devices group at Brown University. The company was spun out of Brown, and obtained seed funding in 2002 to begin development of sensor devices based on this evolving technology of spin-dependent tunneling. Three NSF Phase I SBIR awards assisted us in the initial development of these sensor devices. Based on this support, we launched our two primary product families in 2005 (the SpinTJ sensor family and the Circuit Scan family of semiconductor diagnostic tools, also based on our microsensor devices). In 2005, the company demonstrated a six-fold improvement in sensor response based on the use of a magnesium oxide (MgO) tunnel barrier. The current project has the goal of developing a full sensing module based on our magnetic sensor components already on the market. The new module will represent a "plug and play" solution for ultra-high sensitivity magnetic field measurements in two or three dimensions. In addition to other benefits, the technical work involved in creating this module will dramatically improve the linearity and orthogonality of our magnetic field measurements.

Micron Optics Inc.

Phase II Award No.: 0724231

Award Amount: $499,939.00
Start Date: 11/15/2007
End Date: 10/31/2009

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Sector: Devices & Instruments

SBIR Phase II: Spatially-Resolved Swept-Laser Spectroscopic System for Gold Nanoparticle Sensing

MOI is developing a high-speed, high-resolution bio-medical imaging modality based on optical coherence tomography (OCT) and gold nanoparticle bio-sensors. This technology offers 100 times better resolution than ultrasound technique, and the combined advantages of high resolution, speed, and target specificity should enable in-vivo diagnostics of diseased and cancerous tissue for various pre-clinical and clinical applications.

Industrial Impact: A key medical imaging technology to perform effective early cancer diagnosis and pharmaceutical research
Societal Impact: A new non-invasive diagnostic capability to improve healthcare, and to aid research in enhancing understanding of cellular biology

The first (in vitro) OCT images were presented in 1991 by a group of researchers from Dr. James Fujimoto's laboratory at the Massachusetts Institute of Technology. The first in vivo tomogram (of the human optic disk) was published in 1993 by Dr. A. F. Fercher's group at the University of Vienna.

Mytek, LLC

Phase II Award No.: 0823022

Award Amount: $485,794.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Extended Performance Red VCSELs

This Small Business Innovation Research (SBIR) Phase II project will demonstrate significantly improved output power, temperature range of operation, and reliability of red VCSELs. Commercialization of red VCSEL technology has been plagued by the limited temperature range and output power of the devices and unknown reliability characteristics. The Phase I project demonstrated the 1) feasibility of improving output power and temperature range through a number of techniques, 2) that the fundamental limit of the temperature range is at least as high as 125°C, and 3) dramatically improved reliability. The Phase II approach proposed here breaks away from traditional models for fabricating VCSELs and consists of a variety of growth and fabrication methods allowing us to provide a high thermal conductivity path from the active region to the package. The goals and expected technical results are to demonstrate > 0.5mW single mode, and >1mW multi-mode useful output power at 670nm at 85°C, and the same power output power objectives for 655nm at 65°C on a reproducible basis. This project will also demonstrate greater than 10,000 hours device lifetime at 85°C continuous operation. Project activities consist of design, wafer growth and fabrication, performance testing, and reliability testing.

To date, the only commercially available VCSELs have been at 780nm to 850nm, due to the substantial materials challenges at other wavelengths. This proposed effort is applicable to a variety of VCSEL wavelengths (similar thermal issues exist at 1310nm to 1550nm), as well as other optoelectronic devices. Commercially, a significant enhancement in red VCSEL performance can enable the migration of plastic fiber based home and auto networks to higher data rates, faster and higher quality laser printing, longer distance and more precise motion control sensing, new types of portable or wearable medical sensing, and improved robustness and cost of radiography equipment. The success of this project not only creates a significant business opportunity for a red VCSEL supplier, but also enhances the competitiveness of customers by making available a valuable new technology. The reduction in power consumption and improvement in medical technology costs address particularly important societal issues.

NanoLambda, Inc.

Phase II Award No.: 0823023

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: MEMS & Electro-Optics

STTR Phase II: High Resolution Spectrometer-on-a-Chip Based on Nano-Optic Plasmonic Device

This Small Business Technology Transfer (STTR) Phase II project is to develop an ultra-compact, high-resolution and low-cost spectrometer-on-a-chip, based on plasmonic nanowire arrays. In response to the growing demands for miniaturized non-invasive spectroscopic sensor, there have been many efforts to miniaturize optical spectrometers using various conventional technologies. However they are not yet conducive to both dramatic miniaturization and also high spectral performance at low production cost. Unlike the bulky and expensive conventional diffractive optical devices, the proposed nano-optic device utilizes the wavelength-dependent plasmonic phenomena occurring on metal nanowire surfaces and the gaps between the metal nanowires. This single layered nano-optic filter array is expected to enable a high resolution spectrometer-on-a-chip, overcoming the limits of diffractive optics. This proposal is to design, and fabricate the nano-optic filter array structure using standard wafer processes, to integrate it with a custom designed CMOS detector array to form a spectrometer-on-a-chip. The anticipated outcome of this project are spectrometer-on-a-chip samples for customer test and evaluation, and demonstration of high spectral resolution (10nm) over 380nm ~780nm wavelength range in a compact size, less than 5 mm x 5 mm x 2 mm, at significantly lower cost.

If successful the proposed ultra-compact high-resolution low-cost spectrometer-on-a-chip can be used in various applications such as high-resolution color sensing, multiple gas detection, and mobile/wearable health monitoring. Consumer electronics manufacturers, portable medical device vendors, and wireless sensor node suppliers can be all potential customers. As a key component to these markets, it is anticipated that the total addressable market for the proposed spectrometer-on-a-chip will be over $1 billion in around 2012. Considering the manufacturability of the proposed technology and the readiness of the markets, it is feasible to launch the first commercial product in 2010. The proposed activities will contribute to enhancing color quality and color consistency across consumer color devices, and has potential to contribute to advancing personalized point-of-care, environmental monitoring, and homeland security by enabling non-invasive, high-throughput, low-cost sensing. The proposed activities will provide further solid understanding of the phenomena occurring when a light interacts with nanostructured metal, and enhance the mass production capabilities of nano-structures. Successful completion of this project will also open up new application opportunities in the convergence areas of information, bio and nanotechnologies.

Network Foundation Technologies

Phase II Award No.: 0750136

Award Amount: $512,000.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Implementation, Testing and Refinement of a Hybrid Distributed / Traditional System for Broadcasting Live and Pre-Recorded Content to Large Online Audiences

Network Foundation Technologies (NFT) has developed and is refining a distributed online broadcasting technology that dramatically decreases the cost of delivering television-like live and long form content over the Internet to large audiences. The technology underlying NFT's NiFTy TV product has been used to broadcast sports content for many leagues and organizations including the Central Hockey League, the Arena 2 Football League, World Pro Handball, the Chicago Bandits Fast Pitch team, USA Judo, USA Weightlifting, and numerous other entities. The aim of the company is to "bring television to the Internet" beginning with sports content and branching out into faith, music and entertainment, and public and political affairs. Instead of simply replicating online what is already available via terrestrial, satellite, and cable broadcasting, NFT is committed to dramatically expanding end-consumer content choices by broadcasting online content that either attracts a worldwide audience that is too dispersed to be effectively reached with traditional broadcast approaches, or does not draw an audience of sufficient size to warrant the infrastructure costs associated with existing approaches.

The major innovations that underlie Network Foundation Technologies' NiFTy TV product were developed by Dr. Mike O'Neal in the winter and spring of 2001 while on a sabbatical from Louisiana Tech University. The core technology was patented in the summer of 2001. Development and testing have been ongoing since that time, accelerating significantly in 2007 with the company's first round of substantial funding and the award of SBIR funding from the National Science Foundation. As of December 2008, NiFTy TV technology has been used to deliver approximately 1 million viewing sessions for Central Hockey League and Arena 2 Football League games.

New Jersey Microsystems

Phase II Award No.: 0646422
Phase IIB Award No.: 0932036 (pending)
Award Amount: $521,998.00
Start Date: 03/15/2007
End Date: 02/28/2009

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Sector: Wireless Technologies

SBIR Phase II: RFID Tags for Cardiopulmonary Monitoring in Clinical Setting

This project develops micropower sensor tags for biomedical application. These sensor tags operate within an RFID star-type network operating in the 902-815 MHz ISM wireless frequency band. Monitoring heart sounds is the focus of this sensor application which uses a proprietary acoustic sensor and operates with an international standard communications protocol. The project has demonstrated feasible sensor nodes for a biomedical body sensor network. The basic RFID technology is funded for product launch and with extended applications beyond biomedical by our strategic funding partner.

New Jersey Microsystems is a high tech manufacturing firm located in the Business Development Center at the New Jersey Institute of Technology. NJM has evolved from a research-oriented firm to manufacturing of electronic sensor systems for domestic and worldwide use. The present micropower products at New Jersey Microsystems, Inc have evolved from research work at the New Jersey Institute of Technology begun by Prof. William Carr and his graduate students in the Electrical/Computer Engineering Dept and the Physics Dept. This early work resulted in over a dozen US patents owned by the University. The foundation research began by Prof. Carr as the NJ Chair Professor of Microelectronics is now continuing on a commercial basis at NJM. In 2007 Prof. Carr retired from the payroll at NJIT to become Professor Emeritus but has continued on a voluntary basis to supervise and secure funding for several doctoral students.

Our company has been on the forefront of micropower sensor network development for several years beginning with a prior SBIR award from the US Army at Picatinny Arsenal in 2001 to develop a micropower temperature sensor tag for monitoring various munitions. The Army work has evolved to the present SBIR work now funded in the biomedical application area from the National Science Foundation.

Nitek Incorporated

Phase II Award No.: 0848994

Award Amount: $499,305.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: MEMS & Electro-Optics

SBIR Phase II: High Power, Vertically Conducting UV LEDs

This Small Business Innovation Research (SBIR) Phase II project will result in the commercialization of high power, large area, deep UV LEDs based on a novel vertically conducting geometry that is arbitrarily scalable. AlInGaN based deep UV-B LEDs (ë = 300 - 340 nm) have recently been developed and commercialized but have not reached the performance metrics of shorter wavelength UV-C LEDs, or longer wavelength visible LEDs. These devices have been able to penetrate some niche markets but because the output power is far below that which is required for penetration of the largest UV-B market segments (e.g. biomedical instrumentation and industrial curing) they have been limited in their reach. Visible LEDs faced a similar challenge 5-10 years ago and it was recognized that to compete with existing technology, high power large area LEDs were required. This approach has been limited for deep UV LEDs because the insulating UV transparent substrates combined with relatively large resistance AlGaN materials result in current crowding and non-uniform device bias when geometry is scaled up. To address this challenge, the company is developing vertically conducting large area LEDs with expected minimum output powers of 10 mW per 1 mm x 1 mm device. Deep UV light emitting diodes represent a new opportunity for commercialization of semiconductor products for component and systems use. U.S. based manufacturers have succeeded in competing globally in the visible LED market with two of the five largest LED manufacturers being based in the U.S. with two in Japan and one in Germany. This optoelectronic field continues to grow each year and if the outcome of this effort is successful its outcome will contribute to the advancement of a novel light source. The creation of this company will capitalize on the high-tech research that is being performed at the University Of South Carolina by providing an environment in which to transition this knowledge into a commercial setting as part of efforts to transition the local economy from traditional industries such as textile manufacturing.

Novashield, Inc.

Phase II Award No.: 0750299

Award Amount: $500,000.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Enterprise Software Applications

SBIR Phase II: SAFE: Behavior-based Malware Detection and Prevention

The goal of this project was to develop a next-generation, behavior-based, anti-malware software that is capable of detecting and stopping new and unknown malware that traditional signature-based anti-malware software cannot detect. . The innovation behind our approach is the behavior engine that is based on breakthrough SAFE (Secure Activity Filtering Engine) technology developed during phase I. Unlike traditional anti-malware products that use old and reactive signature-based technology, SAFE is unique as it proactively and constantly monitors all running programs to detect potential malicious activities involving sensitive events such as file, registry and network events. Because our behavior detection engine does not use signatures, our approach can detect new and unknown threats which traditional anti-malware solutions cannot. Therefore, the technological advantage of proactive monitoring makes it much more effective than signature-based products in detecting and remediating newer and more sophisticated types of malware such as Trojans, key-loggers, rootkits, bots and worms. Malware is becoming more prevalent and sophisticated than before with hundreds or even thousands of new malware and malware variants being released every month by hackers. Furthermore, the new malware and their variants evolved rapidly because the motivation of malware writers has evolved from being fame-oriented to profit-oriented. According to studies conducted by many agencies, including the FBI, IT security problems caused by malware has cost the economy billions of dollars annually.

NovaShield believes its patent-pending behavior-based technology will provide better protection and significantly reduce the costs incurred by consumers, businesses and government agencies by protecting them against new generation of malware. The company is ahead of its product commercialization goals. NovaShield Anti-malware was released commercially on Nov 1, 2008 and more than 7,000 trial copies have been downloaded.

The innovation is related to basic research in the lab of Prof Somesh Jha at University of Wisconsin-Madison under a grant from DARPA. The feasibility of behavior-based detection was originally demonstrated by Hao Wang in 2006, then a PhD student under Dr. Jha.

PAIR Technologies, LLC

Phase II Award No.: 0848096

Award Amount: $499,844.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

STTR Phase II: Planar Array Infrared (PA-IR): A Compact Rugged Double Beam Infrared Spectrometer for Laboratory and Field Analysis

This Small Innovation Technology Transfer (STTR) project will demonstrate the utility of infrared planar array technology to study water pollutants such as industrial contaminants and biological impurities. It proposes to optimize the design and construction of a compact, high-sensitivity, double beam infrared instrument based on focal plane array detection, which meets or exceeds performance standards of commercially available Fourier transform infrared spectroscopy (FT-IR) solutions and is able to operate in ambient environments to provide measurements of dilute concentrations of organic and biological contaminants.

If successful the outcome of this project will enable real time effluent detection from a manufacturing site such as that found at chemical companies who could realize tangible and intangible savings from being able to pro-actively identify and measure the presence of pollutants. A portable Planar Array Infrared (PA-IR) spectrograph could be used to measure contaminants in rivers, streams and ponds, thereby providing 'real time' feedback on changes in the environment. The World Laboratory Analytical Instrument Market is estimated to be $9.36B in 2008. IR spectroscopy is estimated to be $738MM.

Pattern Insight, Inc.

Phase II Award No.: 0822888

Award Amount: $500,000.00
Start Date: 01/01/2009
End Date: 12/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Efficient static analysis tools for detecting bugs and improving developer productivity

This SBIR Phase II project develops software products to improve software quality and developer productivity. Computers are used everywhere in our lives with most applications requiring high reliability, availability, and security. Despite efforts to improve quality, bugs are still too common and costly. To address these problems the team has conducted research in static-analysis and bug detection - taking a pattern-based approach - applying data-mining to software code analysis. The Phase II effort will focus on integration of the tools into the software development lifecycle providing customers an optimal way to benefit from the tools. The team will also develop needed functionality (Branch Quality Management, Patch-Mining) and code search - all new, unique, broader and important usages of technology identified by customers from Phase I.

The tools, once commercialized, can benefit a large percentage of IT departments in different business segments (IT, finance, government, entertainment, insurance, etc) to improve their software quality and productivity and reduce the software development cost via automatic bug detection. In contrast to traditional manual effort that usually takes a programmer 1-2 weeks to detect a bug, the proposed tools can easily identify hundreds of bugs in millions lines of code automatically in 1-2 hours. Once a bug is detected (either from these tools, or any other tools, the tools can be used to ensure that the bug-fix is applied throughout the code. In addition to detecting software bugs, the proposed tools can also be used to detect illegal software plagiarism from open source or other software.

Phoenix Science & Technology

Phase II Award No.: 0645824
Phase IIB Award No.: 0925895 (pending)
Award Amount: $480,185.00
Start Date: 03/01/2007
End Date: 02/28/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: Development of a New High Intensity Pulsed Light Source System

This project is developing a new high intensity pulsed lamp for stripping paint and treating drinking water and contaminated water. Specifically, the research is on the erosion properties of electrode materials under high-current pulsed operation. Materials used for pulsed power electrodes were originally formulated for continuous or alternating current at low peak current. This research has lead to new combinations of additives and processing procedures for tungsten composite materials that reduce electrode erosion at high peak current. The lifetime of previous lamps was limited by contamination from conventional electrode materials. Use of the improved material has lead to an order of magnitude increase in lamp life.

The innovation is related to previous research to develop a high intensity UV lamp under an Advanced Technology Program from NIST. The capabilities of the new lamp were developed in the ATP grant, but electrode erosion problems limited lamp life.

Photodigm, Inc.

Phase II Award No.: 0848649

Award Amount: $499,957.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: MEMS & Electro-Optics

STTR Phase II: High Performance Single Frequency Lasers

This Small Business Technology Transfer Program (STTR) Phase II project will enable a new generation of single-frequency semiconductor lasers to enable applications in displays, precision instruments and defense. Under the Phase I project the team developed industry-leading first generation lasers up to 200 mW. The initial customer feedback from a variety of applications has converged around the need for higher power under CW operating conditions and spectral stability under arbitrary modulation. Further feedback points to the need to address these requirements in a cost effective manner to ensure a competitive solution. The proposal outlines an innovative combination of materials engineering and monolithic device features to address these issues. The team proposes to fabricate and deliver for customer evaluation single frequency lasers operating (1) >500 mW under CW conditions or (2) meeting specified levels of spectral stability at pulse widths below 100 nsec with various duty cycles.

If successful this STTR Phase II project will enable a new generation of low cost single-frequency semiconductor lasers to enable applications in displays, precision instruments and defense. This work has a strong educational component with students in device and fabrication classes at SMU been exposed to and benefit from the proposed research. The devices, software and concepts developed on this STTR will educate students and visitors to the SMU photonics website, impact the world economy with laser instrumentation for medical and scientific applications, provide laser displays, and have a humanitarian contribution since these lasers are used in magnetometers to find mines and improvised explosive devices in war torn regions of the world.

ProSpect Photonics, Inc.

Phase II Award No.: 0848997

Award Amount: $487,850.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Ultra-Compact, Low-Cost, and Robust Volume Holographic Spectrometers

This Small Business Innovation Research (SBIR) Phase II project focuses on the commercialization of a new class of ultra-compact, low-cost, robust, and alignment insensitive spectrometer for diffuse source spectroscopy with lower cost and considerably better overall performance compared to conventional slit-based spectrometers.

Intellectual merits: The spectrometers available in the current market are based on core technologies invented around one hundred years ago. The main problems of the traditional spectrometers are being bulky, sensitive to input alignment, relatively expensive, and low optical throughput, because narrow slits, lenses, high quality thin gratings, and the detector array are required in the system. As the portability, cost, and sensitivity are top concerns in recent biological and environmental sensing applications, a new class of spectrometers that satisfy those needs is in high demand. The proposed research is to commercialize an ultra-compact, low-cost, robust, and alignment insensitive spectrometer, which is composed of only a volume hologram and a detector array. The operation frequency range and the spectral bandwidth of the proposed spectrometers cover the requirements of most practical applications. The spectrometers can also be used to form special-purpose functional spectrometers with any desired spectral transfer function.

If successful the proposed spectrometer will have a broad range of applications in the fields of biochemistry, medicine, pharmaceuticals, industrial quality assurance, homeland security, mineralogy, and environmental purposes. Specifically, in the applications where the light source has a diffuse nature (e.g., fluorescence spectroscopy) the developed spectrometer will show the best sensitivity among all the existing technologies. The ultra-compact lightweight nature of the proposed spectrometers makes them a perfect choice for handheld sensing devices that are of high current demand in several fields mentioned above. The entire US market volume that can be covered by this technology has been $2.6B in 2005, with a prospected 7% growth rate through 2010. The use of volume holograms (which are typically recorded in low-cost materials like photopolymers) to replace multiple bulky optics (e.g., slit, collimating lens, and Fourier transforming lens in the case of spectrometer) is an important enabling technology that can impact several applications (e.g., imaging and sensing) beyond the proposed functionalities.

RadiaBeam Technologies, LLC

Phase II Award No.: 0724505

Award Amount: $500,000.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Devices & Instruments

SBIR Phase II: A Novel Imaging Device for Infrared and Terahertz Radiation Beams Utilizing Thermochromic Liquid Crystal Materials

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.

Raindrop Geomagic Inc.

Phase II Award No.: 0521838
Phase IIB Award No.: 0730401
Award Amount: $1,025,444.00
Start Date: 07/15/2005
End Date: 06/30/2009

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Sector: Enterprise Software Applications

SBIR Phase II: Applications of Morse Theory in Reverse Engineering

NSF-funded researchers at Geomagic, Inc. (Research Triangle Park, NC) have developed a Digital Shape Reconstruction system that converts digital scans of physical objects into precise design models that reflect the original design intent of the object. This process automatically recovers structural properties of the models that are needed for design, engineering, inspection, and custom manufacturing. The technology complements Computer-Aided Design (CAD) software as an essential part of the digital design and manufacturing life cycle. By connecting the point domain of measurement with the shape domain of design, this technology aligns the physical and digital worlds, ensuring design models accurately represent as-built products. Closing this loop is often overlooked in traditional product design lifecycles at significant cost, where changes made during manufacturing create differences between the as-designed model and the physical product.

Dr. Michael Facello and his team have successfully developed this technology through the application of advanced mathematical theories and algorithms, as well as a strong cooperation with industry leaders in the turbomachinery market (Pratt & Whitney, GE, and Siemens) and in the digital dentistry market (KaVo Dental, 3M, and Great Lakes Orthodontics), among others, greatly increased the commercial applicability of this technology. Social benefits include the enhancement of working environments through the conversion of manual processes into digital. All-digital manufacturing processes will reduce manual labor costs, since the same person can deliver higher throughput at a much lower per-unit cost. The proposed technology enables U.S. companies to produce highly complex products and components faster, better and with greater profitability, thus strengthening their competitiveness in the global economy and keeping more jobs at home.

This research is related to basic research performed by Dr. Herbert Edelsbrunner at Duke University and Dr. Tamas Varady at the Hungarian Academy of Sciences. The current Phase IIB project is the merger of two Phase II projects performed in conjunction with Duke University and the Colorado School of Mines.

Rehabtek LLC

Phase II Award No.: 0750515

Award Amount: $485,564.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Devices & Instruments

STTR Phase II: Low-Cost Portable Telerehabilitation System for Intelligent Stretching and Remote Assessment of Hypertonic Arm Joints

A portable tele-rehabilitation system has been designed for remote treatment and evaluation of elbow impairments in patients with neurological disorders. A master device and a slave device are used to drive a mannequin arm and the patient's arm, respectively. The elbow flexion angle and torque are measured at both the master and slave devices, and sent to each other for teleoperation. The tele-rehabilitation system stretches the spastic/contractured joints under accurate control at a remote location and provides patients with remote access to expert healthcare services. To evaluate spasticity/contracture of the patient's elbow remotely, the clinician asks the patient to relax the elbow, moves the mannequin arm at a selected velocity, and haptically feels the resistance from the patient's elbow. In other tasks, the patient moves his/her elbow voluntarily and the clinician observes the corresponding mannequin arm movement and determines the active range of motion (ROM). The clinician can also remotely resist the patient's movement and evaluate the muscle strength. To minimize the effect of network latency, two different teleoperation schemes are used depending on the speed of the tasks. For slow movement tasks, real-time teleoperations are performed using control architectures that considers causality of the tasks, with performance similar to that during an in-person examination. For tasks involving fast movements, a teach-and-replay teleoperation scheme is used which provides the examiner with transparent and stable haptic feeling. Overall, the teleassessment system allows the clinician to remotely evaluate the impaired elbow of stroke survivors, including assessment of the passive ROM, active ROM, muscle strength, velocity-dependent spasticity, and catch angle.

