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Cantilever epitaxy

Promising brighter LEDs

Sandia National Laboratories

What is LDRD

Sandia's world-class science, technology, and engineering work define the Labs' value to the nation. These capabilities must remain on the cutting edge, because the security of the U.S. depends directly upon them. Sandia's Laboratory Directed Research and Development (LDRD) Program provides the flexibility to invest in long-term, high-risk, and potentially high-pay-off research and development that stretches the Labs' science and technology capabilities.

LDRD supports four primary strategic business objectives: nuclear weapons; nonproliferation and materials assessment; energy and infrastructure assurance; and military technologies and applications; and an emerging strategic objective in homeland security. LDRD also promotes creative and innovative research and development by funding projects that are discretionary, short term, and often high risk, attracting exceptional research talent from across many disciplines.

When the LDRD symbol appears in this issue, it indicates that at some state in the history of the technology or program, LDRD funding played a critical role.

On the Cover:

Researcher Christine Mitchell examines a substrate used with Sandia's cantilever epitaxy growth process. This R&D 100 Award-winning process holds promise for brighter, light emitting diodes (LEDs) for solid-state lighting. (Photo by Randy Montoya)

Sandia Technology (ISSN: 1547-5190) is a quarterly journal published by Sandia National Laboratories. Sandia is a multiprogram engineering and science laboratory operated by Sandia Corporation, a Lockheed Martin company, for the Department of Energy. With main facilities in Albuquerque, New Mexico, and Livermore, California, Sandia has broad-based research and development responsibilities for nuclear competitiveness and other areas of importance to the needs of the nation. The Laboratories' principal mission is to support national defense policies by ensuring that the nuclear weapon stockpile meets the highest standards of performance. For more information on Sandia, see our Web site at *http://www.sandia.gov*

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Fall Issue 2004

FROM THE Editor

Dear Readers,

While the bulk of Sandia's work addresses national issues, our engineers and scientists are also called on from time to time to look at local problems through a unique small business assistance arrangement with the state of New Mexico. Applying technologies used in national security programs to small business problems — often stretching or adapting them in new ways — has proven beneficial both to the state's economy and to Sandia.

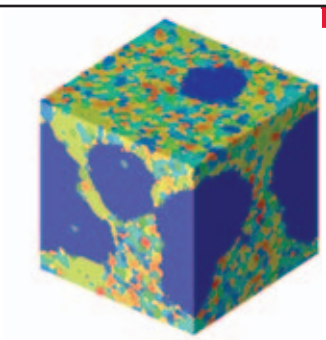
In an article by Elizabeth Holm, a Sandia researcher managing a multiple-year project to take a scientific look at the process of metal annealing, the author makes a startling comparison between the crystalline cell structure of metal and the dispersal of galaxies flying apart through space.

And while Independence Day revelers were picnicking in a California park, Sandia engineers were demonstrating a new "sensor management architecture" they hope will lead to a system to allow rapid response of law enforcement agencies to high-profile special events.

We also take time to brag about our two R&D 100 Award winners and Sandia Vice President Jim Tegnelia's appointment as chair of the Army Science Board.

Another article shows how the Labs continue to partner with private industry to address mutual problems, in this case high-consequence accidents and fires. Solutions to these issues have potential benefits to not only our commercial partner but to the nation.