The STTR effort is related to research and development in the lab of Prof. Li-Qun Zhang at the Rehabilitation Institute of Chicago and Northwestern University under relevant grants from NIDRR and NIH, as well as the STTR Phase I support from NSF. Dr. Park's PhD thesis at Korean Advanced Institute of Science and Technology was on telerehabilitation system with various relevant control algorithms investigated. The feasibility of the intelligent stretching device was originally demonstrated using the ankle and elbow stretching devices. A related "intelligent stretching" technology was developed by Zhang et al. and has received US and international patent. The tele-rehabilitation part in the project has been developed as an extension of the portable stretching, including a related effort in developing a rehabilitation engineering research center on telerehabilitation.

RES Group, Inc.

Phase II Award No.: 0822975

Award Amount: $496,357.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Enterprise Software Applications

SBIR Phase II: OpenBio Workbench for Sharing of Mathematical Models in Drug Discovery

This Small Business Innovation Research Phase II project will develop an innovative software platform called OpenBio Workbench that will enable researchers in drug discovery to easily access and share mathematical models and model results. Modeling is becoming increasing important, motivated by the FDA's drive to modernize the drug discovery process and the advent of emerging fields such as Systems Biology. A broad adoption of modeling has been limited, however, because the current practice requires programming and computational skills not typically possessed by experimental researchers in biological sciences. In the Phase II project, the tool's capabilities will be augmented by allowing users to calibrate models by including experimental data, adding innovative advanced modeling tools such as model building.

The potential commercial value of this workbench is high as the pharmaceutical industry is investing significantly in mathematical modeling and Systems Biology aiming to overcome both the high costs of drug development and the stagnation in the discovery of new drugs since the 1990's. Further, aging populations in developed countries are going to cause sharp increases in health care costs, while at the same time there are serious budgetary pressures (both from government and private insurers) to keep health care costs under control. Thus, methods that speed up the research cycle and reduce development costs for new drugs and treatments are going to become increasingly important.

Resonant Sensors Incorporated

Phase II Award No.: 0724407

Award Amount: $500,000.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Sector: MEMS & Electro-Optics

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

Resonant Sensors Incorporated (RSI) has developed a new class of high-throughput biosensor systems for pharmaceutical and biotech research customers. Our patented products are based on label-free optical guided-mode resonance sensor technology. RSI products include next-generation micro-array sensor plates and spectroscopic reader systems that quantify biochemical reactions in real time with outstanding accuracy and repeatability. This differentiating technology provides new assay tools that will dramatically reduce the time and cost of pharmaceutical and medical product development. Currently, RSI has completed the design, assembly and testing of a commercial-grade biosensor system and associated disposable sensor plates. This detection system is fully automated through a software program (developed by RSI) that provides data acquisition and analysis capabilities. The user can measure both binding kinetics and quantify concentration for a wide variety of biochemical interactions, including protein-protein, protein-drug, DNA and microbials. Results can typically be obtained in less than 15 minutes (limited only by the binding dynamics of the antibody-antigen interactions). RSI has received funding for this work from NSF Small Business Innovative Research grant numbers 0539519 (Phase I) and 0724407 (Phase II).

The advantages of the guided-mode resonance concept for sensing applications reside in its inherent physical characteristics, including the ability to monitor biochemical reactions in real-time, polarization diversity, materials independence, choice of spectral regions, and ultra-high density capable system configurations. These physical properties enable this sensor technology to provide high sensitivity, high accuracy, and simultaneous multi-species detection including monitoring of chemical background variations. 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 with high impact on society, including medical diagnostics, proteomics, genomics, environmental monitoring, and homeland security. Since little or no chemical processing is required for detection readout, application of this technology for homeland security and environmental monitoring may provide new portable tools for detection of biotoxins, explosives, and hazardous materials. Future applications of this sensor concept appear plentiful and promising with significant economic impact and societal value.

RSI sensor technology is based on many years of basic and applied research in the Department of Electrical Engineering at UT Arlington by Professor Robert Magnusson and his graduate students.

Robotic Technologies of Tennessee

Phase II Award No.: 0849008

Award Amount: $499,994.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Robotics & Assistive Technologies

STTR Phase II: Development of a Remote Climbing Robot for Automating Welding Processes in the Shipbuilding Industry

This Small Business Technology Transfer (STTR) Phase II research project will advance a Mobile Robotic Welding System (MRWS) to significantly improve automated ship fabrication techniques in the United States. Providing automation to the American shipbuilding industry poses significant challenges. Traditional robotic systems are inadequate in industries such as shipbuilding characterized by size and scale because of their inherent inability to adhere and maneuver across uneven and even inverted environments while maintaining a weld. The team addresses these problems by merging recent climbing robot technology developed for remote inspection tasks in the electric power industry with automated welding equipment. This project will advance this technology, moving it from the laboratory to the field and address the technical challenges posed by real-world conditions. This will include vehicle and manipulator interaction in a dynamic environment, sensor systems capable of handling variable conditions, and robust navigation and control algorithms with self preserving and correcting behaviors.

This proposed effort focuses on technology innovation to significantly advance automation of manufacturing, inspection and maintenance processes through an autonomous, mobile climbing robot. If successful the outcome of this project will additionally advance the state of knowledge in performing robotic tasks remotely in unstructured environments. The general need for such capability in robotics is immense. Shipbuilding is an extremely labor-intensive, $15 billion dollar industry in the US, and its success depends on improvements in productivity. Over $40 trillion will be spent worldwide in infrastructure spending between 2005 and 2030. The US will spend $6.52 trillion overall and $1.53 trillion in energy/power segment with includes pipelines, storage facilities and alternative energy.

Sand 9, Inc.

Phase II Award No.: 0848716

Award Amount: $498,500.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Wireless Technologies

SBIR Phase II: Nanomechanical Resonator Technology for Passive and Active Devices in Wireless Applications

This Small Business Innovation Research (SBIR) Phase II research project seeks to develop novel radio-frequency components for wireless communication using an innovative nanomechanical resonator technology platform. The team has developed the world's highest-frequency mechanical resonator and will use this device to create RF filters for wireless communications in the 100 MHz to 3 GHz range. Building on the simulation results and optimal device designs the team will fabricate, test and characterize nanomechanical filters for use in wireless communication devices. There is a significant problem that designers of cellular handsets and other wireless devices are facing when adding additional air interfaces such as WiFi, WiMax, Bluetooth and Global Position Service (GPS) into their products. Each additional air interface requires a new set of RF filters and as the number of air interfaces multiplies the number of conventional filters required increases dramatically.

The goals of the Phase-II project are to (i) develop nanomechanical filters in the 100 MHz - 3 GHz range; (ii) test and characterize the device for optimal performance parameters; (iii) transfer the manufacturing process to a commercial foundry for wafer-level fabrication; (iv) package the devices using wafer-level packaging in an external foundry. If successful this technology will allow the replacement of existing discreet filters in cell phones and other mobile wireless devices with the ability to access many different air interfaces with excellent radio performance. This innovative technology will impact many industries that operate on wireless technology. Also the product will be used in cell phones thus having world wide impact.

SC Solutions Inc.

Phase II Award No.: 0450482
Phase IIB Award No.: 0729964
Award Amount: $930,000.00
Start Date: 06/01/2005
End Date: 05/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: An Integrated Software Tool for Modeling and Model-Based Control of Semiconductor Manufacturing Equipment

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.

Scattering Solutions, LLC

Phase II Award No.: 0848572

Award Amount: $500,000.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Sector: Sensors

SBIR Phase II: Process Control Sensor for Fine Particles

This Small Business Innovation Research (SBIR) Phase II research project proposes to develop Dynamic Light Scattering (DLS) instruments capable of measuring fine particles in suspensions beyond the limits of current technology. By simultaneous or independent use of three innovative techniques, larger detection aperture, smaller field size, and optical, homodyne amplification, the team can now measure hydrodynamic radius over greater ranges of particle size and concentration than was formerly possible. Two key ideas for this effort are: 1) the construction of a numerical model of the complex phenomenology of DLS with eight free and independent parameters; 2) the ability to apply this new understanding to the quantitative analysis of existing instruments, and to optimize new system designs for extended applications. These ideas have been confirmed empirically, correctly defining operational boundaries, formerly less well understood and quantified. A key advantage is the ability to design DLS systems with superior ranges of performance, versatility, accuracy, and cost, noting especially that deeper understanding improves performance and reduces error limits of reported data.

Newly capable and economical instruments are made available for characterizing suspended colloidal particles, from sub-nanometer to micron radii and from almost opaque to almost completely transparent. Extended capabilities include process control of high concentration colloidal materials, common in manufacturing from paint to chemical machining slurries, from foodstuff to pharmaceuticals. At the opposite end of the spectrum of difficultly lie suspensions scattering very little light, such as proteinaceous drugs, fuel cell catalysts, and many other materials of great interest to in-vivo non-invasive measurement of small sample volumes. Aside from a ready market in both real time monitoring and offline analysis for quality control in existing industrial processes, the extended capabilities offer attractive research opportunities into the properties of nanomaterials, a burgeoning field of interest and importance. Such instruments and their enhanced capability will increase materials research opportunities and be economical enough to use in a teaching environment, significantly augmenting the many and complex technologies already used for the assessment of these important materials. In contrast with more invasive measurements that may require dilution or evaporation for sample preparation irrevocably altering what is to be measured, extended DLS techniques complement and may be applied to undisturbed samples as small as a picoliter.

Scientific Media

Phase II Award No.: 0848600

Award Amount: $500,000.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Sector: Enterprise Software Applications

SBIR Phase II: The Scientific Media Concise Message Routing System

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and build a method and system for integrating sophisticated advertising capabilities into the Scientific Media Concise Message Routing System. The technology allows anyone with an internet domain name (individuals, small businesses, large corporations, or other organizations) to quickly, easily, and cheaply distribute information via a variety of mobile media, with particular emphasis on text messaging, or SMS. The technology comprises hardware and software that route text-message requests and responses between "subscribers" who access information and "content publishers" who distribute information. This project seeks to create the system and methods needed to append highly-targeted advertisements to the content requested from publishers by subscribers. Scientific Media believes that the system establishes the framework of an important new method of distributing information via SMS that can be applied in a variety of settings, including consumer, education, and research settings.

Semprius, Inc.

Phase II Award No.: 0822770

Award Amount: $475,557.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: Single Crystal Silicon Flexible Display Backplane

This Small Business Innovation Research (SBIR) Phase II project focuses on fabrication of flexible display backplanes using transfer printed electronics. The display industry has been successful at fabricating amorphous silicon (a-Si) thin film transistor (TFT) backplanes on rigid glass. However, a-Si TFT manufacturing does not easily translate to flexible substrates due to handling issues and the high temperature process of a-Si deposition. In transfer printing, a novel elastomeric stamp is used to pick-up specially designed circuits from the parent wafer and transfers the circuits to the desired target substrate. The parent wafer is fabricated using a standard silicon IC foundry and the single crystal silicon transistors have much better performance than the a-Si counterparts. The SBIR Phase I project demonstrated chip transfer printing process yields of 99.9% and chip placement accuracies better than +/- 5 ìm. Phase II objectives include design, fabrication and characterization of flexible backplane prototypes and further optimization of transfer printing by increasing throughput and demonstrating rework methods. The anticipated result is a manufacturing approach to flexible electronics that is cost competitive, low temperature and well suited to handle flexible substrates.

The competitive advantage of the proposed approach is the fact that all the demanding fabrication process steps necessary to fabricate high performance electronic systems are performed on the 'mother' substrate and not on the final plastic substrate. If successful the inherent mechanical or chemical instabilities of the receiving plastic substrate do not limit the choice of semiconductor manufacturing processes for fabricating devices. The ability to manufacture flexible display backplanes to the demanding standards of the display industry will open up a broad market of opportunity in flexible electronics far beyond displays, including configurable X-ray sensors, RFID tags, and wearable electronics and biosensors. In displays, backplanes using the proposed technology will be utilized by all major display manufacturers and many specialty manufacturers.

Sensor Electronic Technology, Inc.

Phase II Award No.: 0620525
Phase IIB Award No.: 0852619 (pending)
Award Amount: $589,704.00
Start Date: 09/01/2006
End Date: 08/31/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: High Power Deep UV LED-Based Lamps

Sensor Electronic Technology. Inc. (SET, Inc.) won the SPIE /Laurin Publishing 2008 year Prism Award for its new Deep UV Light Sources in the wavelength range from 240 nm to 365 nm.

Major technical and scientific achievements completed in course of Phase II NSF grant OII-0620525:

i. Design the layout of large geometry LED chips and LED arrays to minimize access resistance, increase output power and maximize heat extraction. Generate photolithographic LED masks to fabricate these devices

ii. Demonstration of large area LED chips (up to 1 mm2 active area) and electrical and electroluminescence characterization of the devices

iii. Development of novel UV-compatible submounts capable of bonding multiple small area LEDs that are mounted in an array format:

iv. Comparison of electrical properties of large area LEDs to equivalent junction area small geometry LED arrays

v. Design alternative LED header configurations for reduced thermal resistivity of the packaged lamps

vi. Evaluation of alternative submount materials (SiC, and polycrystalline diamond with our proprietary UV-compatible coatings) for increased thermal conductivity

vii. Evaluation of quartz and sapphire optical components for lamp-like beam profile production in the deep UV spectral range from 265 nm to 365 nm .

SFC Fluidics, LLC

Phase II Award No.: 0848253

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Sector: Sensors

SBIR Phase II: Shape Variations in the Development of Miniature Micropumps

This Small Business Innovation Research (SBIR) Phase II research project focuses on the development of a product line of miniature pumping systems for the controlled delivery of fluids in ultra-low flow rate range (nanoliters to microliters per minute). This line of micropump systems will provide pulse-free flow and controlled micro-volume dispensing in this challenging low volume regime. The non-mechanical nature and operating principles of this pump afford an unusual degree of freedom in pump design. The ability to tailor the shape and size of the micropump to specific applications can be very valuable, particularly in small devices where the available space is significantly constrained (for example, point-of-care devices, portable chemical and biological analysis systems, and micro-dosing devices). There is a growing diversity of chemical and biological analyses that are taking place within small chips, as well as in the rising demand for ultra-small dosing systems. Such analyses are continuing to shrink in size and measurements that have conventionally been performed in a laboratory and are now being adapted to handheld devices. These micro-analysis systems can provide immediate results without waiting for laboratory analyses. For example, the analysis of blood samples is being adapted to small devices, so important results are available at the point-of-care. Likewise, the desire is growing for small, portable dosing systems for animal studies and for human medications (like insulin and chronic pain management). All of these applications require micropumps for the controlled delivery of compounds. Fundamental engineering constraints mean that conventional mechanical pumps cannot be simply decreased in size to meet this challenge. These miniature non-mechanical pumps require very little power, can be controlled to deliver at constant flow rate or specific dispensing volumes, and offer the pulse-less flow that is not accessible by other pumps. This provides a significant market opportunity in the liquid pumping market (roughly $160 million presently), into the animal dosing (valued at approximately $90 million per year) and human drug delivery (valued at $80 billion presently) markets.

SpectralSight Inc.

Phase II Award No.: 0724494

Award Amount: $499,421.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: Development of a Tunable Filter for Mini Hyperspectral Imager

Phase II will prototype a MEMS-based tunable filter module that is the heart of our ultimate product, a miniature hyperspectral imaging camera about ten cubic centimeters in volume. Because of its size, form, and cost factors, our Gen I product will be easily integrated into small hand-held modules, headgear, eyewear, and be capable of multi-spectral imaging from visible and near IR, which will enable immediate applications across a variety of markets as well as become a foundation for exploration of previously unimagined applications:

• Alert our modern warfighter and emergency first responders by seeing beyond our vision and identifying terrorists threats. Appropriate actions could result in the saving of human lives and billions of dollars;

• Safeguard our nation's water and food supplies by utilizing affordable hyperspectral systems to identify bacterial contaminations before they are consumed;

• Improve the diagnosis and treatment of human disease by adding a novel affordable dimension to our medical professional's sight and

• Put hyperspectral imaging in the hands of our Nation's students and researchers. Hyperspectral imaging continues to grow, exploring and assembling spectral signatures into comprehensive libraries upon which future emerging applications will be built. Ultimately making it as common as today's digital photography, because of its inherently low cost.

Progress continues to be made towards achieving a first order, tunable filter of large aperture and small size for use in the visible to near infrared wavelengths. After initial failure to add silver mirrors and electrodes to the previously produced large area, 12 mm membranes, we have completed alternative materials experiments and are currently on a path to produce working tunable filters by mid-year. The electronics module has undergone one redesign to reduce noise and is currently being tested for thermal effects. A final lens design has been completed and prototypes will now be ordered. In a new development SpectralSight has been working with ITC on a MEMS multispectral Fixed Filter Array to be used with micro-lenses to capture sixteen (16) images at the same time each at a different wavelength. This would provide spectral images at a very high speed. SpectralSight has an exclusive license for this technology as well.

The Fabry-Perot filter was discovered by Charles Fabry and Alfred Perot at the University of Marseille in 1897. Many versions have been built using thick ultra flat mirrors as both fixed and tunable filters. Small (1-2 mm dia.) MEMS tunable filters have been made for selecting communication wavelengths such as those around 1.55 um. Early work by Jerman and Mallinson resulted in a small area tunable filter made with bulk micromachining or MEMS techniques. Subsequent work at Delft University of Technology, Delft, The Netherlands has provided additional examples of microspectrometers fabricated using MEMS technology. More recently the effort to fabricate a large area (12-40 mm) Fabry-Perot tunable filter by NASA Goddard in collaboration with several universities, while not totally successful, has been very instructive.

Stethographics, Inc.

Phase II Award No.: 0724449

Award Amount: $500,000.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Sector: MEMS & Electro-Optics

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

Premature babies in neonatal intensive care units (NICU) require monitoring for signs of lung congestion and heart murmurs. Currently, NICU medical personnel use acoustic stethoscopes. The use of an acoustic stethoscope has a number of highly undesirable side effects. Contact with a stethoscope often frightens the neonate. It can lead to withdrawal response, flinching, apnea, hypoxemia, and change in sleep state. It also increases the possibility of contamination. The ability to share auscultatory findings among medical personnel is also a problem because of observer variability. In addition, auscultation is not done simultaneously and findings may change over short time intervals. As an acoustic stethoscope is not ideal in the NICU settings for the reasons mentioned above, we have set on a course of developing a non-contact optical stethoscope. A non-contact optical stethoscope could greatly improve the quality of care of neonates. The optical stethoscope will be also available for general auscultation of heart and lung sounds in children and adults, where it could make a difference by eliminating the rubbing artifacts, finger noise, and cross-contamination problems. We also believe that a noncontact stethoscope will be clinically useful in monitoring burn victims.

Stethographics has developed noninvasive automated lung and heart sound analysis technology and related products based on 3 granted U.S. patents, two FDA approvals, and numerous grants from NIH, NSF, and DOD. This device is a natural extension of our efforts toward development of effective noninvasive auscultation tools.

Swamp Optics, LLC

Phase II Award No.: 0724370

Award Amount: $469,584.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: Compressing and Measuring Ultrashort Laser Pulses in Imaging and Spectroscopy

Working with the shortest events ever created is very difficult! This is the problem for the rapidly growing communities of researchers and technologists that use exciting new ultrashort laser pulses for bio-imaging, micro-machining, surgery, telecommunications, the study of very fast event, and many other applications. In essentially all such applications the shorter the pulse the better—but all 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), potentially solve this problem, but they are difficult to work with and have a tendency to introduce other distortions, making them difficult to commercialize. Consequently, we are developing 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. Another problem is the need to measure the pulses, which is very difficult. To further complicate the task, all such pulses are focused to very very small spots, where, unfortunately, available pulse-measurement devices cannot measure pulses. Thus, another device we are developing for this project will, for the first time, conveniently yield the complete measurement of an ultrashort laser pulse at the focus of a lens or microscope, where its measurement is most needed. This device will also measure shaped pulses—pulses deliberately shaped into complex waveforms. This is important because shaped pulses are used for many applications, but currently no device exists to confirm the resulting pulse shape. The combination of these two devices will allow, for the first time, simple and accurate control over the exotic light pulses used in these novel and important technologies.

This work grew out of that of Prof. Rick Trebino's group at Georgia Tech (funded by the National Science Foundation, grant ECS-9988706), which has been developing techniques for measuring and manipulating ultrashort laser pulses for over a decade. His group first solved the problem of measuring the intensity and phase (color) vs. time of an ultrashort laser pulse in 1991, culminating in the method under development at Swamp Optics, the company he founded to commercialize these devices. The pulse-measurement device under development in this project solves the much more difficult problem of measuring such pulses in time and space. And the pulse compressor emerged from Swamp Optics' development of an earlier pulse-measurement device that measured some simple spatio-temporal distortions in pulses and then finding that most pulses were in fact badly contaminated with such distortions! This is because most optical components actually introduce such distortions, and also no device was available to measure them. The two devices under development for this project will solve both of these problems!

SwitchBook

Phase II Award No.: 0848990

Award Amount: $500,000.00
Start Date: 02/15/2009
End Date: 01/13/2011

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Sector: Enterprise Software Applications

SBIR Phase II: Open platform for semantic search

This Small Business Innovation Research (SBIR) Phase II project will create and test a working semantic search platform using Search Maps to represent users' Search intent. The effort will extend the ontology used in Phase I and build a complete system for generating high quality search results for typical searches. The recommendation architecture uses the similarity between Search Maps to introduce users to websites already discovered by others with similar Search Maps.

If successful, this project will enable a new type of semantic search called User-driven Search, creating a new Search-enabled layer on top of the World Wide Web. As new way for users to manage, express, and resolve their Searches anywhere on the Internet, Search Maps create a new metaphor for helping users get more value out of the World Wide Web, no matter where they go. Coordinating queries and Search results provides immediate value as an enhanced Search tracking service. Allowing users to seamlessly send their Search Map to any provider would allow users to shortcut the traditional search and navigation paradigm at any and every website they visit. The implications for e-commerce and enterprise search are significant.

Synkera Technologies Inc.

Phase II Award No.: 0724478

Award Amount: $500,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Materials

SBIR Phase II: New Ceramic Sub-Microchannel Plates

Microchannel Plates (MCPs) are compact solid-state electron multipliers used in night vision systems, scientific detectors and biomedical imaging systems. The price of high-resolution MCPs can be in the thousands of dollars, making it often the most expensive single component of many detectors. The intrinsic limitations of current glass MCPs and increasing demands on their performance motivate the search for new approaches for making MCPs with better performance and/or lower cost. To address this opportunity, Synkera is developing a novel ceramic technology that enables significant gains in MCP performance and lifetime. Not only are these features unattainable with the state-of-the-art MCPs, but the proposed technology has a potential to enable mass-production at a fraction of the cost of current MCPs.

Under NSF Phase II SBIR funding, Synkera is continuing the development of the technology with the goal of producing operational MCP prototypes and validating them for application in specific detectors and imaging systems. Significant progress was achieved in the first year of the program. Within the next three months we expect to complete the first round of testing with our subcontractor at UC Berkeley and have prototypes available for our application development partners both in the scientific community as well as in the night vision and detector industries.

The innovation is based on Synkera's nano- & micro-fabrication technology platform that enables a dual approach - top-down (micromachining) and bottom-up (intrinsic self-organization) - for creating amplification channels in alumina ceramic. Using the bottom-up approach for creating channels with 0.2 – 0.8 μm diameter was demonstrated for the first time under Phase I SBIR funding from NSF (OII-0539824) in 2006. The current development under NSF Phase II grant is critical in achieving technology milestones and producing operational prototypes that could validate the advantages of the ceramic MCPs to our application development partners.

TagArray Incorporated

Phase II Award No.: 0822542

Award Amount: $500,000.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Wireless Technologies

SBIR Phase II: Clock-on-Demand: High Performance, Ultra Low Power

This Small Business Innovation Research Phase II research project is to develop a prototype and proof of concept for the tag and reader that uses an innovative low power Clock-on-Demand (CoD) and baseband/ media access controller (MAC) calibration algorithm to be used with ultra wideband communication systems. The new CoD and algorithm are motivated by application of ultra wideband to the RFID (Radio Frequency Identification) market. In this prototype, the CoD and the baseband/MAC layer algorithm are implemented in standard CMOS for tag and the UWB receiver and narrowband receiver with discrete components for reader. The low power requirement is achieved by the CoD and by dividing the time into epochs and epochs into slots. The CoD only runs until the tag transmits its impulse in the relevant slot, and the reader decodes the ID representations of all tags by the slot number. Therefore, if an epoch is divided into 210 slots, an impulse by tag represents 10 bits of the information. The robustness is achieved by having an UWB impulse transmitter in the tag and by repeating the impulse in different epochs.

RFID is an exponentially growing market. However, the technology that supports its expansion is not able to provide robust communication and signaling between a tag and a reader. Furthermore, today?s technology only supports a low tag density (10s of tags/sec), while the applications that will fuel the exponential expansion of the RFID market, like point-of-sale, inventory management, shelf management, etc., require 100s and 1000s of tags/sec.

Team Patent LLC

Phase II Award No.: 0750550

Award Amount: $500,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Collaborative Patent Drafting Software

TeamPatent is a new type of online word processor…one tailored to a particular document type with advanced, specialized features not available elsewhere (even on the desktop). It's directed at highly-paid attorneys who currently manage a cumbersome and archaic process to prepare patent applications. TeamPatent's text editor automatically recognizes part references, helping ensure they're used consistently. A drawing editor allows users to place callouts that are cross-referenced to the aforementioned part references in the text. This integration ensures terms are well-supported and allows users to quickly navigate and comprehend complex technical documents.

TeamPatent will provide the underlying technology for a constellation of application-specific document editors/readers. For example, it may be extended to other document types as diverse as scientific papers and product manuals, thereby allowing groups of authors to maintain documents that discuss drawings in fine-detail and allowing readers to easily comprehend these complex documents.

The innovation was conceived after the founder collaborated on various applications with patent attorneys. He found the process to be archaic and wasteful. In addition, the document's brittleness precluded the inclusion of lately-discovered embodiments, reducing the application's relevance and value. In response to these limitations, he developed this project's editor with the expectation that the underlying technology will be useful for both patent applications as well as other documents consisting of interrelating text and drawings.

TeraVision Inc.

Phase II Award No.: 0750559

Award Amount: $508,705.00
Start Date: 02/15/2008
End Date: 07/31/2010

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Program Director: Juan E. Figueroa

Sector: MEMS & Electro-Optics

STTR Phase II: Coherent THz Sources and Amplifiers Using Carbon Nanotubes

TeraVision is developing the first high power amplifiers for use between 0.2 and 2 terahertz (THz) frequency. These amplifiers, based on vacuum electron technology can be used to greatly increase the output of a transmitter, boost a signal prior to detection or be turned into high power transmitters. Detailed computer models, using state of the art computer codes running of DoD supercomputers indicated gains of 30 dB (1000x) are possible. The first amplifier (0.35 THz) has been fabricated is under test. A second, higher power (higher gain) is nearly complete as of this writing. Fabrication is about to start on a 0.35 THz oscillator (source) based on the same technology. Existing sources are inefficient, complex, expensive, and yield very little power. The availability of compact, inexpensive, high power terahertz sources will constitute a paradigm shift for the terahertz industry. The amplifiers TeraVision is developing promise to immediately improve the performance (range/sensitivity) of terahertz system used for military and homeland security applications. They also have great promise for Radio-Astronomy, Atmospheric, and Space Sciences research. Further, the technology is also readily applicable to both air and space-borne high bandwidth communications and radar imaging.

The innovation is related to basic research on vacuum electron terahertz radiation generation conducted in Prof. Walker's Radio Astronomy Laboratory at the University of Arizona. Besides NSF funding, the research has received early funding from the US Department of Defense and from Raytheon Missile System's Advanced Programs Division. Our design and modeling efforts (including the use of state of the art particle wave interaction codes and access to Department of Defense supercomputers have been supported by the Air Force's High Power Microwave Division at the Air Force Research Laboratory in Albuquerque.

The Echo Nest Corporation

Phase II Award No.: 0750544

Award Amount: $500,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Enterprise Software Applications

SBIR Phase II: Automated Community and Sentiment Mining for Global Media Preference Understanding

"The Echo Nest builds systems that read what people are saying on the online world about music and other media. Using natural language processing and machine learning research, we're trying to uncover how to link what people are saying to what they feel about something, and also trying to see if we can automatically figure out what communities someone may belong to based purely on either how they write or what their music preferences are. This sort of work leads directly to the best kind of music recommendation and analysis systems for both listeners and musicians. We don't need to ask you questions or have a bunch of editors tells us about the music, we can figure this sort of information out automatically without any sort of bias towards popular artists. Using The Echo Nest's Musical Brain API and products, music companies and developers can start building tools that take advantage of these new technologies to better inform their customers of musical trends and tastes."

Tristan Jehan and Brian Whitman both spent 6 years doing their PhD on music analysis at the MIT Media Laboratory. Tristan used Digital Signal Processing to explain the acoustic signal, while Brian used Natural Language Processing to describe the cultural bias of music. This research is a joint effort in combining the two different paths for better describing music and the listener's preferences.

Thermal Solutions, Inc.

Phase II Award No.: 0848829

Award Amount: $500,000.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Program Director: Muralidharan S. Nair

Sector: Sensors

SBIR Phase II: Validation of Remotely Powered and Interrogated Microwire Temperature Sensors for Composites Cure Monitoring and Control

This Small Business Innovation Research (SBIR) Phase II research project addresses an unfilled need in the composites manufacturing and repair industry. Current manufacturing and repair methods for curing Carbon Fiber Reinforced Plastic (CFRP) composite materials do not employ real time temperature feedback from the critical interior of parts or repair bond lines because no practical sensors can be permenantly embedded to report to a remote reader. This Phase II Project will lead to the commercialization of three complementary products designed to provide this capability so as to improve curing processes. Product 1 is an inexpensive microwire temperature sensor that is easy to use and does not negatively affect structural integrity. Product 2 is an autoclave/oven control system: modular antennas that reside inside the hot chamber and a reader with control software outside that combine to control the curing process via real-time temperature feedback from embedded sensors. Product 3 is a temperature-sensing accessory for all existing portable composite repair systems. This accessory allows existing repair systems, without modification, to monitor temperature from embedded Product 1 sensors. These complementary products will vastly improve legacy curing processes by cutting curing times, reducing labor, and reducing the number of rejected parts due to uncontrolled exotherm.

The commercial aircraft industry's rapidly expanding use of CFRP composites is driving the marketplace demand for process enhancements that increase efficiency, yield and part quality. If successful the outcome of this project will address the needs of control system manufacturing companies, end-user companies and commercial aircraft manufacturers. The low cost of the microwire sensors and the anticipated improvements to the speed of legacy curing processes both for initial cure and repair may accelerate the use of CFRP composites within the automobile industry. This should result in reduced fuel/energy usage worldwide. Furthermore, the extremely low thermal mass of these microwire temperature sensors gives them such fast thermal response that they may allow for the development of unconventional and faster composite curing systems and processes that employ real time feedback, such as microwave ovens for initial cure and induction heating devices for repair cure, further speeding overall industry use of composites. Finally, microwire temperature sensing technology holds promise for remote measurement of internal temperatures of lithium ion batteries for electric and hybrid cars.

T-Spline Company

Phase II Award No.: 0620461
Phase IIB Award No.: 0848891
Award Amount: $682,745.00
Start Date: 08/15/2006
End Date: 07/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: T-Splines for Surface Intersection

Trimless T-Splines Intersection (TTI) solves a problem identified in 1999 as the single most significant unsolved technological problem in the CAD industry. The problem is that the conventional mathematical framework for creating CAD models introduces unwanted gaps or holes into CAD models. This framework, called NURBS (non-uniform rational B-Splines), is used by in all CAD software. These gaps in NURBS models are not acceptable in analysis software or in manufacturing. The painstaking process of closing gaps can require up to weeks for a large model, such as an automobile or aircraft, and downstream engineering departments spend as much as fifty percent of their time dealing with such CAD files. It has been estimated that a solution to this problem could save over $600 million annually in the US automobile industry alone. This problem is experienced in numerous other industries, including aerospace design, ship design, and industrial design, and is often referred to as a billion-dollar problem.

This innovation is an outgrowth of basic research completed by Dr. Thomas Sederberg at BYU under grants from NSF.

Uncopiers, Inc.

Phase II Award No.: 0646557
Phase IIB Award No.: 0919615 (pending)
Award Amount: $512,000.00
Start Date: 03/15/2007
End Date: 02/28/2009

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Sector: Sensors

SBIR Phase II: A Quality Monitor for Enabling Water Recycling in Semiconductor Processing - The Particle Scout

This project has developed an innovative method for detecting extremely fine in-liquid particles. Particles on semiconductor wafers lead to defective chips, so all the ultrapure water used in semiconductor processing must be monitored for nano-particulates. Current optics-laser technologies cannot detect sub-100nm particulates, which the Uncopiers' acoustic technology can. The principle of detection is similar to the sonar, except it is done using very high frequency. Particles themselves have a very weak sonar signature and cannot be directly detected. Uncopiers, overcomes the difficulty by generating a bubble at the particle site and detecting that bubble and thus inferring the particulate. Bubbles have strong sonar signatures.

Valencell Inc.

Phase II Award No.: 0848943

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: MEMS & Electro-Optics

STTR Phase II: Monolithic Multiwavelength Blue-to-IR LED for Biomedical Diagnostics

This Small Business Technology Transfer (STTR) Phase II project, in collaboration with North Carolina State University, will develop and validate an innovative, mobile, multiwavelength pulse oximetry module for noninvasive health monitoring of various blood metabolites simultaneously in real time. At the heart of this pulse oximetry module will be a novel multiwavelength emitter having independent control of up to nine spectrally narrow wavelengths, ranging from blue to mid-IR, emitting from a single 1 mm2 LED die. In contrast with traditional dual-wavelength pulse oximetry, which measures oxygen saturation in the blood, the proposed multiwavelength LED will enable real-time analysis several additional metabolites critical to health monitoring via the same noninvasive paradigm. Furthermore, the individually controlled self-aligned wavelengths enable superior motion artifact cancellation, which is essential for eHealth and mobile fitness applications. The key objectives of this feasibility study are to: Demonstrate luminescent films with peak emissions from 400-1100 nm Integrate these films into a compact multiwavelength pulse oximetry module Optimize novel pulsing algorithms for multiwavelength pulse oximetry Validate the mobile multiwavelength pulse oximetry module in a lab setting

The medical impact of dual-wavelength pulse oximetry, in both saving lives and reducing healthcare costs, has encouraged the development of broader platforms using additional optical wavelengths. Incorporating 3 or more independently controlled wavelengths has been shown to enable the real-time monitoring of multiple health factors while further reducing readout errors ? thus saving more lives. Beyond blood oxygen monitoring, a real-time noninvasive assessment of renal and hepatic health can be realized by integrating several wavelengths in the same clinically accepted pulse oximetry paradigm.
Though multispectral pulse oximetry systems incorporating several optical sources have been successfully demonstrated by physicians and industry leaders, incorporating multiple LEDs (made from dissimilar semiconductors) has led to costly reliability errors and even product recalls. If successful the proposed mobile, multiwavelength single-die approach surmounts these limitations by providing independent control of several wavelengths from a single, self-aligned, compact LED. Integrating these advanced, cost-effective optical sources into traditional pulse oximetry opens up new markets in noninvasive metabolic monitoring for clinical research, paramedics, physical therapists, drug discovery, consumer eHealth markets, and home healthcare. As a spectroscopic source, other applications include air-quality/pollution monitoring and agricultural/industrial controls.

Vega Wave Systems, Inc.

Phase II Award No.: 0724237

Award Amount: $500,000.00
Start Date: 10/01/2007
End Date: 09/30/2009

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Sector: MEMS & Electro-Optics

SBIR Phase II: Wavelength-Selective Lasers for Photonic Integrated Circuits

This Small Business Innovative Research project addresses the commercial need for novel wavelength-selective laser diodes for 10 Gigabit Ethernet applications. Current state-of-the-art devices are fabricated using an expensive, low-yield process. The drawbacks of the current method of fabricating laser diodes are the high costs of both the required capital equipment and the operation. In addition, the lower yields make cost-effective integrated photonic components difficult to achieve. Vega Wave Systems has developed a novel high-yield manufacturing method and laser diode design that will enable the fabrication of low-cost wavelength-selective and tunable laser diodes for optical communications. Prototype devices have been fabricated in Phase I. In Phase II Vega Wave will refine the design and fabricated both discrete and integrated devices for 10 Gigabit Ethernet LX4 applications.

The innovation is related to basic research at Vega Wave Systems, Inc. under NSF Phase I SBIR Grant Award Id 0539375.

Verionix

Phase II Award No.: 0646415
Phase IIB Award No.: 0932371 (pending)
Award Amount: $524,000.00
Start Date: 03/15/2007
End Date: 02/28/2009

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Sector: Devices & Instruments

SBIR Phase II: Atmospheric Pressure Microplasma Emission Spectrometer

This SBIR Phase II has developed 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 innovative source will integrated to form new generation of highly portable and low cost plasma emission spectrometers, similar in operational principle to $100,000, 3-5kW power consumption bench-top units at orders of magnitude lower cost, size and portability.

This sensor is based on underlying microplasma technology developed at Northeastern University under NSF funding by Jeffrey Hopwood, Professor of Electrical Engineering and licensed by Verionix.

VideoMining Corporation

Phase II Award No.: 0548734
Phase IIB Award No.: 0831598
Award Amount: $750,000.00
Start Date: 06/01/2006
End Date: 05/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: Video Mining for Customer Behavior in Retail Enterprises

Retailers & Consumer Product Manufacturers spend billions of dollars each year on different drivers such as Weekly Mailers, In-store Special Displays, EndCaps, Promotions, Pricing, and Shelf set redesigns etc to entice more customers to buy their products. There is no systematic way of understanding the impact of any of these drivers in increasing traffic, engagement or converting them into buyers. VideoMining is working on providing a systematic frame work for quantifying the impact of these initiatives by measuring shopper behavior using video analytics technology. VideoMining, thorough this project has developed specific video analytics technology (understanding deeper shopper interaction with products, group shopping behavior etc) to augment its existing technology to add more features to our solutions and has improved the performance of the technology by addressing specific issues specific to the retail environment (detecting shopping carts etc).

Though our solutions we are working towards bringing the same level of feedback to in-store marketing & merchandising as that existing in the online world. This would help in optimizing the marketing & merchandising budgets by figuring what works and what doesn't work before rolling out across the thousands of stores.

Vision Dynamics, LLC

Phase II Award No.: 0848825

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: MEMS & Electro-Optics

SBIR Phase II: Lens-forming nanocomposites for high strength, clear ophthalmic lenses

This Small Business Innovation Research (SBIR) Phase II project addresses the development of a UV curable bulk nanocomposite having enhanced optical and mechanical properties for ophthalmic lenses. The work focuses the incorporation of metal oxide nanoparticles into a transparent polymer to engineer the refractive index and mechanical properties. This requires the synthesis of stable nanoparticles approximately 20 nm or less in diameter. The nanoparticles require a surface treatment that will aid in the monomer stability and impart improved mechanical properties to the polymerized lens. The functionalized dispersion can then be incorporated into a second monomer and then polymerized into a finished ophthalmic eyeglass lens using the lens casting system currently used by several hundred Vision Dynamics LLC customers. This extends the capabilities of an independent retail dispenser to deliver quality eyeglass lenses to consumers in less than an hour. The project will further the understanding of nanocomposites which are a very unique and important material.

This SBIR Phase II project is directed toward the ophthalmic eyeglass lens market which is a $7B industry in the United States. Much of the eyeglass lenses in this industry are imported from overseas and through recent consolidations the three largest producers of lenses are foreign companies. If successful this technology removes the distribution rungs between the consumer and the optician, allowing independent retailers to more efficiently deliver quality eyewear to their customers. This allows retailers to continue to compete in this difficult landscape that has been dominated by acquisitions and mergers squeezing the independents. Furthermore, UV curing has been identified as a green coating technology for its low VOC emissions and low energy consumption. Currently UV cured polymers are limited in refractive index so this technology will play out in several industries.

VQlink Incorporated

Phase II Award No.: 0848558

Award Amount: $500,000.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Enterprise Software Applications

SBIR Phase II: Use of No-Reference Measurements of Subjective Quality to enhance Next Generation systems for Video Distribution

This Small Business Innovation Research (SBIR) Phase II project concerns the design, development and commercialization of systems for real-time measurement and enhancement of the quality of video distributed over emerging networks. The Phase I project has demonstrated the feasibility of a real-time version of an automatic video quality meter (AVQ) that has several novel features. By not requiring a reference to the source video, and by being compute-scalable, the AVQ meter can reside anywhere in the video distribution chain. In addition, AVQ scores correlate extremely well with subjective assessments of users, making it valuable not only as an accurate measurement tool, but also as the starting point for VQ Enhancement (VQE). This Phase II work will create an industry-ready suite of AVQ products that can reside in the network (AVQ-N), home (AVQ-H) and Set Top Box (AVQ-STB). It will also create solutions for video quality enhancement (VQE) that will reside in several network points. The AVQ and VQE products will depend on several innovations in design, including the retention of performance in the leaner versions of AVQ and VQE, and portability of a core AVQ engine into multiple PC-native, board-level and chip-level platforms.

In rapidly emerging scenarios, video information is generated, gathered and distributed in real time, using a larger number of communication networks than ever before. Increasingly, users who are exposed to the notion of high-quality, high definition television will demand a high quality of video experience in all circumstances, in both fixed and mobile systems. The solutions proposed in this research will initially help content providers, aggregators, distributors and receiver manufacturers in meeting user expectations in emerging systems for entertainment video. These systems include cable and telco services as well as mobile and internet video.

VSee Lab

Phase II Award No.: 0750558

Award Amount: $495,154.00
Start Date: 01/15/2008
End Date: 12/31/2009

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Sector: Enterprise Software Applications

SBIR Phase II: Multi-Party Peer-to-Peer V3oIP

The industry norm to achieve multiparty video/web conferencing is the client-server architecture, eg, WebEx, LiveMeeting, Adobe Connect, GotoMyMeeting, etc. However, the client-server architecture is expensive to deploy due to the number of servers required and the bandwidth required at the server nodes. Peer-to-peer approaches have been successfully used for large scale file sharing, e.g., BitTorrent, and VoIP, e.g., Skype. However, peer-to-peer approaches have been relatively unexplored to scale the number of participants in a single V3oIP meeting; e.g. Skype only allows 1-1 video calls. This research combines real-time network sensing and the domain knowledge of video and web conferencing to create a scalable and cost effective peer-to-peer streaming algorithm.
The maximum number of sites in a multiparty videoconferencing is typically 4-6. Given the limited screen resolution of a laptop/desktop, methods for showing 10-30 full motion video and a shared application are relatively unexplored. Poor user experience from inadequate user interface is a major barrier to the adoption of previous video/web conferencing tools. This research combines recent human factor discoveries to create a novel user interface that intuitively supports multiparty V3oIP.

This research originally started at Stanford University where the PI was doing his PhD. After Stanford, the PI and his team founded VSee Labs to create a collaboration product. The original motivating question for this line of research was that since AT&T invented videoconferencing in 1927, videoconferencing has been one commercial failure after another. The PI's previous research has shown that such failures are rooted in inadequate knowledge of the human factor requirements of videoconferencing. Based on the NSF SBIR support, they have developed a commercial software system, VSee, which has made substantial impact on telework, remote education, and humanitarian operations for customers ranging from IBM, Cisco Learning, Shell, NASA, US Congress, etc.

The PI started working on videoconferencing and remote collaboration while a PhD student at Stanford. His PhD research was funded by a DoD fellowship. After Stanford, the PI and his team formed the Company. And we are grateful for this first NSF SBIR grant.

Western Robotics Co.

Phase II Award No.: 0646438
Phase IIB Award No.: 0924170 (pending)
Award Amount: $550,000.00
Start Date: 02/01/2007
End Date: 01/31/2009

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Sector: Robotics & Assistive Technologies

SBIR Phase II: Robotic Material Removal System

NSF-funded research by Western Robotics has created a robot that works in the same manner that biological creatures do: by using force. Conventional automation works by position, rigidly repeating motions that demand a working environment of high precision and repeatability. Most often this is not economically feasible, or even possible, necessitating human effort for many basic manufacturing operations like component assembly, polishing and smoothing, and cutting and trimming. By creating a robot that can compliantly interact with a workpiece, it can sense, react, and adjust to part imprecision and variable work requirements. The key to this achievement is the robot's novel construction that minimizes inertia, produces extremely smooth motions, and has extremely low friction: in short, dynamics comparable to the human arm. Human-arm performance enables implementing human-inspired work strategies. In smoothing, for instance, the robot applies pressure with a finishing tool over the surface of the part, "feeling" bumps and discontinuities. The part geometry dictates the motion path, and the robot can focus efforts on areas needing the greatest attention.

The initial targeted application for this project is turbine blade manufacture for the aircraft engine and power generation industries, where today blades undergo multiple, manual material removal steps to produce the needed shape and smoothness. This technology is further applicable to a range of other products formed by casting, forging, molding, and machining in the industrial, automotive, aerospace, and medical device industries, where people are employed in great numbers for their adaptability and sense of touch, yet work in dirty, difficult environments and suffer high incidences of repetitive stress injuries. By providing an automation alternative for this type of work, this technology will increase U.S. global manufacturing competitiveness, remove a key driver for relocating goods production to low labor cost countries, and reduce the human toll of work-related musculo-skeletal injuries that cost the U.S. an estimated $50 Billion/yr.

This work began under NSF Phase I SBIR award 0232362, where Western Robotics and Dr. Wyatt Newman of Case Western Reserve University tested a mock-up of the novel robot architecture for force sensitivity, compliance controllability, and smoothness and stability in applying a powered grinding tool to a rigid surface. NSF SBIR Phase I award 0539650, also performed in conjunction with Dr. Newman and CWRU, investigated algorithms that leveraged part contact and compliance to allow the robot to self-acquire part geometry measurements and automatically generate actions based on a surface finishing strategy. It demonstrated that, using force compliance algorithms, precision smoothing was achievable with imprecisely defined work, and that task programming and workpiece setup could be dramatically simplified.

Xradia

Phase II Award No.: 0620578
Phase IIB Award No.: 0814097
Award Amount: $999,233.00
Start Date: 07/15/2006
End Date: 06/30/2010

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Sector: Devices & Instruments

SBIR Phase II: Development of an Imaging X-Ray Spectrometer

The nanoXFi was developed by Xradia and funded by NSF to address a very important and growing need in many American industries – to non-destructively image surface and subsurface elemental structures at very high spatial resolution (~30nm) in a complex, compound material. This task leverages Xradia's market leading expertise in the manufacture of x-ray lenses called Fresnel Zone Plates which are simultaneously an imaging and a chromatic device. Combining these two properties, Xradia developed nanoXFi which creates images of elemental structures. Xradia has succeeded in demonstrating sub 50nm resolution capability of nanoXFi by imaging surface and sub-surface structures containing elements ranging from Oxygen to Tungsten (spanning nearly the entire periodic table) thus bringing into market a unique, first and only one of its kind, imaging spectrometer. However, for wider acceptance of nanoXFi in the market place, Xradia is developing higher efficiency, larger NA optics to increase the system's throughput and this effort is funded through NSF Phase IIB grant.

This innovation is a consequence of leveraging Xradia's leading expertise in the manufacture of x-ray lenses called Fresnel Zone Plates which are simultaneously an imaging and a chromatic device. These unique properties of zone plates make them eminently suitable in the area of fluorescence imaging and the proof of principle was demonstrated in year 2003. NSF awarded Xradia with a Phase 1 grant to adapt nanoXFi to a commercial SEM suitable for commercializing the product and later awarded the NSF Phase II grant (Grant #: 0620578) to develop a full fledged multi-element imaging spectrometer. NSF Phase IIB grant is a continuation of the previous grants to develop very high efficiency zone plates to significantly increase the throughput of the nanoXFi system.

Zenwa Inc.