Will Keener
Editor



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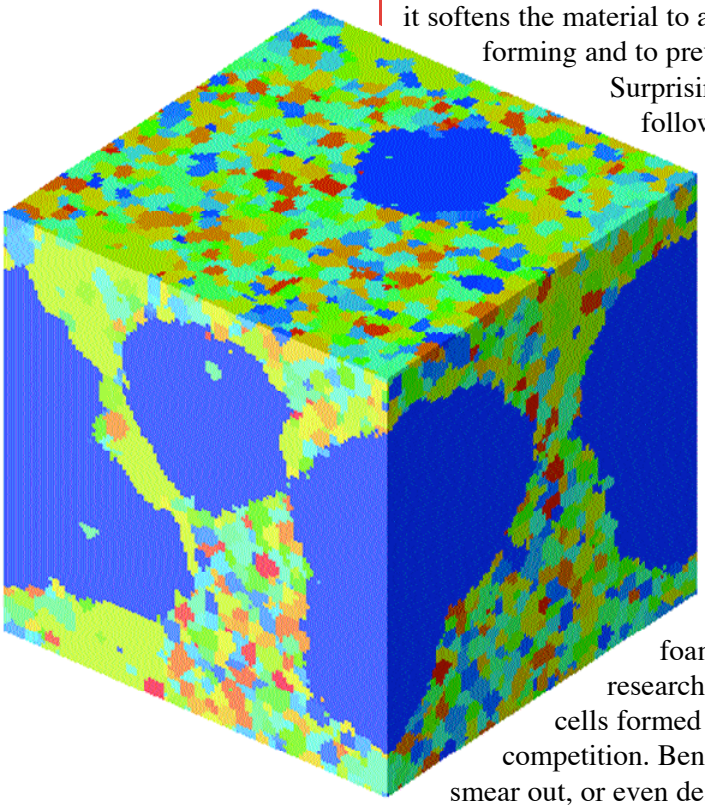
Annealing
Microcosm in a piece of metal

LDRD

Automobiles, airplanes, and cookware all start out the same way: as flat pieces of metal. Engineers shape sheet metal into bumpers, wings, and pans through sometimes complicated cycles of bending and heating. The heating step, called annealing, is especially important, because it softens the material to allow further forming and to prevent breaking.

Surprising results followed from a Sandia research team's study of bending and annealing.

After bending, the substructure of a piece of metal organizes into cells — tiny crystallites of material arranged like bubbles in foam. The researchers knew that cells formed as the result of a competition. Bending tends to smear out, or even destroy, the substructure. But the material's intrinsic tendency is to maintain order. In balance, the competition between bending and ordering organizes the metal into crystalline cells.



In a computer simulation, a few crystalline cells (dark blue) grow at the expense of their neighbors as annealing begins. When annealing is over, the substructure will be entirely consumed. The small cells in this picture are about one-fiftieth the diameter of a human hair.

This article was written by Elizabeth Holm, who is leading a multiyear project to understand annealing.

Early on, the Sandia team asked whether other processes seek the same balance and stumbled upon a big one, the largest conceivable one, known as the Big Bang. In the earliest moments of our universe, this giant explosion sent galaxies flying apart through space. Galaxies do not disperse randomly, though, because their gravities attract each other. The competition between Big Bang expansion and gravitational ordering organizes galaxies into cell patterns.

When we plotted metal cell structures on the same graph as galaxy spacing, we were amazed. They followed exactly the same curve. It is scientifically interesting and aesthetically beautiful to find a microcosm in a bent piece of metal.

Order and chaos

While the two processes differ in their details, the competition between order and chaos is the same in each. Just as bending smears out the substructure in metal, the Big Bang smears out the structure of the universe. The tendency toward crystalline order creates a cell structure in metals; gravity does the same for galaxies. The result is similar structures at enormously different scales.

The multiyear project to understand the annealing process is funded by the Department of Energy's Office of Basic Energy Sciences. Colleagues from around the world, including California, the United Kingdom, and China, join in this effort.

Annealing is a fundamental process in metallurgy; metalworkers have been doing it since the Bronze Age. We want to understand the science behind it, particularly how the process initiates.

Despite its long history, scientists still do not understand every aspect of annealing. The Sandia team uses advanced computer simulations to show how the substructure of a piece of metal changes upon heating. Because their simulations are so realistic, the team is able to observe and explain the critical initiation events for the first time.

A multiyear project to understand annealing, a fundamental metallurgy process dating to the Bronze Age, has resulted in some surprising comparisons of microscopic cell structures with the ordering of galaxies in the Universe.

Expanding cells

Sandia simulations show that upon heating, certain rare cells expand at the expense of their neighbors. These special cells grow until they consume all the other cells, resulting in a soft material, free of substructure. Then, the bending and heating process can start again.

This is the initiation process in a nutshell. If that was all we did, we'd be thrilled. But the trip was as exciting as the destination.