Phase II Award No.: 0822695

Award Amount: $499,990.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Program Director: Juan E. Figueroa

Sector: MEMS & Electro-Optics

STTR Phase II: 3D Lithography of Thick Photopolymers for Imaging and Photonic Crystal Waveguides

This Small Business Technology Transfer (STTR) Phase II project will culminate in a new form of 3D lithography capable of fabricating imaging arrays and photonic-crystal waveguides that are cheaper, higher performance, lighter, more flexible and have capabilities not currently possible with current ?stack and draw? manufacturing. For example, by directly fabricating these parts at the micron scale, perturbations such as global scaling (to implement magnifying arrays), global rotation (to implement image inverters) or local scaling (to implement modal tapers or integrated lenslets) can be created in a single process step. Unlike current methods which must draw out a minimum of km from a preform, here single parts can be cm in length. The imaging arrays have significant commercial potential as replacements for current endoscopes, fiber face plates and image inverters. They also enable new markets including inexpensive eye monitoring for clinical and public safety applications, wearable gaze-tracking for human-computer interface for paralysis victims, and ultra lightweight heads-up displays for military and consumer entertainment. The team will develop both the lithography and materials to create these all-polymer imaging cables.

The transport and manipulation of optical images is ubiquitous but nearly uniformly implemented with delicate, rigid lens trains. Discrete imaging devices such as fiber bundles are sufficient for modern digital displays and cameras and are naturally robust, but currently limited by cost and capability. By enabling flexible, lightweight transport of discrete images, the results will impact Education, Medical and Biological Research and Macular Degeneration. The Phase I including supplementary funding has partially funded 7graduate, 1 post-doc and two undergraduate students. An exchange of graduate students with Dublin Ireland extended this impact. The lithography system has been used in multiple undergraduate class projects and for multiple cross-disciplinary graduate research programs. Disposable endoscopes with high resolution, small diameter and large field of view exceed current capabilities at much lower costs. Zenwa has signed a collaborative agreement with the Smith-Kettlewell Eye Research Institute to develop a lightweight customized image delivery system to restore sight to the severely vision impaired.

Zomega Terahertz Corporation

Phase II Award No.: 0848811

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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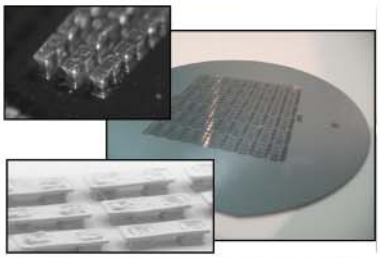
Program Director: Juan E. Figueroa

Sector: Devices & Instruments

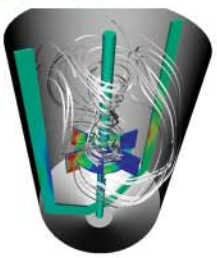
SBIR Phase II: Compact THz-ABCD Spectrometer

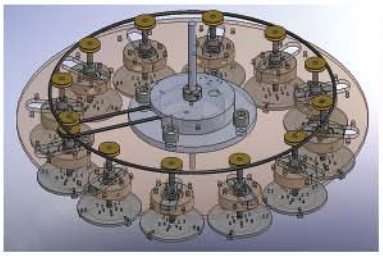
This NSF Small Business Innovation Research Phase II project proposes to develop a compact THz-ABCD (air-biased coherent- detection). spectrometer based on a new technique for generating and measuring ultra-broadband THz waves utilizing a laser induced plasma in ambient air and selected gases. A focused optical pulse with >100 uJ pulse energy and <100 femtosecond pulse duration in gas creates a plasma (ionized gas molecules), which produces very intense (>300 kV/cm), highly-directional (<6 degree), and ultra-broadband (10% bandwidth from 0.1 to 10 THz) THz waves in the far field. Through the reciprocal process, air or selected gases also serve as an ultra-broadband sensor of pulsed THz waves through air-biased coherent- detection (ABCD).The region of the electromagnetic spectrum from 0.3 to 10 THz (1 mm - 30 um in wavelength) is now a frontier area for research in physics, chemistry, biology, materials science and medicine. Recently, the observations of THz wave generation and detection in the laser induced atmospheric plasma provide new method in remote sensing and spectroscopy. The use of air as THz wave emitter and sensor provides unprecedented bandwidth (spectral range of 0.1 to 30 THz), sensitivity (heterodyne method), and spectral resolution (<MHz) which were previously considered impossible to achieve simultaneously. In addition, this technique produces THz electric field strengths approaching 1 MV/cm, unlocking the potential for nonlinear THz spectroscopy previously inaccessible by conventional optics lab facilities.

Recent advances in the use of air/gases to emit, control, enhance, and measure broadband THz waves open up a range of research opportunities. Applications including nondestructive testing, tomographic imaging, label-free genetic analysis, cellular level imaging, explosives detection, and chemical/biological sensing have thrust THz research, from relative obscurity, to new heights. The proposed development of a compact THz ABCD spectrometer will provide a key enabling technology for interdisciplinary research. In addition it will advance numerous sensing and imaging concepts in the THz frequency range, with an immediate impact on non-destructive spectroscopic analysis (eg: pharmaceutical R&D, materials research), a near-term application (3 to 5 years) for homeland security and a longer-term interest (5 to 10 years) in the biomedical sector. If successful the outcome of this project will make significant contributions to academic and governmental laboratory collaboration, student education, and instrumentation development.



Nanotechnology, Advanced Materials & Manufacturing (NAM)





ADA Technologies, Inc.

Phase II Award No.: 0848567

Award Amount: $498,166.00
Start Date: 02/15/2009
End Date: 01/31/2011

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Program Director: William Haines

Sector: Nanotechnology

STTR Phase II: A Carbon Nanotube Metrology System for Conterfeit Detection

This Small Business Technology Transfer Phase II project is to develop advanced nanometrology of carbonaceous nanomaterials, in particular for the burgeoning counterfeit detection marketplace. Nanotechnology offers a new paradigm for the world's anti-counterfeiting efforts; in particular, the carbon nanotube (CNT) offers a new means for development of irreproducible labels. This project will develop an instrumentation platform for field operations in counterfeiting detection.

The World Customs Organization estimates that counterfeiting accounts for 5% (or more) of global trade. Through the tailorable material properties of nanomaterials, there is an opportunity to offer a new development paradigm of anti-counterfeiting labeling platforms. Such labels could be used across a broad swath of the world's economy in products such as drug packaging, food processing, electronics, etc.

Advanced Diamond Technologies

Phase II Award No.: 0521596
Phase IIB Award No.: 0650397
Award Amount: $1,011,426.00
Start Date: 07/01/2005
End Date: 06/30/2009

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Program Director: Cheryl F. Albus

Sector: Coatings

SBIR Phase II: Ultrananocrystalline Diamond as Wear Resistant and Protective Coating for Mechanical Shaft Seal Applications

Mechanical shaft seals are critical elements found in almost every industrial sector. Seals are responsible for maintaining processing media within a pump or compressor and protecting our environment from exposure. The overall performance of a seal is often determined by the material properties the of "face" of a seal. The basic seal design consists of one seal face that is stationary while its mating face rotates with the shaft of the equipment. The wear and tribological performance of these two or more faces along with a "separating" thin lubricating film, often of common material with the pumping media, is critical to the overall seal's useful life. When the seal fails processing media leaks and shutdowns are required to repair the equipment.

During this program the outstanding properties of diamond (low friction, hardness, and chemical resistance) has been used to improve the performance of seal faces. A unique and patented form of diamond, UNCD, was taken from a laboratory environment and deployed on a commercial scale. UNCD was originally developed at the Department of Energy's Argonne National Laboratory and was subsequently licensed for commercial use to ADT. UNCD consists of fine crystals of diamond that are applied to seal faces using a modified chemical vapor deposition process. UNCD faced seals have been demonstrated to result in seals that operate with lower friction and provide significantly increased life in poorly lubricated conditions. The friction of UNCD running against silicon carbide, a common ceramic material used in mechanical seals, is several multiples lower than current hard-on-hard seal face combinations. This feature results in seals that run longer and are more suitable for use with abrasive media. These properties have been recognized by industry and the program has resulted in the world largest manufacture releasing their largest line of seal types with UNCD faces. Additionally several major seal manufactures are following-suit and are in the process of working to evaluate how they can incorporate UNCD into their product lines.

This effort is related to the basic research in wear-resistant and low friction carbon materials, and specifically in ultrananocrystalline diamond films, that was supported by the Department of Energy and conducted at Argonne National Laboratory (ANL). The feasibility was originally demonstrated with the support of NSF's SBIR program, DOE's ANL, the John Crane Company, and Advanced Diamond Technologies, Inc. (ADT). During 2006 ADT transitioned the laboratory-scale process developed at ANL to a commercially viable platform that is currently being used to produce products. Early in 2008 ADT offered a product line of mechanical shaft seals for sale and in the first quarter of 2008 released UNCD® Faces providing seal manufactures with the ability to integrate UNCD surfaced SiC faces within their proprietary seal faces. Since the introduction of UNCD Faces, John Cane, the world's largest seal manufacture, has announced "JC Diamond" products based on the patented UNCD materials resulting from this product development. John Crane has subsequently contracted with ADT to provide commercial quantities of UNCD Faces for use in their most popular cartridge seal line. During mid-2008 other seal manufactures began launching their own product development activities around UNCD Faces. We currently are providing UNCD Faces for on-going seal development within several of the largest seal manufactures in the world as well as several smaller manufactures.

Advanced Diamond Technologies

Phase II Award No.: 0823002

Award Amount: $484,464.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Program Director: William Haines

Sector: Nanotechnology

STTR Phase II: Diamond Nanoprobes for Atomic Force Microscopy - Imaging, Metrology, Material Property Measurement, Process Control, and Manipulation with Ultrahigh Performanc

This STTR Phase II project will develop commercially viable atomic force microscope (AFM) probes fabricated from ultrananocrystalline diamond. The project will refine the processes developed in Phase I and bring contact and non-contact all-diamond probes to market. Probes using conducting diamond that are chemically and electronically tunable and have superb tribological properties will also be developed.

This work will facilitate new industrial applications for AFM, including high-throughput imaging, metrology, and characterization of large quantities of materials, local electrical characterization for process control in micro/nanoelectronics, nanomechanical characterization of MEMS/NEMS devices, and ultraprecise hard mask correction for the micro/nanolithography industry.

Advanced Engineering Research, LLC

Phase II Award No.: 0848986

Award Amount: $468,494.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Program Director: Cheryl F. Albus

Sector: Materials

SBIR Phase II: Develop an Autonomic-Healing Hot Mix Asphalt

This Small Business Innovation Research (SBIR) Phase II project will assess the performance of autonomic-healing concrete asphalt through large-scale testing. Each year, about 500 million tons of hot mix asphalt is produced in America, with an average price of $80 per ton. Compared to concrete, hot mix asphalt features lower material cost, but is prone to fatigue cracking when subject to repeated traffic loads. Developing an autonomic-healing concrete asphalt that will actively arrest the microcrack propagation is of great importance and provides an economic savings.

The broader/commercial impact of this technology is a cost saving of approximately $340,000 for each mile of pavement construction.

Advanced Materials & Devices Inc.

Phase II Award No.: 0823112

Award Amount: $480,409.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Program Director: William Haines

Sector: Nanotechnology

STTR Phase II: Low-Cost Nanoparticles for Enhanced Heat Transfer

This STTR Phase II project is to develop and commercialize copper nanofluids for heat transfer enhancement applications. The low cost nanoparticle production methods developed will produce quality nanoparticles for this application.

Success of this STTR project will benefit a wide range of applications for heat transfer enhancement including: electronics, HVAC, transportation, textile and paper manufacturing, and energy production systems. The project will also provide educational impact by offering opportunities for student recruitment, research and training, and curricula design at the University of Nevada, Reno.

Advanced Thermal Technologies

Phase II Award No.: 0823012

Award Amount: $499,734.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Materials

SBIR Phase II: Low-Cost Hot Press Die Casting of Graphite-Metal Materials

This Small Business Innovation Research (SBIR) Phase II project seeks to develop an unique hot press die casting technology to be used to produce graphite-metal materials. These materials will be used to produce packaging components for use in high power electronics packaging. There is a critical need for advanced materials with improved thermal properties capable of meeting the thermal management requirements of current and future high power electronic systems. The heat dissipation rate of electronic systems has increased dramatically, as a result of ongoing advances in semiconductor materials, compression of circuit physical architecture, size reduction of packaging envelops and faster switching speed. The technology developed in this project will enable the manufacture of cost effective graphite-metal packaging that offers improved thermal properties critical to thermal management solutions for next generation power electronics.

The broader impact/commercial potential of this project will be the development of the hot press die casting technology for use in producing graphite-metal billet materials. 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 more efficient, longer life electronics; reduced energy consumption; and improved environmental quality.

Amethyst Research Incorporated

Phase II Award No.: 0724233

Award Amount: $430,775.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: Photon-Assisted Hydrogenation Process Technology for Manufacturability and Improved Operability of HgCdTe Infrared Detectors

HgCdTe is an extremely efficient and versatile material for use in infrared imaging systems, but can be problematical for high quality imaging due to inherent material defects that compromise the electrical performance of many of the pixels in the imaging array. In order to rectify this problem, Amethyst Research has developed hydrogenation methodologies that can effectively neutralize these material defects from an electrical performance standpoint. By neutralizing defects, sub-performance pixels can be brought up to the same performance level as the more defect-free pixels, improving the pixel to pixel uniformity, and hence the overall image quality. The basic hydrogenation technique consists of diffusing atomic hydrogen into the material, where it reacts with the physical defects and thereby effectively eliminates these defects as sites that tend to trap charge carriers or otherwise interfere with the electrical characteristics. While there are many methods for generating atomic hydrogen from molecular hydrogen, the HgCdTe surface is very fragile, and can be easily damaged by techniques that are too aggressive. For this reason, Amethyst Research has developed and applied for a patent on a UV-assisted hydrogenation technique that is more benign to the HgCdTe surface than any other method that we have investigated.

Through extensive experiments with HgCdTe epi-layers from several device manufactures, Amethyst Research has demonstrated that the UV-assisted process does successfully activate the formation of atomic hydrogen that diffuses into HgCdTe layers, and reacts with defects in the these layers. Furthermore, studies on individual diode performance have shown that this hydrogenation technique can lead to definitive improvements in performance metrics. The findings have created significant interest among several device manufacturers, who are currently collaborating with Amethyst Research in research projects intended to demonstrate a similar improvement in overall performance of entire diode arrays.

The preliminary hydrogenation studies on HgCdTe were carried out at Amethyst Research under an SBIR grant from the Army Night Vision Laboratory (NVESD). These initial studies explored both glow discharge and UV-assisted hydrogenation techniques. During subsequent research, funded by MDA and NSF, Amethyst has shifted its emphasis away from glow discharge techniques and now concentrates mostly on the UV-assisted methods.

Anasys Instruments Corp.

Phase II Award No.: 0750512

Award Amount: $493,057.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Program Director: William Haines

Sector: Devices & Instruments

SBIR Phase II: Sub-100nm Infrared Spectroscopy Based on Atomic Force Microscopy

Two analytical techniques have found use in analyzing materials in a broad range of research and industrial applications. These are Scanning Probe Microscopy (SPM), which provides nanoscale topography information and IR Spectroscopy (FTIR) which provides chemical composition information at the several micron scale and up. Researchers have long recognized that if the nanoscale information of the SPM could be combined with the chemical composition information in FTIR the range of applications and benefit to a broad group of researchers would be enormous. The focus of this project is to build upon previous work and some more recent innovations to develop and bring to market a microscope that would provide nanoscale chemical composition information.The initial phase I work demonstrated the possibility of achieving nanoscale resolution and we are now early in the phase II work which is focused on taking the initial proof of concept and developing a robust system. The SBIR funding has allowed us to significantly accelerate our development efforts on this technology which should bring this technology to market in a much shorter timeframe.

A number of research groups have focused on developing nanoscale chemical identification capability using the Scanning Probe Microscope. Recent efforts include Dr. Novotny at the Univ of Rochester who is a leader in the effort of developing SPM based Raman microscopy and Dr. Keilmann at Max Planck, Munich who is a leader at SPM based IR microscopy. However the scientific challenges involved here have prevented a commercial product. We believe that our patent protected technology would enable us to commercialize a system that provides nanoscale chemical composition information on a broad range of samples.

Atlas Nanotechnologies, LLC

Phase II Award No.: 0823103

Award Amount: $499,993.00
Start Date: 12/15/2008
End Date: 11/30/2010

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Program Director: Cheryl F. Albus

Sector: Materials

SBIR Phase II: Dry Thermal Adhesive Based on Carbon Nanotubes

This Small Business Innovation Research (SBIR) Phase II project seeks to develop a flexible, double-sided, dry adhesive "tape" that is applicable to science, space, industry and home use. The thermally and electrically conductive tape will be detachable and reusable, and, will not have the disadvantages associated with other adhesion methods. Surfaces will not require being smoothed, clean, non-porous, nor ferro-magnetic for adhesion, nor will it require special fixtures for attachment. This project will permit tape to be directly applied as the intermediary between any two surfaces that require 1) high thermal heat transfer from one surface to the other, and/or 2) strong adhesion. The project will explore manufacturing aspects, as well as preparation for production of prototype double-sided adhesive tape with superior thermal and adhesive properties. The coexistent mechanical, thermal and electrical properties, makes this innovative adhesive tape advantageous to many applications including semiconductor chip mounting, heat sinking and systems that require a rapid mount.

The broader impact/commercial potential of this project will mean significant improvements in thermal performance of many electronic devices and time-savings in manufacturing by removing the need to bolt down (sub-) assemblies. The true commercial value of using this innovation, in terms of superior performance, streamlined designs, ease of manufacture, trouble-free operations and simplified assembly, could very well run in the millions of dollars in cost savings.

Atomic Precision Systems Inc.

Phase II Award No.: 0750076

Award Amount: $499,908.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Program Director: Cheryl F. Albus

Sector: Manufacturing Processes

SBIR Phase II: High-Speed Atomic Layer Disposition System for Compound Semiconductor Thin Films

High-Brightness LEDs (HBLEDs) are manufactured are by stacking atomically thin and also thick films of various expensive semiconductors with high degree of precision and quality. HBLED light bulbs provide an average lifetime of 50,000 h (10 + years in household use) and consume 50% less electricity – as compared to CFL bulbs. Moreover, HBLED bulbs do not contain mercury, give pleasant white light and can be dimmed. To an average consumer, HBLED based lighting can save hundreds of dollars in utilities bills every year. However, current HBLED manufacturing technology is inefficient and expensive and slow. Atomic Precision Systems is a Santa Clara, CA, based start-up. Atomic Precision is developing its patented high-speed Atomic Layer Deposition (ALD) thin film semiconductor technology aimed at providing cost reduction to 1/10th of current to manufacturers of HBLEDs. Atomic Precision's proprietary ALD equipment and process technology will enable the reduction of the HBLED bulb retail unit price from the current $45 to below $4. This significant cost reduction will make it feasible to bring affordable HBLED light bulbs to the worldwide consumer markets.

The innovation is related the technology developed at Atomic Precision by Dr. Prasad N. Gadgil. Preliminary feasibility of operation of Atomic Precision's patented thin film manufacturing system was verified through the NSF SBIR Phase-I grant No IIP-0637512 with helium gas only. In the current phase-II program, Atomic Precision aims to establish feasibility of low-cost, high-speed and high quality GaN thin and thick film processes. Subsequently, Atomic Precision will commercialize its HBLED manufacturing technology by Q3 of 2012.

Claytec Inc.

Phase II Award No.: 0822808

Award Amount: $500,000.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Manufacturing Processes

SBIR Phase II: Automotive Nanocomposites

This Small Business Innovation Research (SBIR) Phase II proposal aims to commercialize a new mesoporous silicate nanoparticles for the reinforcement of thermoplastic polymers used in the manufacture of U.S. cars and light trucks. Whereas nanoparticles, in general, provide some polymer reinforcement benefits, they typically lack the ability to provide strength as well as stiffness. Also, they normally require extensive organic surface modification for dispersion in the polymer matrix. Organic modifiers limit nanoparticles thermal stability and compromise their suitability for nanocomposite manufacturing through cost-effective melt processing methods. The purely inorganic mesoporous silicates this project plans, circumvent all of the limitations caused by organic modifies by providing a unique combination of surface polarity, mesopore size, surface area, and pore volume which optimizes interfacial interactions between the particles and the polymer matrix for effective dispersion and reinforcement. In addition to providing stiffness at particle loadings, the mesoporous silicates provide strength, which allows the amount of polymer needed to produce an automotive part to be reduced in proportion to the added strength. The polymer savings alone allow users of the technology to reduce the weight of the vehicle, achieve stiffness, and improve fuel economy at no added cost.

The broader impact/commercial potential of automotive nanocomposites can directly impact the US energy economy, as well as environmental quality. The combination of reduced vehicle weight and increased fuel economy translates into a reduction in petroleum consumption and green house gas emissions. The process for producing mesoporous silicate nanoparticles is neither energy-intensive nor environmentally harmful. Based on aqueous sol-gel chemistry, this project's nanoparticles are manufactured in yields at a temperature of with no harmful waste released to the environment.

Dendritech, Inc.

Phase II Award No.: 0848490

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Nanotechnology

SBIR Phase II: Ultra-Low k Interlayer Dielectrics for 22 nm Technology Node and Beyond

This Small Business Innovation Research Phase II project is to develop a new technology for manufacturing ultra-low dielectric constant materials for leading-edge logic devices for the 22 nm technology node and beyond. The research approach is based on the bottom-up synthesis of honeycomb-like nano-structured films in which porogen component is pre-built into the nano-sized cells and can be decomposed in a strictly controlled manner.

By extending microchip miniaturization this project may impact information technologies and related fields. This program may also significantly expand the overall knowledge and understanding of nano-structured materials and nanotechnology in general.

Displaytech Incorporated

Phase II Award No.: 0646460

Award Amount: $499,999.00
Start Date: 06/15/2007
End Date: 05/31/2009

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Sector: Devices & Instruments

SBIR Phase II: A New Class of Complex Ferroelectric Liquid Crystal Mesogens for Advanced Electro-Optic Devices

This project aims to explore a new class of dimer-like ferroelectric liquid crystal materials that exceed today's dominant nonlinear optic (NLO) inorganic crystals such as lithium niobate in their NLO strength. This will enable advanced optoelectronic products across multiple markets, from laser illuminators for display, to 100GHz integrated electro-optic (EO) modulators and switches for optical interconnects and telecommunications. These materials combine the advantages of organic poled polymers with FLCs' intrinsic thermodynamical stability, offering an ideal and unique material platform for advanced EO devices. During the past 18 months of their NSF-funded research Dr. Zhang and his collaborators at Displaytech have developed several types of these novel dimer-like FLCs incorporating strong chromophores. Second harmonic generation (SHG) measurements show that the d22 coefficient of the second-order susceptibility tensor for one type of materials is 15 pm/V, the largest NLO coefficient reported to date for calamitic NLO FLCs. This value is comparable to those of many commercial inorganic EO crystals. A polymer form of NLO FLC materials would be optimal for developing integrated, stable, and high-performance EO devices. Dr. Zhang and his collaborators are focusing on developing optically uniform polymer films with strong NLO and EO performance. The culmination of this two-year project is intended to be prototype materials and test results enabling the envisioned new classes of commercial EO and NLO devices. This technology will provide societal benefits through the commercialization of this technology by enabling brighter laser illuminators and much faster integrated EO modulators.

This innovation is related to basic research conducted in the lab of Prof. David Walba at the University of Colorado, where a new class of dimer-like FLCs were investigated for their potenital to exhibit large NLO and EO coefficients.

Exa Corporation

Phase II Award No.: 0750465

Award Amount: $497,699.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Virtual Prototyping Tool for Complex Flows of Polymers and Suspensions

The equations for flows of fluids like water and air have been known for nearly two centuries. However, equations defining flow properties for many industrially and commonly important materials such as (motor) oils, paint, polymers, powders, food products, pharmaceuticals, have remained largely intractable and even unknown for many decades. In this NSF project, Exa Corporation is developing reliable and technologically usable computer–based digital prototyping tools for such fluid systems in industrial settings. The new methods combine the mathematical description of large scale flow properties with detailed microphysics that describes these complex fluids without guesswork. Exa's new virtual prototyping tool being developed here combines flow microscopic/macroscopic modeling capabilities developed in Phase I of this project with Exa's unique, robust, and patented lattice-Boltzmann based technique (branded as PowerFLOW) and is expected to be a 'blue ocean' opportunity that will leapfrog the competition and open new market horizons because of synergy between three main factors: (1) Exa's fully automated creation of a robust and faithful computer model of the flow process. Project time-to-completion can then be reduced from months/weeks to days/hours; (2) Getting more accurate answers, enabled by employing Exa's revolutionary hydrokinetic prediction methods prototyped in Phase I and being finalized in Phase II; and (3) Getting answers faster by means of large numbers of computer processors used in parallel. These new software tools can revolutionize how engineers use digital prototyping for diesel engines, chemicals, food products, pharmaceuticals/nutritional processing, disk drive manufacturing, semiconductor equipment design production, and many other applications. Moreover, core US industries, such as chemical, biomedical, automotive, and oil & gas, will reap the benefits of streamlined manufacturing design efficiencies resulting in lower costs, faster and more accurate design execution, and greater ROI.

This work originated from fundamental developments at Exa Corporation, that is now being converted into a broadly applicable digital prototyping methodology. Planned commercialization of this Phase II product will include integration into future releases of Exa's PowerFlow software suite.

Hyperion Scientific, Inc.

Phase II Award No.: 0724183

Award Amount: $466,981.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Development of Efficient Short-Wavelength Radiation Sources For Next-Generation Lithography

Optical projection lithography is the technology currently used for the patterning of semiconductor wafers. Up until recently, continued improvements in optical lithography has enabled the manufacturing of faster and cheaper computer chips, with the number of transistors in integrated circuits doubling every 18 months (Moore's Law). However, optical lithography is reaching its limitations for developing chips with smaller and smaller feature sizes, and shorter wavelength light sources will be necessary to manufacture chips in the coming decade. EUV lithography – which utilizes light at a wavelength that is more than an order of magnitude shorter than that currently used in photolithography (13.5 nm versus 193 nm) – will allow chip manufacturers to produce next-generation semiconductor chips with critical dimensions at or below 32 nm. By providing the ability to manufacture chips with smaller feature sizes, this new production capability will greatly facilitate the advancement of exciting new technologies in the semiconductor industry. The essential requirement for this technology is to have a reliable, clean, and powerful light source at a wavelength of 13.5 nm. A laser-produced plasma source is currently the most promising option for an EUV light source. A suitable EUV source will require the efficient conversion of the incident laser energy to EUV radiation at 13.5 nm.

At Hyperion, our activities are directed to developing sources with high conversion efficiency into 13.5 nm light. During this Phase II project, we have successfully set up our laboratory and diagnostics packages for measuring the key radiative properties of Sn laser-produced plasmas, and performed several series of experiments to develop highly efficient EUV sources. To date, one type of novel source developed at Hyperion shows significant potential for being used as a high efficiency source for EUV Lithography systems.

Hyperion Scientific was spun out of Prism Computational Sciences at the beginning of this NSF Phase II SBIR project for the purpose of developing highly efficient light sources for commercial applications. Prism was founded in 1998, and focuses on performing basic research and developing software for studying plasma radiation sources. Over the past 10 years, Prism has developed state-of-the-art plasma radiation physics simulation tools that are now widely used by major national laboratories and universities. Using its simulation tools, Prism, during Phase I of this NSF SBIR project, developed designs for laser-produced plasma light sources that have significantly higher conversion efficiencies than those previously achieved.

Industrial Optical Measurement Systems

Phase II Award No.: 0723669

Award Amount: $529,107.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Sector: Manufacturing Processes

STTR Phase II: Development of an In-Line Cylinder Bore Inspection System

In this project Industrial Optical Measurement Systems (IOMS) will manufacture and supply to the Gehring Company, a manufacturer of honing equipment for the automotive industry, cylinder bore probe systems for incorporation into cylinder bore inspection stations that will be jointly marketed by IOMS and Gehring to manufacturers of piston engines. IOMS has demonstrated operation of the probes in cooperation with the University of Michigan, improved the probe hardware and software to be more robust and less expensive to manufacture and service, and has provided Gehring with the upgraded probe system to test. NSF funded IOMS to develop the laser probes for the inspection of surface finish of combustion cylinders of engine blocks on an engine block production line. This included development of the probes, probe electronics and software, the analysis of the results to determine whether surface finishes were acceptable or defective, and development of display software to quickly indicate the location and type of problem causing a surface finish defect. As a result of this work Gehring entered into a partnership with IOMS to jointly develop and market cylinder bore inspection stations.

This technology is unique (patented) and is expected to improve control and reduce costs in the manufacture of piston engines through use of advanced instrumentation for cylinder surface finish inspection. It is a disruptive technology in that it replaces and automates existing methods of inspection (primarily human visual inspection). It helps to establish the nation as a global leader in fundamental transformational science and engineering by providing objective, recordable data that can be used to better understand and control the combustion cylinder manufacturing process.

Innegrity LLC

Phase II Award No.: 0823014

Award Amount: $500000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Materials

SBIR Phase II: Low Dielectric Fiber for High Frequency Circuit Board Applications

This Small Business Innovation Research (SBIR) Phase II project aims to develop the production and application of low dielectric fibers for use in high frequency circuit board applications. As the frequency of digital communications approaches the frequency at which microwave ovens work, the importance of the dielectric properties of the substrate material on which digital circuits are formed is becoming of critical importance. This project will use material and processing strategies to increase the physical properties and reduce the cost of fibers based on cyclic olefin copolymers. These fibers will be woven into fabrics and made into prototype circuit board materials to show their utility. The anticipated results of the project is a fully developed fiber which is ready to be commercialized which can be combined with glass fiber to reduce the dielectric constant and dielectric loss of high frequency circuit board substrate materials, but in all other ways is compatible with processes and materials used to manufacture these circuits.

The broader impact/commercial potential will be the achievement of processing blends of amorphous and semi-crystalline polymers in fiber extrusion at speeds approaching 2 kilometers per minute. If successful, this project will introduce a low cost material that enables further advances in digital data processing and communication, with all the incumbent benefits, doing so with reduced energy dissipation in the circuit board materials. The materials are also lighter weight than their glass fiber predecessors, and therefore reduce the weight of mobile electronic and communication devices.

InnoSense LLC

Phase II Award No.: 0823108

Award Amount: $499,999.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Coatings

STTR Phase II: Low-Cost Processing of Nanoporous, Super-Hydrophilic, Multifunctional Coatings for Glass and Plastic Surfaces

This Small Business Technology Transfer (STTR) seeks to develop three significant permanent, self-cleaning, anti-fog coatings for plastic and glass surfaces. Fogging of the windows of a car is a hazard most drivers have experienced at one time or another. Fogging results in poor visibility, and unsafe driving or flying conditions. Durable, anti-fog coatings that provide a permanent solution to the problem have potential to satisfy critical needs, especially for the growing number of aging baby boomers.

The broader impact/commercial potential of the coatings has been tested independently; these coatings will be fine-tuned for applications in aircraft cockpit windows, motorcycle helmet visors, and in related personal protective gear. These multifunctional hard coatings can be used as abrasion resistant, anti-fog and anti-reflection coatings on both glass and plastic surfaces. The coatings are made from inexpensive raw materials and simple processing techniques like dip or spray coating suited to forming conformal coatings.

Innovative Surface Technologies, LLC

Phase II Award No.: 0848918

Award Amount: $499,424.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Coatings

STTR Phase II: Superhydrophobic Coatings for Water Repelling and Corrosion Control

This Small Business Technology Transfer (STTR) Phase II project will develop a superhydrophobic nanotextured coating that is highly water repelling and anti-corrosive. The coating will be applied to specific hearing aid surfaces (i.e., microphone ports, receiver, joints, battery, and case) to impart a water resistant barrier that repels moisture and other environmental contaminants. Penetration of water into hearing aids from such sources as moisture, sweat, and rain interferes with acoustical performance and causes corrosion, circuitry malfunction and breakdown of the hearing aid. Openings are required for the transfer of sound waves. A seam is located around the battery and the Zinc/air batteries, themselves, cannot be sealed because they require oxygen to function. With all of the open areas and seams in a hearing aid, it is not surprising that water often penetrates into the interior of the hearing aid. Individuals are living longer and healthier lives and they want to be able to hear while they participate in boating, hiking, running, and golfing and other forms of exercise. The water repellent anti-corrosive coating will allow hearing aid manufactures to offer more durable and reliable instruments, that stand up to the rigors of an active life style for the 2.2 million hearing aid users nationwide.

The broader/commercial impact project will be more durable hearing aids and that will potentially reduce the costs associated with hearing aid maintenance. Hearing aids are not the only electronic instruments that suffer from active lifestyles and environmental contaminants. Cell phones, earphones, digital cameras, watches, laptops, and other electronic devices could potentially benefit from the water repellent anti-corrosive coating technology.

InterPhases Solar, Inc.

Phase II Award No.: 0823118

Award Amount: $416,021.00
Start Date: 12/15/2008
End Date: 11/30/2010

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Sector: Manufacturing Processes

SBIR Phase II: Spray Deposited Transparent Conducting Zinc Oxide Films

This Small Business Innovation Research (SBIR) Phase II project seeks to develop a cost-effective, non-vacuum technology to deposit p-type transparent conducting oxide (TCO) films. The lack of effective p-type TCOs has been a long-standing problem for the electro-optic industry. It is the crucial component to advance photovoltaic technology with n-type absorbers. The Phase I project developed cutting-edge spray pyrolysis technology to deposit wide-gap p-zinc oxide (p-ZnO) films. The project achieved important breakthroughs, both in terms of the new deposition system, as well as achieving p-ZnO films with inexpensive spray pyrolysis. The structural and electro-optical data for the ZnO films validate the feasibility of the new deposition approach and provide a compelling measure of project success. The Phase II project will advance the deposition system, improve the scientific understanding of doping issues, derive process-property correlations to optimize the electro-optical properties, and integrate technology into existing technology.

The broader impact/commercial potential for new optoelectronic products is increasing exponentially, owing to the demand for clean energy and the microelectronics revolution. The deposition method offers cost and manufacturability advantages over current vacuum methods; it is remarkably versatile to deposit a number of other technological semiconductors that are amenable to spray deposition. The p-ZnO films can be used for short-wavelength light-emitting diodes, laser diodes, energy efficient windows, flat panel displays, gas sensors and other opto-electronic applications. It can extend photovoltaic technology to n-type absorbers and multi-junction flexible solar cells for higher efficiency. The commercialization of this technology will provide energy security, avert future power crises and reduce global warming.

Ionic Systems Inc.

Phase II Award No.: 0724467

Award Amount: $464,282.00
Start Date: 10/01/2007
End Date: 09/30/2009

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Sector: Materials

SBIR Phase II: Diffractive Electrode Structure for on Chip Embedded Passive Components.

Increasing demand for portable consumer electronics is inextricably tied to integration of computing and communications functions into smaller, faster, affordable portable appliances. By moving passives from surface mount to on-chip we create an efficient and cost effective means of production. Ionic has developed materials and processes to lithographically create passive micro-optical capacitance structures on chip to provide needed functionality, mass producibility and reduced cost. A nanocomposite material is molecularly engineered in a closed PECVD process. The deposited nanocomposite has shown excellent stability and integratiability with other microelectronic fabrication techniques. The material exhibits variable index of refraction with exposure to ultra violet (254nm) radiation. The ability to alter index of refraction also indicates the ability to alter dielectric constant. This is a unique and highly useable property. The nanocomposite material is deposited and lithographically exposed to create planar capacitance structures. The dielectric constant is then reduced by subsequent UV exposures to the entire wafer as a flood exposure or locally to selected devices either through a photo mask or to individual devices with a well focused beam or laser based device. The capacitance of a capacitor so formed may be precisely varied by up to 20% in value.

Ionic Systems has worked closely with Hughes Radar Systems Group, Lockheed Palo Alto Research Laboratory, and Westinghouse Advanced Technology Laboratory to demonstrate hermetic thin films on avionics. Hughes successfully tested Ionic Systems hermetic film on an avionics module for six months in situ and flight tested the module for several weeks on a F18 aircraft. Modules for space made by Lockheed Palo Alto Research Laboratory were hermetically protected with an Ionic Systems film. The parts were tested and approved by NASA Goddard and flown on NASA's Polar Satellite in continuous use since 1995.

The first iteration of the early hermetic films was a photosensitive dry resist process tested by Army Night Vision Laboratory under DAAMB07-95-C-M048 and NSF 9560218 and 9701670, Dry resist for IC manufacturing. The low dielectric constant materials were demonstrated on NSF 9661312, Low dielectric materials. Other support came from DSWA01-98-0208, Low loss waveguides, DTRA 01-02-C-0023 Low loss waveguides, and SPAWAR N66001-07-C-2048, Ultra low loss, low index optical waveguides. Ionic demonstrated ability to vary index of refraction to form passive devices under Air Force F33615-99-C-2960 Trimmable capacitors and NSF 0320494, Waveguide Optical Gyroscope. Fairchild Semiconductor has long supported Ionic Systems by providing feedback, in-kind services and production manufacturing technology.

Kent Displays Inc.

Phase II Award No.: 0750379

Award Amount: $500,000.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Sector: Materials

STTR Phase II: Photochemically Switched Chiral Materials for Chiral Nematic Displays

A new film display technology provides displays that are photo addressed. Unlike traditional display technologies, the film displays are void of electronic circuitry. As such, the displays are of extremely low-cost, thin, flexible and can be used in applications where low cost, erasable, high resolution images have not been possible before such as: stored value cards, ID badges and point of sales signs. The displays are similar to a photographic film except that the images can be erased and a new image put on the film. An image can be stored on the film for an indefinite period of time without degradation until erased. The photo displays are made from photosensitive liquid crystalline material and are simple to construct on thin plastic sheets. The display films can be easily processed on a high volume roll-to-roll manufacturing line. Digital images can be addressed on the film with an optical image writer. In a recent advancement we have extended the technology to full color images. By stacking photo sensitive films of the primary colors (red, green and blue) we have demonstrated color images. In a stack film, the colors additively mix in which any number of colors can be created by using different shades of the primary colors. Color images add to the commercial attractiveness of the technology.

The bistable liquid crystal electronic display technology was invented under a National Science Foundation (NSF) supported Science and Technology Center. ALCOM, at the Liquid Crystal Institute at Kent State University in 1994. In Phase I of this NSF STTR contract, photosensitive compounds were developed and stabilized erasable photosensitive displays utilizing bistable liquid crystals were invented. In Phase II of this contract the technology was advance to flexible film displays and to full color.

LT Technologies

Phase II Award No.: 0646184
Phase IIB Award No.: 0932001 (pending)
Award Amount: $541,645.00
Start Date: 03/01/2007
End Date: 02/28/2009

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Sector: Materials

SBIR Phase II: A Novel Microwave Technique for Rapid Thermal Processing of Silicon Carbide Wide Bandgap Semiconductor

NSF funded researches at LT Technologies (LTT) are developing a proprietary cavity-less microwave thermal processing technology for application in the semiconductor Rapid Thermal Processing (RTP) market. LTT's proprietary technology generates uniform, spatially broad, frequency-specific, high-power, short-duration microwave bursts that has the potential to be applied against an entire semiconductor wafer surface. This technology has the potential to enable batch processing of wafers while achieve precise activation of select materials across and within the wafer volume.

Applying LTT's proprietary microwave RTP technology on SiC (a wide bandgap semiconductor used in high-power, high-frequency devices), we have achieved:

- Lowest reported sheet resistance to-date of any p-type implanted SiC(1.3 k□/□) which is an order of magnitude lower than that of current best commercial products.
- Very low surface roughness (~1nm) for ion-implanted SiC.
- Remarkably lower defect densities, near dislocation free.

LTT has developed a prototype unit of commercial product based on the single head microwave technique developed from this NSF SBIR project. Naval Research Lab will be the first government lab to purchase LTT's microwave RTP product in 2009. LTT has been developing computer-based control system for uniform heating of large wafers using an array of multiple microwave heads. The photo in the image section below demonstrates microwave heating of 1 inch SiC wafer with an array of six heads.

The innovation is related to PI's patent pending invention (2005) to overcome the limits and technical barriers of existing magnetron-cavity based microwave techniques for ultra-high temperature RTP of semiconductors. The PC based control system for transient temperature control of multiple-head heating is related to a mathematical model and control algorithm developed from NSF Grant DDM-9115417 in 90s.

Lumeras

Phase II Award No.: 0848526

Award Amount: $500,000.00
Start Date: 02/01/2009
End Date: 01/31/2011

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Sector: Devices & Instruments

SBIR Phase II: Ultraviolet Laser for Ultra-high-resolution Photoemission Spectroscopy

This Small Business Innovation Research Phase II project is to develop a shortwavelength, narrow-bandwidth, high-brightness photo-ionization laser; that can be used for used for ultra-high energy-resolution, angle-resolved photoemission spectroscopy (ARPES), and for single-photon-ionization (SPI) in order to improve mass spectroscopy-based detection capabilities of complex organic molecules, especially low-vapor-pressure explosive compounds and trace residues.

The compact size, efficient optical conversion, and high brightness of the proposed laser source will enable integration into "field-ready", on-line mass spectrometry tools. The capabilities of the proposed single-photon-ionization light source will also complement a broad array of established mass-spectral analysis techniques to enable the development of instruments capable of analyzing heterogeneous samples with no a-priori knowledge of the sample composition. This capability is urgently needed for a variety of homeland security and non-proliferation applications.

Lynntech, Inc

Phase II Award No.: 0750183

Award Amount: $467,171.00
Start Date: 02/15/2008
End Date: 01/31/2010

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Sector: Materials

SBIR Phase II: Advanced Materials for Hybrid Electrochemical Capacitors

Electrochemical capacitors (ECs) (also called ultracapacitors or supercapacitors) provide a key technology to improve the performance and reliability of energy delivery systems. Electrochemical capacitors provide an energy and power solution that cannot be met with either conventional dielectric capacitors (low energy density) or conventional batteries (low power density, poor cycling performance). Specific advantages of ECs include the ability to be rapidly discharged/recharged at rates significantly faster than batteries, high energy efficiencies, and significantly longer cycle lives compared to current batteries. The development of improved ECs is critical to achieving cost-competitive hybrid electric vehicles, where the use of ECs has the potential to significantly extend battery lifetime and improve energy efficiency. Despite their potential, current ECs have two primary factors that limit their use: (i) their significantly lower energy densities compared with batteries, and (ii) their high costs. Asymmetric (hybrid) configurations that utilize a low-cost, non-carbon electrode can provide lower cost ECs that have significantly higher energy denisties than current symmetric configurations. Lynntech, Inc. has developed an innovative, low-cost nanostructured composite electrode for high energy and power density asymmetric electrochemical capacitors. The metal oxide-based composite electrode material can provide packaged asymmetric ECs with high power densities (>1000 W/kg) and considerably higher energy densisites (> 17 Wh/kg) than current symmetric cells (~3-5 Wh/kg) which are based on carbon electrodes. The objectives of the Phase II project are to optimize energy density, power density, and cycle life of the material and develop a low-cost, large-scale manufacturing process to produce the material at low costs. Asymmetric ECs with higher energy densities than current cells will provide improved performance power systems for hybrid electric vehicles as well as numerous medium and high-power applications.

The innovation resulted from an extension of basic research within the laboratories of Dr. Debra Rolison and Dr. Jeffrey Long at the Naval Research Laboratory under funding from the Office of Naval Research. The innovation was developed and demonstrated at Lynntech, Inc. under a Phase I SBIR grant from NSF. The project is currently proceeding under a Phase II SBIR grant from NSF.

M4 Sciences Corporation

Phase II Award No.: 0822879

Award Amount: $511,660.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Manufacturing Processes

STTR Phase II: Modulation-Assisted Deep Hole Drilling of Micro/Meso-Scale Biomedical Components

This Small Business Technology Transfer (STTR) Phase II project aims to develop a Modulation-Assisted Machining (MAM) system with novel capabilities for micro/meso-scale deep-hole drilling of biomedical components. The system is structured around a new device; an accessory developed for computer numerically controlled (CNC) machine tools. This new device superimposes a low-frequency sinusoidal modulation onto machining processes enabling controlled chip formation and easy disposal, enhanced lubrication of tool-chip contact, reduces energy consumption, and, potentially, a reduction in tool wear. When implemented in the appropriate system framework, unprecedented increases in productivity and efficiency of deep-hole drilling processes are envisaged.

The broader impact/commercial potential of this project will be commercialize MAM technology in manufacturing of biomedical components and related applications in automotive and aerospace fluid systems manufacturing. Complemented by a strong education and training program. By driving the development of a class of clean machining processes with reduced effluent streams and energy consumption, and improved efficiency, this project will impact sustainable manufacturing for the discrete products sector, with broad societal benefits.

Magnetic Development, Inc.

Phase II Award No.: 0822525

Award Amount: $511,873.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Coatings

STTR Phase II: Condensing Ejector for Second-Step Compression in Reversed Rankine Cycle

This Small Business Technology Transfer (STTR) Phase II project seeks to continue the research and analysis of condensing ejectors for second stage compression in a refrigeration cycle. A condensing ejector is a two-phase jet device that produces outlet pressure higher than either of inlet pressures. The project combines theoretical and experimental models in order to design the condensing ejector for use in more efficient refrigeration systems. The results thus far show that the new design is capable of improving the efficiency of vapor compression refrigeration cycle by approximately one-third with R22 refrigerant. The goal is to draw closer to this ideal value with environmentally friendly refrigerants like R410A. The application of critical two-phase flow devices will lead to development of more efficient thermodynamic cycles for refrigeration and A/C and in the future possibly for propulsion and power generation.

The broader impact/commercial potential from this project will bring considerable economic and societal benefits by reducing our nation's dependence on foreign oil, improving safety of nuclear reactors and natural gas pipelines, and better understanding of phenomena of two-phase flow. Applications of the condensing ejector theory in heat pumps might promote use of renewable geothermal energy sources in the remote communities with limited energy choices. This project leads to enabling technologies by providing the technology platform for a new approach to evaluating two-phase flows. The capability to handle rapid phase change simulations has generated interest from the automotive industry to simulate flash boiling in automotive fuel injection. This project also provides the basis for establishing fundamentally new engineering and designing methods for equipment operating on two-phase flow.

Mainstream Engineering Corporation

Phase II Award No.: 0750416

Award Amount: $469,109.00
Start Date: 03/01/2008
End Date: 02/28/2010

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Sector: Devices & Instruments

SBIR Phase II: Innovative Two-Phase High-Heat-Flux Heat Exchanger

The next generation of high-power electronics requires advanced cooling methods in order to reduce the likelihood of failure. Designs already exist for amplifier modules that advance the state-of-the-art, but viable methods of cooling such devices do not exist. Increased power density allows for more effective radar equipment for the military and higher performance electronics for the commercial sector.

Mainstream is developing cavitation enhanced microchannel cooling devices that will allow electronics manufacturers to continue to increase component power while decreasing component size. Mainstream's cavitation enhanced cooling devices facilitate superior heat transfer when compared to liquid-only cooling devices. Furthermore, Mainstream's devices allow for a more uniform temperature distribution over the surface of an amplifier chip than conventional cooling methods.

Advances in electronics cooling technology will facilitate the development of next-generation electronics. The next generation of electronics will reduce the weight, and improve the performance of a multitude of electronic systems. Specifically, military electronics such as radar devices; and high-performance computing components, will benefit greatly from an innovative method of electronics cooling.

The innovation is related to research in the lab of Professor Yoav Peles at Rensselaer Polytechnic Institute. A fundamental study of flow regimes in cavitating flow was the original intent. However, the annular flow regime that was demonstrated as a result of orifice induced cavitation in microchannels is favorable for two-phase heat transfer. Mainstream's primary market thrust is high-heat-flux cooling technology and we partnered with Prof. Peles to investigate possible synergies. The feasibility was originally demonstrated in an NSF funded Phase I SBIR (award# OII-0610991). The ongoing Phase II effort focuses on further device refinement, integration with existing electronics, and commercialization of the demonstrated cooling technology.

MedShape Solutions, Inc.

Phase II Award No.: 0750247

Award Amount: $499,826.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Materials

SBIR Phase II: Shape Memory Polymer Based Orthopedic Fixation Devices

This Phase II SBIR project is intended to design, develop, manufacture and validate soft tissue repair devices based on shape memory polymers. The Phase II work is focused on the prototype design and manufacturing processes for commercialization of a shape memory polymer device intended for Anterior Cruciate Ligament (ACL) knee reconstruction. Significant progress has been made towards the successful completion of this grant. Biocompatibility testing has been completed which resulted in formal registration of the shape memory polymer with the Food and Drug Administration under Device Master File #1533. The implant geometry was also developed and confirmed to have equivalent performance to other commercially available products use in soft tissue repair. The benefit of the use of this technology is the ease of implantation and the uniform shape recovery that results in soft tissue failures (during ultimate strength testing) significantly more favorable over the other commercially available devices. This performance advantage was confirmed. Finally, prototype instrumentation for shape memory polymer implant delivery were developed, along with packaging to maintain the temporary geometry during shipping and storage, and clinicians successfully evaluated the technology by implanting the prototype devices in cadavers.

This technology was based upon research conducted at the University of Colorado and supported under an NSF grant (2002-2005 Shape Memory Polymer Based Nano-Composites for MEMS, Nanomanufacturing Program. PI: Gall). The company formation was originally supported by the University of Colorado Technology Transfer Office and, ultimately, transferred to the Georgia Institute of Technology with the relocation of Dr. Kenneth Gall, the founder of MedShape Solutions. The university, in combination with the Georgia Research Alliance, is providing management advice, logistics support and access to grant funding opportunities.

The project team (Gall, Bartz, and Griffis) began working on shape memory polymers and alloys in late 2004. Their work featured the first successful utilization of a load bearing shape memory polymer device for soft tissue repair in a bovine model. It resulted in the filing by University of Colorado of a provisional patent application in early 2005. In 2007, MedShape Solutions was awarded a Phase 1 and Phase 1B grant through the NSF as well as securing additional funding through strategic partnering with a large orthopedic company. Development continues for the shape memory polymer device through the Phase 2 NSF grant, recently resulting in successful utilization of the device by surgeons in cadaver knees and prototype instrumentation for implantation. The company anticipates being ready to submit the shape memory polymer device for market clearance by the US Food and Drug Administration in late 2009.

MemPro Ceramics Corporation

Phase II Award No.: 0822914

Award Amount: $500,000.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Sector: Materials

STTR Phase II: Metal Oxide Nanofibers for Filter and Catalyst Support Structures

This Small Business Technology Transfer (STTR) Phase II project seeks to take advantage of unique performance properties of ceramic nanofiber supported catalysts for applications in automotive, power generation, and chemical process industries. The efficiency of ceramic nanofiber composite materials to capture nano-sized particulates (inorganic and soot) is of particular interest to the automotive industry. Also, an opportunity to field test a composite catalyzed nanofiber material in a power generation facility to remove low-levels of NOx has been developed through commercialization activities within the power generation industry. This is a significant opportunity that will require the fabrication of a ceramic nanofiber/polymeric composite media and a field test apparatus. Successful completion of this opportunity will provide the background necessary to develop a first-generation ceramic nanofiber product.

The broader impact/commercial potential of this project will provide the initial detailed examination of catalyst deactivation mechanisms using nanofiber support structures as well as providing a critical investigation of nano-sized particulate capture by nanofiber composite materials. This baseline information is beneficial to define and support future investigations of ceramic nanofiber materials. It is anticipated that catalyzed ceramic nanofiber/microfiber media will maximize the efficient use of catalytic materials (precious metals), enhance destruction of greenhouse gases (NOx and CO) from combustion processes, and capture harmful particulates from various gas process streams. These characteristics will help the power generation industry (fossil fuel burning), the motor vehicle, and the chemical industry meet current and future emission reduction standards while simultaneously benefiting the environment. Also as globalization leads to added pressures on U.S. companies to produce products and materials at a lower cost to remain competitive, reduction in the overall cost of energy production and transportation costs will improve U.S. competitiveness.

Metal Matrix Cast Composites, LLC

Phase II Award No.: 0750180

Award Amount: $499,994.00
Start Date: 02/01/2008
End Date: 01/31/2010

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Sector: Materials

SBIR Phase II: Ultra High Thermal Conductivity Aluminum/Graphite Composites from Low Cost Natural Graphite

For every 10C decrease in operating temperature, the life of an electronic device is doubled. Conversely, more efficient cooling schemes enable devices to be manufactured with higher performance at higher power densities and in smaller spaces. The materials developed in this project will enable such performance enhancements and, if we are successful, at lower cooling costs. The work on low impedance interfaces here are technologically significant and enable near theoretical heat transfer simply by modifying the alloying ingredients rather than expensive coating processes. This technology will reduce our dependence on copper for ETM applications and will find serious application in space and military radar and communication systems as well as microprocessor cooling, laser diode cooling and cooling of LED automotive illumination and large format displays. We have determined that natural graphite, in the form of flake (NGF) mined and beneficiated from the earth, has thermal properties as high as the best grades of artificial graphite (HOPG, APG, TPG) at a 1/1000 the materials cost. Translating high thermal conductivity (TC) of NG into high TC in aluminum/graphite composites (AlGrp) requires a low thermal impedance Al/graphite interface and well controlled NGF preform architecture so that, after pressure infiltration with molten Al alloy, high TC composites will be produced for electronic thermal management (ETM) applications. Thermal expansion (CTE) is designed into the material by controlling volume fraction NGF to match CTE of semiconductor packages and enhance ETM performance. By designing the alloy as well as the preform to provide liquid metal access to all NGF surfaces, a low thermal impedance interface will be formed, permitting high TC goals to be met. The intellectual challenge, then, is to design the architecture and specify the interface and to do so with a material and process that is cost competitive with OHFC copper. The project objectives are:

1. Develop a family of high TC materials for a wide range of ETM (electronic thermal management) applications.

2. Develop these materials using processes that will enable these products to be cost competitive with OFHC copper on a volume for volume basis.

3. Introduce these products into the ETM marketplace

MMCC has been developing CTE matched electronic thermal management materials for years based upon pressure infiltration casting technology developed by the founder at MIT during the '80s and MDA funding during the late '90s and during recent years. This technology involved milled graphite fibers. This present effort was inspired by the use of low cost natural graphite flake materials during some early scoping experiments at MMCC and lead to the proof of principal in NSF Phase I grant # NSF 06-553. Material from this project is now being prototyped and evaluated by a growing number of commercial manufactures

Micro Magnetics Inc.

Phase II Award No.: 0724913

Award Amount: $523,883.00
Start Date: 07/15/2007
End Date: 06/30/2009

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Program Director: Cheryl F. Albus

Sector: Manufacturing Processes

SBIR Phase II: Enhanced Plasma deposition Process for MgO-Based Magnetic Tunnel Junctions with 500% Magnetoresistance

This project involves a series of efforts dedicated to improving the performance of Micro Magnetics' proprietary magnetic sensor technology. Our sensors are based on a novel quantum tunneling effect -- the so-called tunneling magnetoresistance effect -- and feature layers of material which are as thin as five atoms thick. Because of this, they have the potential to become extremely powerful magnetic field sensors, combining very high magnetic sensitivity with low power consumption in a compact and cost-effective package. At this point, our sensors have the ability to detect magnetic fields down to 10-10 Tesla, which is 500,000 times weaker than the Earth's field. The resulting sensor devices will find utility in a number of important applications in the automotive, consumer, and military markets.

This Phase II project focuses specifically on improving the quality and uniformity of the six to eight thin layers of material which make up the sensor itself. These films are coated onto silicon wafers in a vacuum chamber via a process called sputtering, and a major part of this project is improving the consistency and accuracy of this coating procedure. By rotating the silicon wafers and controlling their position within the chamber, we have been able to improve the thickness tolerance of the finished devices by more than five times. We also have focused on improving the various processing steps which occur after the sensor films are created, including the patterning of the sensors and the thermal annealing step which is used to improve the film quality and control the magnetic performance of each batch of devices. We have also developed new and more efficient methods for measuring the sensors to better understand their behavior. The result of these steps has been an improvement in the percentage of high-quality sensors on each silicon wafer.

Micro Magnetics' core technology of magnetic tunnel junction sensors had its origins in original research conducted in the Nanoscale Physics and Devices group at Brown University. The company was spun out of Brown, and obtained seed funding in 2002 to begin development of sensor devices based on this evolving technology of spin-dependent tunneling. Three NSF Phase I SBIR awards assisted us in the initial development of these sensor devices. Based on this support, we launched our two primary product families in 2005 (the SpinTJ sensor family and the Circuit Scan family of semiconductor diagnostic tools, also based on our microsensor devices). In 2005, the company demonstrated a six-fold improvement in sensor response based on the use of a magnesium oxide (MgO) tunnel barrier. The current project aims to continue improving the fabrication process of these MgO-based sensor devices, by optimizing the critical sputter deposition process which is used to create the ultra-thin films which comprise each sensor. This will further improve their sensing performance and will greatly enhance their manufacturability.

MicroFab Technologies Inc.

Phase II Award No.: 0749979

Award Amount: $499,961.00
Start Date: 02/01/2008
End Date: 01/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Vapor Generator for the Calibration of Explosive Trace Detectors

This project uses precision micro-dispensing technology in the development of vapor generation instruments for the calibration and testing of explosive detectors. Several digitally controlled systems ranging from bench-top/research instrument to a portable unit using ink-jet technology have been prototyped and tested. The use of digitally controlled ink-jet dispensing to precisely eject minute amounts of dilute explosive solutions and convert them into vapor has been demonstrated. An electrical pulse applied to a piezoelectric micro-dispenser causes a drop of fluid to be ejected through a precise orifice. These droplets land on a heater that converts them to vapor. The amount of explosive delivered to the detectors can be controlled by the number of drops (dose mode – specified number of drops is generated) and the frequency of the droplet generation (continuous mode – droplets are generated continuously at fixed frequency). An additional control of the amount of explosive is provided by the concentration of the explosive solution that is dispensed facilitating the generation of infinitely small amounts of explosive vapors. The prototypes built have been evaluated with commercially available detectors in both dose and continuous modes. Ultimately, the ability to further miniaturize the vapor generators will lead to units that are embedded into next generation detectors for real-time verification and calibration. The overall societal benefit of successfully developing vapor generator products will be improved protection of the public, both real and perceived, from terrorist threats while minimizing the cost and negative perception related to false alarms. The technology also has spin-off opportunities in olfaction based medical diagnostics.

The innovation is related to basic research performed at MicroFab Technologies under NIH SBIR Phase I & II grants. The initial olfactometer instrument developed under the NIH grants was designed for the determination of the threshold (sensitivity) of the human nose which can be used as an early symptom for the onset of neurodegenerative diseases like Alzheimer's and Parkinson's. For this application, precise droplets of odorant are generated and deposited onto a heater where they are evaporated. The vapors are presented to the patient nose and the olfaction threshold can be accurately quantified using a modified staircase procedure. The olfactometer was validated at the Fogelson Neuroscience Center, Presbyterian Hospital of Dallas, TX.

The concept was extended to the evaluation of the sensitivity of explosive vapor trace detectors. A first system was designed and built for the National Institute of Standards and Technology. This system consisted of six different ink-jet dispensers, each with its own reservoir and possibly a different explosive solution, that could dispense programmable amounts of dilute solutions on a heater placed into a flow stream. This system has demonstrated the feasibility of the vapor generator in the evaluation of the explosive trace detectors. Some of the explosive detectors are sensitive to the solvent used to dissolve the explosive so they do not function well in continuous operation. In this mode the droplets are coTtinuously generated and evaporated on the heater and the output consists of a mixture of explosive and solvent vapors. To accommodate these detectors a prototype that operates both in continuous and dose mode was designed, built and evaluated. This prototype will be offered as a standard product in 2009.

Mytek, LLC

Phase II Award No.: 0849006

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Integrated Lens-Laser Packaging Approach

This Phase II Small Business Innovation Research project is to develop an integrated optical and electrical packaging technique that allows for the precision placement of high density, large arrays of VCSELs, LEDs, or photodetectors coupled with arrays of microlenses. The project extends the limits of integration for device to device pitch, and device counts, of VCSELs and microlenses that have not previously been achieved.

This innovation has immediate application to existing computed radiography, scanning and printing applications. The computed radiography market is $1B annually, and is shared by U.S. and Japanese companies. The proposed innovation enables smaller, more reliable and higher resolution systems. In the long run, the application of precision optical assembly techniques may have an impact on the revolution taking place in chemical, biological and medical analytical instrument and sensing devices.

Nano-C, Inc.

Phase II Award No.: 0522093
Phase IIB Award No.: 0650436
Award Amount: $1,017,441.00
Start Date: 07/01/2005
End Date: 06/30/2009

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Sector: Manufacturing Processes

SBIR Phase II: Commercial Combustion Synthesis of Homogeneous Lots of Carbon Nanotubes

Reproducible manufacture of high quality single-walled carbon nanotubes (SWCNT) at sufficiently low cost is necessary for the commercial development of nanotube-containing products such as sensors, computer memory or transparent conducting films. In this project, the conversion of natural gas to SWCNT in a continuous and exothermic combustion process has been achieved. Reproducibility and scalability have been demonstrated after detailed characterization of a large number of batches using a broad spectrum of analytical techniques including Raman spectroscopy, thermogravimetric analysis (TGA), scanning (SEM) and transmission electron microscopy (TEM), atomic force microscopy (AFM), X-ray diffraction (XRD) and UV-Vis spectroscopy. Correlations between process conditions and a) average bundle length and b) the electrical conductivity of SWCNT networks have been established. Probe sampling at different distances from the burner has led to an improved understanding of time-resolved SWCNT growth and has enabled the targeted adjustment of specific operating parameters in view of the high-yield synthesis of SWCNT with selected characteristics such as a given average length. Methodology allowing for the dispersion of SWCNT in different solvents including water, necessary for many applications, has been developed. Work addressing the efficient separation between conducting and semi-conducting SWCNT has been started. Purification of SWCNT has been further optimized allowing also for the supply of material free of carboxylic acid functionalization, if desired. Application development, in-house and in collaboration with suitable partners, remains an essential part of Nano-C's business model. Increasing quantities of as-produced and purified SWCNT have been supplied to commercial costumers and development partners indicating a growing visibility of Nano-C on the market place.

This work is the result of a long-term effort since approximately 1965 aiming an improved understanding of fuel-rich combustion processes in the laboratory of Prof. Jack B. Howard in the Department of Chemical Engineering of the Massachusetts Institute of Technology. Initially mainly motivated by the need for pollution control, e.g., soot suppression, detailed characterization of condensed material formed under certain conditions, revealed the presence of macroscopic quantities of fullerenes, for instance C60, C70 and C84, and led to the foundation of Nano-C. Further work, first at MIT and then at Nano-C, investigating the addition of catalyst precursors to fuel-rich but non-sooting flames enabled the current project. Work at MIT was funded by several DOE, NSF and EPA projects while SWCNT activities at Nano-C started with the NSF SBIR Phase I preceding the current Phase II/IIB.

Nanocopoeia Inc.

Phase II Award No.: 0620563
Phase IIB Award No.: 0822707
Award Amount: $1,158,484.00
Start Date: 09/01/2006
End Date: 05/31/2012

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Sector: Nanotechnology

SBIR Phase II: Nanocomposite Coating on Coronary Stents

The introduction of drug-eluting coronary stents (DES) in 2003 has transformed the management of coronary artery disease. DES have made it possible to open and maintain blood flow through the narrowed coronary artery by a minimally invasive technique. First generation products have had longer-term complications, in which the artery developed a clot at the site where the stent was placed. As a result multiple new approaches are being examined for second and third generation devices. Nanocopoeia has developed a new method for applying drug-eluting polymers to the surface of a stent, using the ElectroNanospray™ process. By applying the drugs and polymer to the stent surface as nanoparticles, the coating has superb adhesion. Coating quality is improved over standard spray or dipping techniques. Additionally, by varying the size of the nanoparticles, the drug release profile can be modified for fast or slow release from the stent surface. The SBIR Phase II funding enabled production of a commercial scale prototype system that is being used in collaborative projects with large device manufacturers who are considering the system for licensing, both for stent coating as well as applying functional coatings to other medical devices.

The ElectroNanospray™ device emerged from basic research in the lab of Professors David Pui and Da-Ren Chen at Particle Laboratory of the University of Minnesota (the Particle Lab is a component of the NSF-funded NNIN at the University. While the first electrospray device was built to shoot genes (large DNA sequences) into living cells, the unique nozzle configuration has been found to have far broader applications for both medical and industrial applications.

Nanocopoeia Inc.

Phase II Award No.: 0823066

Award Amount: $465,090.00
Start Date: 12/15/2008
End Date: 11/30/2010

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Sector: Nanotechnology

SBIR Phase II: ElectroNanospray Process for Nanoformulating Drugs

This Small Business Innovation Research Phase II Project will develop a novel drug solubility enhancing process for improving yields from costly drug discovery efforts, where up to 40% of new drug candidates have poor water solubility and are abandoned despite promising biological activity. Phase I research developed a novel nanoformulation process using the ElectroNanospray process that improved model drug solubility 20-40 fold. In Phase II, the new process will be tested to enhance solubility of a model class of pain therapeutics, the non-steroidal anti-inflammatory drugs.

By expanding the universe of potential drug candidates and by developing enhanced delivery methods for existing drugs the project will seek to enable the development of new drug therapies with an initial emphasis on pain management.

Nanomaterial Innovation Ltd.

Phase II Award No.: 0620502
Phase IIB Award No.: 0841311
Award Amount: $640,000.00
Start Date: 09/01/2006
End Date: 08/31/2010

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Sector: Materials

SBIR Phase II: Synthesis and Processing of High Performance Polymer Nanocomposite Foams

Dr. Chiou and his team at Nanomaterial Innovation Ltd. have developed high performance nanocomposite foams. The breakthrough technologies will create significant job and economic growth over the next 5-8 years. Successful commercialization of their proposed nano-reinforced polymer foams for both basic insulation and structural insulation applications will accomplish this while providing the below associated benefits:

• Replace ozone-depleting HCFC's and CFC's that are currently used as blowing agents.

• Allow use of 100% recycled plastics, primarily expanded polystyrene (EPS).

• Provide novel, light-weight micro-cellular, nano-reinforced materials with predictable thermal and mechanical properties targeted towards specific market opportunities.

NSF funded research at Nanomaterial Innovation Ltd. is directly addressing these goals by integrating newly developed breakthrough technologies like WEPSCN high-strength, microcellular nano-reinforced foam with innovative nanoparticle technology and in-situ extrusion technology. Building on these technologies, Nanomaterial Innovation Ltd. will raise the bar on performance, weight reduction, and environmental benefits. This will enable the rapid growth of high value polymeric foams leveraging the business and marketing strengths of many industrial collaborators and partners.

The innovation is related basic research in the lab of Prof. L. James Lee at The Ohio State University. The feasibility was originally demonstrated using carbon dioxide as the blowing agent for the nanoclays/polystyrene nanocomposite foams. Nanomaterial Innovation Ltd. has extended this innovation into other nanomaterial/polymeric nanocomposites including carbon nanofibers, activated carbon, multiwall carbon nanotubes, PMMA, PPO, etc. The activated carbon/water technology is currently being integrated into the thermal insulation polymeric foams.

Nanosys Inc.

Phase II Award No.: 0620589
Phase IIB Award No.: 0731344
Award Amount: $796,813.00
Start Date: 09/15/2006
End Date: 08/31/2009

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Sector: Nanotechnology

SBIR Phase II: Large-Scale Manufacturing Process for Uniform Semiconductor Nanowires

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.

Novana, Inc.

Phase II Award No.: 0848524

Award Amount: $494,967.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Materials

STTR Phase II: Self-Reinforced Composites Made of Immiscible Polymers from Recycled Products

This Small Business Technology Transfer (STTR) Phase II project is seeking to develop and commercialize a novel method for recycling immiscible polymer (IP) wastes into value-added products. In this new method, the IP waste is converted into highly-orientated filaments with a surface of a relatively lower melting point polymer and a core of a relatively higher melting point polymer. These high-strength bicomponent fibers are then processed into desired composite components by melting and fusing the surface polymer; because only the surface polymer is melted during processing, the end product is reinforced by its high-strength core fibril of the higher-melting-point polymer.

The broader/commercial impact of this project will be an enabling process to cost effectively produce self-reinforced composites from recycled, immiscible Polyprophelene(PP)/nylon. For the carpet recycling market alone, this approach will reduce more than 5 billion pounds per year of carpet waste. By converting the waste stream into value-added products with improved mechanical properties the carpet waste will never reach our landfills. This process eliminates complicated sorting and separation steps, uses less energy for production, and reduces crude oil consumption needed for virgin polymers. For transportation applications, the self-reinforced composites' excellent strength to weight ratio can help produce lighter component parts, enhancing fuel efficiency. The new reinforced materials can be further processed by molding/forming processes to create 3-D parts with enhanced mechanical properties. This technology shows that recycled polymer blends prepared in an appropriate way can deliver superior value-added performance over virgin polymers.

NVE Corporation

Phase II Award No.: 0724306

Award Amount: $499,809.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Materials

SBIR Phase II: Zero-Remanence Tamper-Responsive Cryptokey Memory

This project addresses the problem of reverse engineering, undesired reconfiguration, and IP or data theft from within an integrated circuit (IC). ICs are everywhere around us – from computers to smartcards. Many of these ICs hold proprietary information or private data that could prove costly or damaging if recovered from non-volatile memory. The data stored in these ICs can be recovered if it is not properly erased, or if the erasure mechanism can be bypassed during an attempt at data recovery. To defeat this, NVE is developing a non-volatile magnetic memory that can self erase, even without applied power, in response to invasive tampering with the IC using a permanent magnet based technique.

Consumer electronics products are commonly reverse engineered to bypass costly development costs for both hardware and intellectual property or to gain access to critical data. Additionally, identity theft has become a very large issue in our society and other more computerized societies. The technology proposed under the Phase II program addresses the need of providing 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. The proposed program will render a system inoperable in the event of physical tamper. This will 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. Beyond the commercial applications there are significant opportunities within both US government military and civilian security branches.

AMR-based magnetic RAM (MRAM) research began in the early 80's. Dr. James Daughton, previously at Honeywell, formed nonvolatile Electronics, now NVE, in 1989 with Honeywell licensed technology on AMR-based MRAM. Research on MRAM switched to Giant Magnetoresistance Resistance (GMR) technology due to density issues with AMR technology.

Nonvolatile Electronics began work on GMR-based MRAM in 1989. First Nonvolatile Electronics patent filed in 1991. NVE continues as one of the leaders in the development of MRAM technology and licenses its research work and is beginning to commercialize small memories for specialized applications such as this program. NVE's current concentration is on magnetic tunnel junction-based MRAM and is the basis for this SBIR.
The innovation is mostly directly related to research performed at NVE by Drs. Dexin Wang and Jim Daughton on NSF grant DMI-0091564 "Sub-Nanosecond SDT Devices" and advanced by DARPA award DAAH01-03-C-0315 "MagnetoThermal MRAM.

Ocean NanoTech, LLC

Phase II Award No.: 0823040

Award Amount: $511,960.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Nanotechnology

SBIR Phase II: Development of Cadmium-Free, Water-Soluble and Multicolor Quantum Dots by Chemical Doping

This NSF Small Business Innovation Research Phase II project is to synthesize cadmium-free, water-soluble, and multicolor quantum dots (QDs) by chemical doping. The project will focus on the synthesis of high quality doped ZnSe QDs using a newly developed phosphine-free approach. From these cadmium free doped derivatives with high quality blue, green, and red emissione will be produced. Then the doped core/shell QDs will be processed to make them water-soluble and biocompatible through proprietary methods for biomedical applications.

Successful development of the proposed techniques will result in a new generation of biolabels and make significant advances in biomedical applications of such cadmium-free doped QDs. The "green" nature of the production methods, mineral precursors, natural surfactants, non-toxic and nonvolatile solvents and cadmium free QDs, will assist to maintain a sustainable environment, in addition to delivering high performance end products to the public.

Omega Optics, Inc.

Phase II Award No.: 0724096

Award Amount: $500,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Nanotechnology

STTR Phase II: Fully Embedded Optical Interconnects based on Optical Bus Architecture for Large Size Printed Circuit Boards

This STTR Phase II projects aims at developing a commercial optical interconnects printed circuit board using bus architecture. With the evolution of computer industry driven by Moore's law for over three decades, the interconnection bottleneck between high frequency processors and peripheral devices are becoming more problematic due to the required speed and power consumption. Conventional copper links on printed circuit boards fails to provide enough bandwidth beyond 10Gbit/sec. Optical interconnections are widely agreed as a better alternative to upgrade the system performance. However, existing photonics-related approaches suffer from such issues as packaging, reliability and manufacturing cost. In this program, Omega Optics and the University of Texas at Austin propose a fully embedded board level optical interconnects structure fulfilling an enhanced bandwidth, while eliminating the headaches of optoelectronic packaging and device reliability. The reconfigurable polymer waveguides shaped by low cost molding processes are expected to extend the interconnection to bus architecture, implementing both point-to-point transmitting and multi-point broadcasting, which outstands any optical fiber approaches. We have laid a solid foundation in Phase I by demonstrating 150 GHz bandwidth with 51 cm interconnection distance together with all discrete components and packaging efforts for the final structure to be realized in Phase II. In the past period, we are developing an electroplating method to fabricate a metal template for the hard molding process. Metal template based hard molding method has significant advantages over fabricating method for multimode waveguide array in the aspect of cost, reproducibility, and precision. We also finalized the layout design of the optical bus structure, and completed the fabrication processes as well. We also characterized the performance of 10Gbps VCSEL diodes and photodiodes, which are key active components of the optoelectronic system.

The innovation is related to basic research in the lab of Prof. Ray Chen's group at the University of Texas at Austin under grants from the ARP program from the state of Texas' Higher Education Coordination board. In this program, we try to build an optical interconnect library within which all needed optical and optoelectronic technologies will be available to use for the tasks of the STTR NSF phase II program. The feasibility was originally demonstrated using Su-8 polymer waveguide in conjunction with VCSELs and photodiodes to realize optical signal transmission and detection over a short distance.

Performance Polymer Solutions Inc.

Phase II Award No.: 0848645

Award Amount: $499,960.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Materials

SBIR Phase II: Advanced Polymer Matrix Composites Based on Nanofiber Fused Microfiber Architecture

This Small Business Innovation Research (SBIR) Phase II project will develop and characterize a novel class of polymer matrix composite materials using a continuous NanoFiber Fused-Microfiber (Nf2-M) reinforcement technology. This patented approach, carbon nanofibers are grown in a continuous manner directly from the surface of continuous filaments (introduced in tow form) in a continuous, easily scaled process. Unlike traditional approaches which involve difficult mixing operations to introduce carbon nanofibers into the matrix resin at very low loading levels and with questionable dispersion, this approach produces continuous three-dimensional reinforcement networks which are easily incorporated into composites using standard fabrication techniques, including filament winding and prepreg wet lay-up processes. No additional or modified composite fabrication steps are needed. This technology has enormous potential for a multitude of commercial applications.

The broader/commercial impact of this project are threefold: 1) providing a foundation for a new technology in materials science research; 2) utilizing the fundamental findings to develop and engineer enabling materials to meet growing needs in industry for current and future applications; and 3) providing a low cost, commercially available, high performance carbon fiber reinforcement technology that has the potential to change the face of the composite materials industry. Global market forecast for reinforcing carbon fibers is ~$12.2 billion annually by 2011, and the approach of this project can take advantage of the multitude of existing markets, such as sporting goods, electronics, consumer products, commercial aerospace and automotive industries.

Performance Polymer Solutions Inc.

Phase II Award No.: 0750177

Award Amount: $531,726.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Materials

SBIR Phase II: Innovative Isotropic Ultra-High Thermal Conductivity Diamond Composite Materials

This Small Business Innovative Research (SBIR) Phase II project will develop and demonstrate an innovative class of 3D isotropic diamond/graphite composite ultra high thermal conductivity materials for thermal management and structural thermal management applications. There exists a growing need for ultra high thermal conductivity materials that: (i) exhibit greatly increased isotropic thermal conductivity and lower density compared to existing thermal conductivity materials and composites; (ii) are producible in bulk form to enable practical manufacture of complex 3D components; and (iii) have tailorable electrical, thermal, and physical properties. Materials with these characteristics do not presently exist, but are enabling for these and many other future systems. The most promising material under development in this project is a molding compound based on ultra high thermal conductivity mesophase pitch carbon fibers. The discontinuous fibers are combined with a one-part resin system developed by P2SI to yield an affordable material suitable for low-cost manufacturing of net shape thermal management components. Thermal conductivity values 10x greater than conventional lightweight composite molding compounds have been demonstrated. These materials will be useful for a large number of thermal management applications as low thermal expansion and high conductivity heat spreaders, thermal planes, and hybrid package components. The material can be further optimized for thermal-structural applications by tailoring of the fiber content and fiber length.

This innovation is a direct development of work done under the Phase I effort and incorporates Performance Polymer Solutions Inc. technology in discontinuous fiber composites and polymer resin technology.

Picocal, Inc.

Phase II Award No.: 0822810

Award Amount: $499,694.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: A High-Throughput Scanning Probe Microscope Using Micromachined Ultracompliant Probe Arrays with Embedded Sensors for Simultaneous Topography and Thermal Imag

This Small Business Innovation Research (SBIR) Phase II project aims to produce a commercial prototype of a state-of-the-art high throughput scanning probe microscope (HT-SPM), which can be used for measuring topography and thermal parameters in nanotechnology, bio, and semiconductor applications. The scanning probe microscope has been a very successful tool, but emphasis has not been put on rapid data acquisition. The HT-SPM is an enabling technology that consists of a transformative and patented method for extracting topography which allows for higher throughput. The project leverages experience in atomic force microscope (AFM) probe micro-fabrication and industry. An immediate outcome of this SBIR project will be a fully functional and market ready HT-SPM.

The broader impact/commercial potential of measurements in nanometer scale devices and structures have both scientific and industrial importance. Although the Atomic Force Microscope (AFM) is one of the most important tools for nanotechnology, there has not been any fundamental innovation in the way it operates for more than a decade. This project provides faster measurement as a result of a fundamentally different way of imaging. Faster characterization permits manufacturers to expedite problem isolation, leading to higher productivity and higher return-on-investment (ROI). The HT-SPM also benefits R&D, failure analysis and off-line engineering. The HT-SPM offers critical capabilities that will allow users too quickly and clearly measure topography/friction/temperature at the nanoscale and view critical characteristics. The HT-SPM fills a critical need in integrated circuits, nanotechnology, life sciences and other markets that rely on sub-micron microscopy, as it will provide users with a superior and inexpensive measurement system to aid in studying new properties.

Pixelligent Technologies LLC

Phase II Award No.: 0724417

Award Amount: $500,000.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: R-CEL for DUV Lithography

The steadfast improvement in the resolution of optical lithography enables the manufacturing of smaller, faster, and lower power consumption semiconductor chips that fuels the continued growth of the vitally important electronic industry. The goal of this project is to develop a reversible contrast enhancement layer (R-CEL). An R-CEL changes its transparency as a function of light intensity at lithographic wavelength, the most advanced being 193 nm. This material utilizes the unique optical properties, most importantly the reversible photo-bleaching, of nanometer sized crystals of certain wide bandgap semiconductors. R-CEL improves the performance of optical lithography, possibly extending the current infrastructure to the 16 nm technology node. The implementation of R-CEL will establish the leadership of the US in the semiconductor industry, particularly in the next generation lithography. In this project, optical properties of nanocrystals of several candidate materials have been tested at Pixelligent. Also, Pixelligent has built optical measurement systems that are crucial to the characterization of these nanocrystals, including a pump-probe system (partially supported by SBIR), a z-scan system, and a photoluminescence excitation (PLE) system. As-synthesized AIN tend to agglomerate and various methods have been applied to etch them down to below 5 nm average sizes. Various capping agents have been applied to these nanocrystals to facilitate dispersion as well as to improve their bleaching behavior. These efforts can be further improved by reducing contaminants that absorb at 193 nm. Additional purification may be required for these nanocrystals, possibly in a Phase IIB project. ZnO nanocrystals have been used as a model system to demonstrate the feasibility of R-CEL, albeit at a longer wavelength. It has been shown that ZnO can be dispersed in lithography compatible polymers with ~ 70 vol% loading and be spin-coaedt on a 2" wafer with ~ 2% standard deviation in optical density uniformity. Direct z-scan measurements resulted in ~80% reduction of optical density.

This work is supported by NSF's Small Business Innovation Research grant No. 0724417. The innovation is originally proposed by Pixelligent in 2003. Key patent related to this invention is filed and is allowed by USPTO. (Application number 10/730,382). Pixelligent has funded this effort through a combination of strategic and financial efforts as well as other grant funding.

RES Group, Inc.

Phase II Award No.: 0750406

Award Amount: $488,721.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Program Director: Cheryl F. Albus

Sector: Devices & Instruments

SBIR Phase II: Engine Combustion Simulator

The SBIR Phase II project titled Engine Combustion Simulator (ECS) is a project which is working toward the development of a new software tool Engine Combustion Simulator (ECS). The ECS will enable researchers to develop and utilize accurate reaction kinetics for the design, control and optimization of the automotive engine and exhaust gas aftertreatment device. The ECS will reduce the costly and time-consuming experimental testing, as well as enable the researcher to probe concepts that are difficult or infeasible to test experimentally. Hence, the development of more fuel efficient and environmentally cleaner automobiles will be accelerated. The ECS will be built from a core of advanced database technologies and computational algorithms that will enable the users to easily build accurate reaction mechanisms and quickly perform simulation studies using these mechanisms. Once the production of ECS is completed, successful application of the software tool will result in cleaner and more fuel-efficient vehicles. A small gain in fuel efficiency can translate to billions of saving in fuels as well as reduced dependence on foreign oil. In addition, less fuel consumption directly scales to reduction in emissions thus lowering of greenhouse gases while improving human health. The completion of the project will generate sales and profits many times greater than the investment received from NSF, enabling us to increase payroll and expenditure, contributing to the U.S.'s economic growth. ECS, a new software tool, will be made available at no-charge for use in education and research in academia and some of the key components will be made available as an open-source to the research community to foster collaboration between researchers.

The project is related to the SBIR Phase I research project performed by RES Group, under grants from NSF, which has now been prototyped as the RES Engine Combustion Simulator (ECS): a suite of software tools that incorporates recent advances in the construction of detailed chemical kinetic mechanisms and computation technology. The ECS prototype was developed within the 6 month duration of the Phase I project. It was used to construct a 3-component proof-of-concept diesel surrogate mechanism to demonstrate that a multi-component mechanism can be easily and quickly constructed using the ECS. The surrogate mechanism was represented by a mixture of n-dodecane, toluene and methyl-cyclohexane containing 1357 species and 9045 reactions. The proposed benchmark for computation speed for engine simulation using the diesel surrogate mechanism was achieved. Simulation of a 10-zone engine model using the 3-component diesel surrogate mechanism was achieved in 32 minutes using a desktop PC (Pentium 4, 2.6 GHz). These results allowed for the SBIR Phase I ECS to help expand the automotive and fuels market which allowed RES to plan for SBIR Phase II of the ECS which with completion will be a commercial-quality software product that will be ready for sale to our customers.

Romny Scientific

Phase II Award No.: 0750189

Award Amount: $505,487.00
Start Date: 02/01/2008
End Date: 01/31/2010

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Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: High Performance Cooling Devices through Wafer Scale Manufacturing

Romny Scientific has, for the first time in the thermoelectric industry, developed a manufacturing technology to fabricate micron-scale thermoelectric cooling (TEC) devices on semiconductor wafers. This allows parallel production of hundreds of devices per wafer, reducing cost significantly and reducing material waste. This advancement is part of Romny's threefold approach to making competitive TECs. These three components are; 1) high quality materials processed to maximize device efficiency, 2) efficient manufacturing to increase reliability and lower fabrication costs and, 3) optimally scaled devices which can harness the full potential of each system and reduce material usage.

Romny Scientific has been engaged in improving thermal management systems for the microelectronics and optoelectronics industries via TECs. To make these devices competitive with current cooling systems, improvements must be made in material properties. Romny has developed a simple process to improve materials currently in use today. In addition to material advancements, Romny's novel manufacturing approach is uniquely capable of producing thermoelectric devices that can provide much more energy efficient cooling by optimally scaling the device to the application. Incumbent devices are limited by manual labor techniques and cannot fully realize the benefits of designing devices appropriate to the application. Current research is focused on scaling this production technology to a commercial level and pushing further the envelope of device efficiency.

Dr. Andrew Miner has been actively involved in the development of thermoelectric devices for the past 11 years. As the Senior Member of the Technical Staff at Nanocoolers from 2002-2006, he led an effort to produce thin film devices. Dr. Miner left Nanocoolers and founded Romny Scientific when it became clear that there was tremendous opportunity that was unmet by companies that were solely focused on nanomaterials or thin film approaches. The NSF recognized the potential of Romny's technology, and supported the early proof of concept work at Romny Scientific through an SBIR Phase I grant. Romny has built on that early support by brining together the investment community and customers to build a exciting early stage thermoelectric product line.

Romny Scientific

Phase II Award No.: 0848530

Award Amount: $498,927.00
Start Date: 03/01/2009
End Date: 02/28/2011

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Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: Thermo-Electric Conversion by Optimally Scaled Nanocomposite Materials

This Small Business Innovation Research Phase II project will develop a power generation device capable of converting waste heat into electricity with much lower cost/watt than existing devices. This work is accomplished by bringing together principles of physics and materials science in practical wafer scale semiconductor manufacturing, enabling new, low cost products.

The thermoelectric power generation devices to be developed in this work are key to realizing the often touted but yet unrealized societal benefits of thermoelectric power generation. Examples of benefits that can be forseen in the initial target market, the transportation industry, are economic benefits for the public from reduced fuel consumption and reduced environmental impact due to more efficient operation.

Sage Electrochromics, Inc.

Phase II Award No.: 0724375

Award Amount: $490,991.00
Start Date: 09/15/2007
End Date: 08/31/2009

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Sector: Materials

SBIR Phase II: Nanostructured Materials and Process for Improved Electrochromic Device Performance

Electrochromic windows can save energy by giving building occupants the means to control solar lighting and heating, so they can offset the demand for artificial lighting, heating and cooling. The key element of these windows is their electrochromic coating which can be actively darkened/tinted or lightened/bleached at the press of a button. Researchers at Sage Electrochromics are improving these coatings by finding the optimal compositions and structures for the solid state coating materials. In particular, they are looking for optimal structure on the nanometer scale. Currently, uncontrolled solar lighting and heating in residential and commercial buildings leads to immense costs in terms of artificial lighting, air conditioning and central heating. Equally immense are the proven energy savings that electrochromic windows can offer, if adopted by a wide enough customer base, through significant penetration into the window market.

While the Sage Electrochromics' product clearly outperforms its competition's, the engineering, research and marketing staff at Sage have identified key areas where coating performance can be improved, to meet and exceed customer needs. Improvements in the optical, electrical and mechanical properties of the coatings will let Sage Electrochromics reach a wider market by exceeding the customer requirements for color balance, reliability, and switching speed between light and dark, and by allowing the coatings to be applied to larger windows with wider spacing between opaque driver electrodes. These improvements ought to ensure that electrochromic windows significantly penetrate the residential and commercial window market, for both new and existing buildings.

Thanks to Phase II SBIR funding from NSF, Sage Electrochromics is now exploring several classes of new materials for electrochromic layers, using efficient experimental approaches that allow several compositions and combinations of solid state materials to be evaluated in parallel. Sage Electrochromics is also exploiting the natural tendency for a wide variety of solid state mixtures to spontaneously form a composite of nano-crystals surrounded by amorphous grain boundary material of a different composition. By harnessing this and related processes, including solid state chemical reactions, researchers at Sage are able to optimize the composition and structure of the resulting electrode materials.

SiC Systems, Inc.

Phase II Award No.: 0750064

Award Amount: $522,000.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Nanotechnology

SBIR Phase II: Novel Deposition of Silicon Carbide Boules

Silicon carbide (SiC) is a wide bandgap semiconductor that is fundamentally superior to silicon in many applications. Traditionally, adoption of SiC as a substrate material has been hindered due to extremely high production costs and limited availability.
Our manufacturing technology provides low cost production of large area wafers with immediate benefit in the following areas:

• Order of magnitude cost reduction in existing power management devices for green technologies such as hybrid- and electric vehicles

• Space and cost reduction for solid state white lighting (which is expected to reduce total world energy consumption by 8 – 10%)

• Cost reduction and capability improvement for high frequency RF devices

• Expansion of use of SiC in state-of-the-art semiconductor application
Our progress to date is consistent with our Phase II proposal. We expect first wafer very soon. We have two prototype manufacturing chambers functioning according to expectations.

This invention was originally conceived during targeted creative sessions of dialogue between Dr. Josh Robbins and Dr. Mike Semans, co-holders of the related patents. The invention was demonstrated with a bench scale prototype funded by a NSF Phase I grant. The Phase II work has been funded to date by NSF support (1/4) and financial investors (3/4).

Sinmat, Inc.

Phase II Award No.: 0646586
Phase IIB Award No.: 0924568 (pending)
Award Amount: $521,900.00
Start Date: 02/15/2007
End Date: 01/31/2009

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Sector: Nanotechnology

SBIR Phase II: Gentle Atomic Level Chemical Mechanical Smoothening (CMS) of Gallium Nitride Substrates

Provide a paragraph or two (about 300 words) that provides background on the project, results of the project, the scientific uniqueness; and the project's impact (societal or industrial). Write the Highlight for a "lay audience"; title and lead-in sentence should engage the reader. The overall goal of this project is to develop and commercialize industrially robust, ultra rapid gentle chemical smoothening processes to produce large area, atomically polished wide-band gap (WBG) semiconductor substrates (silicon carbide (SiC) and gallium nitride GaN). GaN & SiC substrates possess excellent electronic properties than can replace current electronic and chip technology. Further it can used in high power/high frequency electronic devices and as well as in solid state lighting applications. Applications include LEDS, high efficient smart power grids for solar and wind power, Blu – ray, water purifications, bright displays for cell phones and flat-screen TVs. The atomically level polishing based on the proposed CMS process for GaN & SiC substrates will help in (a) increase device yield, (b) development of novel device structures and (c) enhance technical performance of GaN based devices and reducing manufacturing cost. The CMS polishing process relies on formation of a thin surface modified layer which is mechanically removed by soft abrasive particles. Sinmat estimates that by development of such polishing technologies will lead to manufacturing cost savings of greater than $74 million/yr, with at least 20X reduction in manufacturing times compared to current state of art.

The innovation is related to technology that was conceived at Sinmat Inc and the full research development of the technology has been carried out at Sinmat. Patent application for the technology is in preparation.

Sinmat, Inc.

Phase II Award No.: 0725021

Award Amount: $512,000.00
Start Date: 08/01/2007
End Date: 07/31/2009

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Sector: Nanotechnology

SBIR Phase II: Novel Hybrid Rapid Thermal Processing (HRTP) Systems for Annealing of Advanced Silicon Devices

Inexpensive Fabrication of Smaller and Faster Computer Chips: Semiconductor fabrication processes are expected to become more complicated and expensive, especially with the introduction of newer process technologies which enable faster computers with smaller chips. To achieve the necessary levels of performance, the manufacturing related to heating and annealing of wafers is expected to become more complex. This SBIR Phase II project proposes to develop and commercialize a novel Hybrid Rapid Thermal Processing (HRTP) system which combines the advantages of RTP and laser annealing. The HRTP innovation provides a faster, hotter and more robust RTP system for instantaneous heating of wafers, from which subsequently processor chips are made. RTP is a critical enabling process used in all semiconductor fabrication. Once commercialized, the HRTP system would be a key enabling technology for future generations of silicon integrated circuits.

The novelty in this technology is that it is Hybrid, and innovatively combines the laser power with unique heating technology, thereby achieving high temperatures and instantaneous heating with low laser power. Thus, HRTP can perform solid state annealing to up to 1400 ºC. Previously, in Phase I, some simulations of the system had been performed and targets of the Phase II proposal were to propose a design for the HRTP system, perform further simulations, and to make a functional system at a deeply reduced cost. All three objectives have been achieved and Sinmat Inc. has an operational HRTP system on which test-runs are being performed currently. The HRTP technology will provide increased productivity and cost-savings for the ~ $300 B Semiconductor industry. This new system will support US companies to maintain competitiveness and leadership in the world. Commercialization of this technology will also create new high tech R&D and manufacturing jobs in the US.

This SBIR innovation was developed through basic research and development at Sinmat Inc. The Hybrid Rapid Thermal Processing (HRTP) system idea was conceived at Sinmat Inc. Currently, on some experimental aspects of the HRTP project, collaborative work is being performed.

Sisu Chemical, LLC

Phase II Award No.: 0620290
Phase IIB Award No.: 0839978
Award Amount: $686,761.00
Start Date: 07/01/2006
End Date: 06/30/2009

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Sector: Materials

STTR Phase II: Formulation of Environmentaly Friendly Lubricants Based on Polymeric Materials for Cold Forging Process

A working prototype of a polymeric lubricant has been developed and is undergoing extensive production-scale trials. When used with an iron phosphate primer, it shows improved performance over the zinc phosphate system on tube drawing applications. The polymer is applied as a coating; therefore, there is no waste stream from this material. Although systems such as oils and metal phosphates are used on a limited basis, their performance does not allow for across-the-board use. The approach and achievement of a high molecular weight stearyl methacrylate (SMA) containing emulsion polymer on a commercial scale has not been accomplished according to an extensive literature search. Prior to this only mini-emulsion techniques have incorporated SMA on a laboratory scale. For the cold forging industry, this will provide a system that can be used to manufacture high strength metal parts in an environmentally responsible manner at reduced costs.

The technique for the incorporation of highly aliphatic monomers was based on earlier original research using smaller pendant group monomers for adhesive systems. The use of acrylic monomers with very high aliphatic pendant groups is known technology for synthetic oils, but not in use for emulsion polymers. This technology was then an attempt to incorporate all of the functionalities of the zinc phosphate system into a single polymer, incorporating the high chain aliphatic groups for lubrication, and thereby eliminating the need for a heavy zinc metal.

Spectral Sciences Inc.

Phase II Award No.: 0724385

Award Amount: $485,919.00
Start Date: 08/15/2007
End Date: 07/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: Control and Optimization of Combustion Based on Multispectral Emission Tomography

Dr. Jin and his team at Spectral Sciences, Inc. (SSI) are developing new tomographic techniques based on passive optical sensors to monitor and control combustion systems. SSI and its commercial and government partners have developed passive optical sensors, which observe specific molecular spectral features to characterize the combustion flow. Application of these advanced sensors in combustion control systems could potentially increase the combustion and thermodynamic efficiency of commercial burners and turbine engines and reduce harmful emissions. Under this NSF-funded Small Business Innovation Research project, SSI has been developing new tomographic techniques to provide truth data for combustion control systems. The optical passive tomographic analysis (OPTA) diagnostic for high temperature analysis in combustion engines and turbines is illustrated in Figure 1. It uses a series of passive optical sensors collecting time-averaged spectrally-resolved emission over multiple views and novel limited-angle reconstruction algorithms to reconstruct the spatial temperature and concentration distributions of combustion flow. This technology is needed in the multi-billion dollar turbine engine industry where manufacturers search for new ways to enhance performance for the next generation of aircraft engines, and their customers seek cost savings through optimal fuel efficiency, lower maintenance costs and extended engine life.

The critical innovation in this NSF-funded project is to develop novel tomographic reconstruction techniques and algorithms for reconstructing emission originated from the combustion volume subject to the constraints of restricted view angles and limited samples. Algebraic approaches are adopted to reconstruct spatially-resolved volumetric emission. The local thermodynamic variables such as temperatures, concentrations and concentration ratios are computed using the known dependence of the molecular spectra on temperature and species density. Reconstruction algorithms are currently being developed and tested against synthetic data and incorporated into real-time operating software for an integrated measurement system to be tested in the next phase of the project.

Sun Innovations Inc

Phase II Award No.: 0848519

Award Amount: $491,501.00
Start Date: 03/15/2009
End Date: 02/28/2011

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Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: Advanced Nano-Phosphors for Novel Electronic Displays

This Small Business Innovation Research Phase II project is to develop a fully functional color "transparent display screen" prototype, based on a set of outdoor stable nano-phosphors with very high fluorescent quantum efficiency and well-controlled nano-particle sizes. With these advanced nano-phosphors, a color display windshield prototype will be developed.

This novel "transparent display screen" technology will enable an entire vehicle windshield or building glass windows to act as an electronic display screen, without affecting the optical clarity. This innovative display technology will leverage and create a broad spectrum of commercial applications and fundamentally change the way that people use "glass" in many designs.

Tamar Technology

Phase II Award No.: 0750368

Award Amount: $499,401.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Sector: Devices & Instruments

SBIR Phase II: Infrared Confocal Measurement System

The manufacture of microelectronics involves creating patterns of lines, trenches and holes in a silicon wafer, and each feature is smaller than the bacteria on a human hair. The tiny size of these features help shrink consumer electronics, such as cell phones and digital cameras. To maintain quality, these features must be measured. The measurement of deep and narrow trenches and holes is particularly difficult, if not impossible, without destroying the wafer. This SBIR Phase II project is to design a sensor that can see through a silicon wafer much the same way people see through a glass window. By looking through the back of the wafer, the trench feature looks like a bump and is much easier to measure. Another use of the new sensor is the measurement of silicon wafer thickness. Many microelectronics manufacturers make their wafers paper thin. They need to measure a "thickness map" of the wafer for quality control. The new sensor resulting from this project will easily be able to make these measurements with far better accuracy than any sensor currently available.

Tamar Technology currently manufactures sensors operating with white light. These sensors are used for a variety of applications, including the measurement of transparent materials such as glass and sapphire. Since silicon is transparent to infrared light, it was realized that if a sensor similar to the current product could be developed to operate with infrared light, then small features in a silicon wafer would suddenly be easily measured.

TDA Research, Inc.

Phase II Award No.: 0724875

Award Amount: $471,515.00
Start Date: 09/01/2007
End Date: 08/31/2009

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Sector: Materials

SBIR Phase II: New N-Type Polymers for Organic Photovoltaics and other Electronic Devices

This SBIR Phase II project aims to develop a new family of n-type conjugated semiconducting polymers to be used as electron acceptors in plastic photovoltaics and other organic electronic devices. During the Phase I project, TDA Research, Inc. successfully prepared several n-type semiconducting polymers via simple reactions. Some of the prepared polymers were soluble in common organic solvents and stable to storage and handling. All of our polymers were colored and strongly fluorescent in the blue to green region of the visible spectrum. Selected polymers showed promising photoluminescence quenching in the presence of a polymeric p-type semiconductor (which indicates that they can accept electrons in a OPV device after absorption of a photon and charge separation, a necessary step to generation of electricity) and had electron affinity similar to that of PCBM, the organic acceptor currently used in OPVs. The objectives of this Phase II project are to improve the synthesis and purification of selected Phase I polymers, improve their charge mobilities, and demonstrate their performance in actual OPV prototypes.

During the first year of the Phase II project TDA focused on improving the production of the N-type polymers. We developed a new process for their synthesis and improved the yield from our original 5-17% to 56%, which is a significant result. The new process is also more reproducible and gives a product of higher molecular weight (the average MW increased by a factor of 2 or 3). We confirmed by electrochemical characterization that the new process produces a polymer that retains the electronic band structure of our original material and therefore is suited to replace PCBM in OPVs. Charge mobility of the polymer made with the new process was measured and resulted to be on the order of 10-6 cm2/V.s. While this is a low number, it definitely confirms that TDA polymers are in fact N-type semiconductors.

During a previous NSF-funded Phase I SBIR project (DMI-0319320) TDA developed a new class of conjugated polymers that were light-emitting and electron-deficient. The objective of the current Phase I and Phase II SBIR projects is to demonstrate that these polymers are n-type semiconductors and optimize their chemical and electronic structures for optimal performance in organic solar cells. During the NSF Phase I project, TDA demonstrated that the polymers have n-type properties and we selected the most promising candidates to move to Phase II. Between the Phase I and Phase II project TDA scaled up the productions of two polymers with internal resources and manufactured pilot batches. Commercial sales of research quantities of TDA's N-type polymers began between in the summer of 2007.

Tetramer Technologies, LLC

Phase II Award No.: 0750637

Award Amount: $523,994.00
Start Date: 01/15/2008
End Date: 12/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: New Synthetic Approaches to Higher Performance, Lower Cost CO2/CH4 Gas Separation Membranes

Tetramer Technologies is working with Membrane Technology and Research to commercialize low cost, high performance CO2/CH4 polymer membranes for use in enhanced oil recovery (EOR), particularly in North American oil fields and tar sands in Canada, upgrading natural gas by CO2removal, gas processing unit operations needed to sequester CO2, syn gas processing, and CO2 to recover coal bed methane. The timing for this new technology is excellent since the need for improved CO2/CH4 membranes matches with the strong recent market interest. For example, a recent DOE report concluded: The potential for these "next generation" CO2-EOR technologies for the additional 10 lower 48 basins/areas studied expanded the future recovery potential to 430 billion barrels." Tetramer's technology has produced practical membrane structures that are 10X more permeable than current commercial gas separation membranes with excellent selectivities using new molecules which allow more gas to permeate. Our program objectives are currently on track as we have successfully scaled up our polymer system to a 2 square meter size (see picture below), and are continuing to develop higher performance polymers by synthesizing new molecular architectures.

This innovation began under a Phase I SBIR grant funded by NSF and has been a joint collaboration between Tetramer and Membrane Technology and Research (MTR) for the past year. Tetramer's business model is to synthesize the polymer materials while MTR will manufacture and sell both the modules and the gas separation systems.

Thies Technology

Phase II Award No.: 0823115

Award Amount: $499,783.00
Start Date: 07/15/2008
End Date: 06/30/2010

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Sector: Materials

STTR Phase II: Multi-Wall Carbon Nanotubes Inclusion for Thermal Conductivity Enhancement of Microencapsulated Phase Change Material Slurry

This Small Business Technology Transfer (STTR) Phase II project seeks to investigate the commercial feasibility of new processes capable of incorporating phase change materials (PCMs) and multi-wall carbon nanotubes (MWCNT) into micro- and nano-capsules thereby producing particles with novel thermal and fluid properties. The primary objective is to take advantage of MWCNT exceptional thermal properties to enhance the thermal performance nano/microencapsulated phase change material (N/MPCM) slurry. Thermally enhanced N/MPCM slurries can provide palpable benefits in the thermal management of commercial and industrial processes and products, from microelectronics devices to large industrial facilities, by providing considerable additional heat capacity and better heat transfer performance. The combined effect of nano/microencapsulated MWCNTs and phase change materials present a unique opportunity to improve the performance of heat transfer fluids beyond current levels. A series of experiments will be carried out to quantify the degree durability, heat transfer enhancements in laminar and turbulent conditions, and in typical heat exchangers.

The broader impact/commercial potential of this project will have a lasting impact on the entire heat transfer industry. Direct impacts include lower flow rates, lower pressure drop, smaller heat transfer area and improved heat transfer effectiveness. The project will also elucidate how the new fluid performs in commercially available heat exchangers. The project will also provide unique educational opportunities to undergraduate and graduate students. The success of the project will broaden scientific and technological understanding of enhanced heat transfer fluids in industry as well as in academia. Indirect impacts include enhanced living standard and improved competitiveness. Successful commercialization of the proposed concept will find applications in biomedical, aerospace, homeland security, and energy generation.

Thixomat, Inc.

Phase II Award No.: 0847198

Award Amount: $500,000.00
Start Date: 01/15/2009
End Date: 12/31/2010

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Sector: Manufacturing Processes

STTR Phase II: New Process for High Strength/Weight Net-Shape Auto and Aero components from Mg Sheet

This Small Business Technology Transfer (STTR) Phase II project aims to scale-up and commercialize a low cost and simple process to produce high strength/density Magnesium (Mg) alloy sheet; using Thixomolding Thermomechanical Processing (TTMP). TTMP avoids the decades-long barriers of twinning and shear band deformation that limits the formability of commercial coarse-grained Mg alloys, rather, in TTMP fine isotropic grains are molded in the first Thixomolding step and then these are thermomechanically processed to impose continuous dynamic recrystalization to finer grains of 0.8 to 2 microns. In this fine grained mode of processing, twinning and shear banding are minimized while slip and grain boundary sliding are promoted. The common intermetallic phases of Mg alloys are also refined to nanometer size so that they can serve as dispersion hardeners. The end result of the refined microstructures is an increase of both strength and ductility. The mechanism may apply also to Titanium (Ti) and Beryllium (Be) alloys.

The broader/commercial impacts of this project are fuel and pollution savings in automobiles and trucks; fuel and payload benefits in aerospace; energy savings in batteries and fuel cells; and medical benefits in bio-replaceable body implants. Commercially, this project will result in a new U.S. business in manufacture of superior low cost Mg sheet.

UES, Inc.

Phase II Award No.: 0822598

Award Amount: $499,858.00
Start Date: 07/01/2008
End Date: 06/30/2010

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Program Director: Cheryl F. Albus

Sector: Coatings

STTR Phase II: A New Process for Boride Coatings for Manufacturing Applications

This Small Business Technology Transfer (STTR) Phase II project is seeking the transfer and further development and commercialization of a new low temperature metal-organic chemical vapor deposition (LT-MOCVD) technology for boride coatings. The project will work to develop coatings for characterizations of adhesion, microstructure, morphology, composition and hardness. Selected coatings will be tested for friction and wear and corrosion resistance under laboratory test conditions on various common engineering substrate materials. The precursor preparation process will be scaled up and deposition will be done in an industrial scale deposition system. The coating process will be optimized for high hardness and good adhesion. Optimized coatings will be applied to components for testing at end users' facilities under production conditions.

The broader impact/commercial potential of wear and corrosion resistant coatings are very attractive for their high hardness and good chemical stability, and have potential for many applications in the manufacturing sector in United States. The process developed in this project, of deposition of borides, will enable a wide spectrum of applications including cutting tools, die casting dies and inserts, transfer rolls for flat glass, components for chemical processes, armament industries, automotive and aerospace industries.

Uncopiers, Inc.

Phase II Award No.: 0750623

Award Amount: $500,000.00
Start Date: 01/01/2008
End Date: 12/31/2009

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Sector: Manufacturing Processes

SBIR Phase II: An Innovative Method for Removing Resist from Wafers

This project has developed an innovative method of removing coatings from semiconductor substrates. The method uses microcavitation and needs only clean water and silent sound to implement the coating erosion. The actual erosion of the coating is brought about by imploding microbubbles. This is an environmentally friendly technique that does not use chemicals, nor does it generate hazardous waste.

United Environment & Energy, LLC

Phase II Award No.: 0822738

Award Amount: $500,000.00
Start Date: 08/01/2008
End Date: 07/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: High Efficiency Low Cost Nitrogen Fertilizer Production from Fly Ash

This Small Business Innovation Research (SBIR) Phase II project aims to develop innovative high efficiency, low cost nitrogen fertilizer manufacturing technology from fly ash. Fly ash is a recycled material from coal power plants that may contain high concentrations of mercury and carbon. Traditional nitrogen fertilizer production uses natural gas as the primary feedstock and is very costly. The traditional fertilizers are water-soluble compounds, resulting in significant loss of fertilizer which in turn pollutes streams and ground water. America's coal power plants produce more than 71.1 million tons of fly ash per year, and most of it is disposed in landfills. The high mercury content in the fly ash makes the disposal more difficult and costly. The Phase II project will bring the viable fly ash nitrogen fertilizer production technology from a laboratory scale to a pilot scale, and will determine the optimal pilot plant operation conditions, produce fertilizer for farmland field testing, and demonstrate its commercial viability. The pilot plant data will be used to understand the importance of design parameters and operating conditions on plant performance, refine the manufacturing plant design, and reduce the risk associated with construction of manufacturing plants.

The broader impacts (commercial significance) if this project is successful will be a high volume and highly technical application for fly ash and a value-added high efficiency low cost nitrogen fertilizer. The production of this fertilizer will not be affected by the availability of natural gas. Moreover, the projected production cost of this nitrogen fertilizer is much lower than that of the traditional nitrogen fertilizer. The use of this new nitrogen fertilizer on farms will increase crop production profitability and prevent fertilizer loss and water pollution. By avoiding the landfill disposal of the fly ash, the coal power plants will save millions of dollars. If all the fly ash produced at coal power plants in the US were used to produce nitrogen fertilizer, the amount of nitrogen fertilizer produced could meet the entire US market demand. The success of this new technology will bring a revolutionary change to the traditional nitrogen fertilizer production process and will have substantial environmental, economic, and technical benefits.

UT Dots, Inc.

Phase II Award No.: 0823029

Award Amount: $499,986.00
Start Date: 08/15/2008
End Date: 07/31/2010

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Sector: Nanotechnology

SBIR Phase II: Chemical Aerosol-flow Synthesis of Nanometals

This Small Business Innovation Research Phase II project will develop new scale up methods for the synthesis of surface stabilized metal nanoparticles from aerosol. The advantage of chemical aerosol-flow synthesis is in its simplicity in procedure and experimental setup, low cost and scalability. The method allows for the synthesis of high quality nanoparticles in continuous flow regimen. Phase I results proved feasibility of the method for the synthesis of high quality silver nanoparticles with high yield. This Phase II project will focus on increasing manufacturing capabilities to decrease the cost of nanoparticles significantly.

Low cost, printed electrical conductors are expected to be a rapidly growing market for flexible electronics and solar cells. Reducing processing temperatures and material costs are key enablers to these growing applications. The low cost production of nanometals will contribute to these trends.

Verionix

Phase II Award No.: 0646388
Phase IIB Award No.: 0932374 (pending)
Award Amount: $524,000.00
Start Date: 03/15/2007
End Date: 02/28/2009

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Program Director: William Haines

Sector: Sensors

SBIR Phase II: Trapping Particle Detector for On-Line Monitoring

This SBIR Phase II project has developed improved particle detectors for monitoring of semiconductor manufacturing tools. This detection technology will increase count rates for >0.2-um-diameter particles by 100-1000x improving correlations between the particle detector and wafer by >10x. For smaller particles this detector will enable detection, ultimately to the nanoparticle regime (<25 nm)

This sensor is based on underlying microplasma source technology developed at Northeastern University under NSF funding by Jeffrey Hopwood, Professor of Electrical Engineering and licensed by Verionix.

Voltaix, Inc.

Phase II Award No.: 0750479

Award Amount: $481,557.00
Start Date: 04/01/2008
End Date: 03/31/2010

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Program Director: William Haines

Sector: Materials

STTR Phase II: Germyl Silanes - Enabling Precursors for Chemical Vapor Deposition of Advanced CMOS Substrates, CMOS-Integrated MEMS, and Nano-Scale Quantum-Dot Silicon Phot

Germyl silanes are chemical building blocks that can be used to fabricate coatings that serve as the active elements of computer chips and solar cells. Active elements are made by depositing coatings of silicon or silicon germanium alloys using a process known as chemical vapor deposition (CVD). To make a silicon germanium alloy, silane (containing silicon) and germane (containing germanium) flow over a hot substrate such as a silicon wafer (computer chips) or piece of glass (solar cells). When the gases contact the hot substrate, they decompose, depositing silicon and germanium atoms. Coatings of germanium or germanium alloys are critical for future computer chips because they enable chips to run faster and for solar cells where they improve efficiency and lower total costs. Unfortunately, it is very difficult to deposit such alloys using the conventional approach, which breaks down for germanium contents in excess of 30%. The germanium and silicon separate on the surface and make an inhomogenous, rough coating that is unsuitable. Breakthrough research at Arizona State University (ASU) has shown that germyl silanes are a solution to this problem. They are a family of molecules that consist of germanium and silicon chemically bound together as shown in Figure 1. Since the germanium and silicon are chemical bound in the precursor, they stick together through the deposition process, producing a uniform film with excellent morphological properties. Because they are available in many variations, they offer unprecedented compositional control at high germanium contents.

Voltaix and ASU are working together to develop methods for manufacturing germyl silanes cost effectively and utilizing them to their full potential. Already we have reduced the cost of manufacture of germyl silanes by a factor of ten and have demonstrated their use in industrial process equipment (a 200mm low pressure-CVD furnace) to make low-defect silicon-germanium buffer layers 20 times thinner than the state of the art. The results are cost and manufacturing throughput improvements that will enable new, cheaper approaches to computer chip and solar cell design to enter mass production, benefiting current processes that create over $20 billion of devices per year and enabling new applications.

These innovations are related to basic research in the laboratory of Professor J. Kouvetakis at Arizona State University with the support of grants from the National Science Foundation (DMR-0221993, DMR-0303237) and the U.S. Army Research Office (ARO). Technical and economic feasibility was demonstrated by NSF STTR Phase I Grant 0539750.

wTe Corporation

Phase II Award No.: 0548698
Phase IIB Award No.: 0822496
Award Amount: $999,988.00
Start Date: 02/01/2006
End Date: 01/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: An Improved Multi-Sensor Manufacturing System for Scrap Metal Sorting

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.

wTe Corporation

Phase II Award No.: 0823046

Award Amount: $499,998.00
Start Date: 11/01/2008
End Date: 10/31/2010

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Sector: Manufacturing Processes

SBIR Phase II: A Fundamentally New X-ray Driven Manufacturing System for Recycling Materials

This Small Business Innovation Research (SBIR) Phase II project will put into service a prototype/pilot facility to assess the technical and commercial feasibility of unambiguously sorting small chips of super-alloys at high speeds. Spectramet Technology is a platform optoelectronic manufacturing technology for analyzing metals and alloys at previously unachievable accuracy and high speeds into known alloys to meet smelter specifications. The technology platform is not only aimed at sorting alloys into base metal groups, but can also sort the alloys by alloy type. One part of the Spectramet Technology focuses on sorting valuable super-alloys such as nickel-, cobalt-, and titanium based metals. This proposal is aims at extending the existing technology with an entirely new innovative sensor approach to process particles one-thousandth the size of prior applications and to identifying and sorting those particles at speeds thousands of times faster than has ever been done before.

The broader impact/commercial potential from this technology will be reducing the amount of strategic super-alloy metal that is downgraded to inferior product uses and applications in the U.S. so that this very valuable scrap metal can be recycled into its highest value application, so it can be used again as super-alloy feedstock for making new super-alloy parts. The result of recycling this material rather than downgrading it to lower value applications will be reduced U.S. dependence on supplies of strategic virgin metals recovered at primary refineries from ore (most of which are purchased abroad), substantial energy savings from use of scrap rather than ore and virgin materials, and greatly reduced emissions because secondary smelting consumes much less energy than primary production.

Xintek, Inc.

Phase II Award No.: 0848749

Award Amount: $466,611.00
Start Date: 01/15/2009
End Date: 12/31/2010

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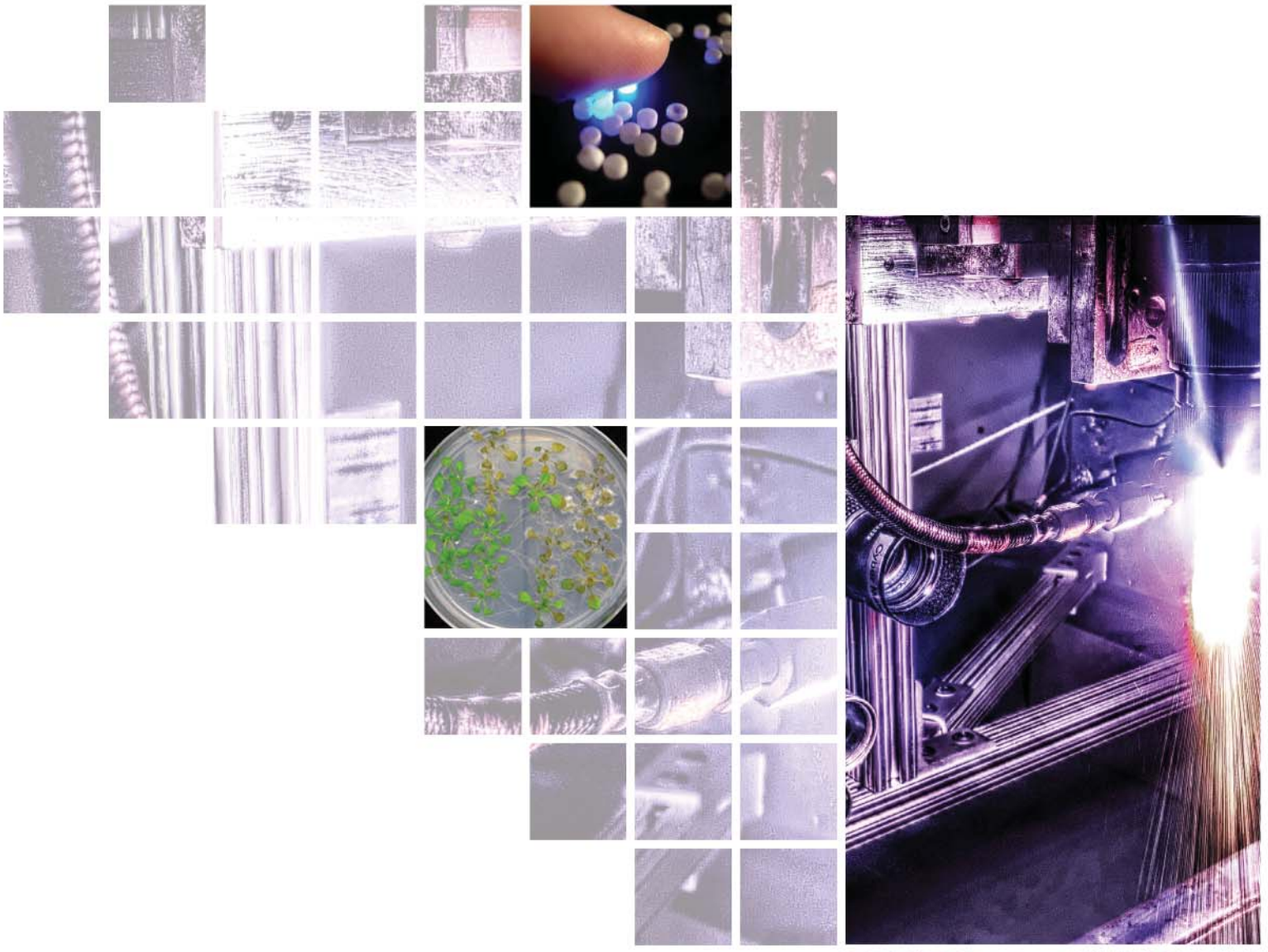
Program Director: William Haines

Sector: Nanotechnology

SBIR Phase II: Efficient Production of High Quality Carbon Nanotube Field Emitters

This Small Business Innovation Research Phase II project addresses scaled up production of high quality carbon nanotube (CNT) field emitters, which are promising electron sources that can potentially overcome the limitations of thermionic source based devices. The current commercially available CNTs have limitations in terms of field emission performance, thermal stability and cost. Xintek and its collaborators at Duke University developed a proprietary few walled carbon nanotubes (FWNTs) which is shown to possess superior field emission performance compared to other commercially available CNTs.

Upon the successful completion of the Phase II project, the low cost high quality field emission FWNTs will be produced to deliver improved field emission performance for a broad range of applications including but not limited to field emission displays, X-ray sources, vacuum electronic devices, accelerator electron guns, and high current electron beam processing facilities.



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