The team is now applying its results to annealing in aircraft aluminum and automotive steel. More realistic annealing models can help industries cut costly time and prototypes from their design schedules. Eventually, engineers may use these models to control sheet metal forming in factories around the world.

But for now, metallurgists can enjoy the scientific connection between their Bronze Age technology and the shape of the Universe.

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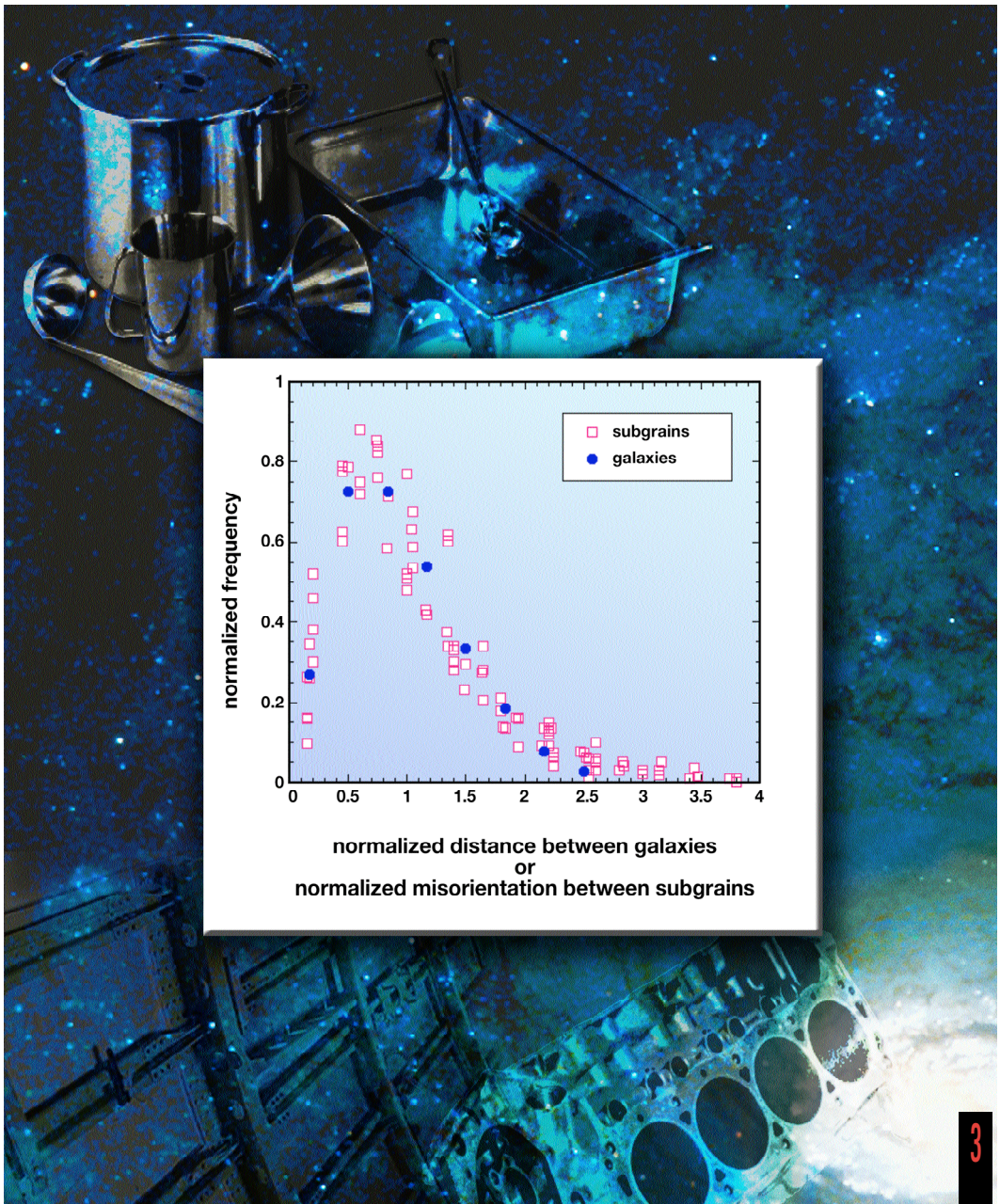
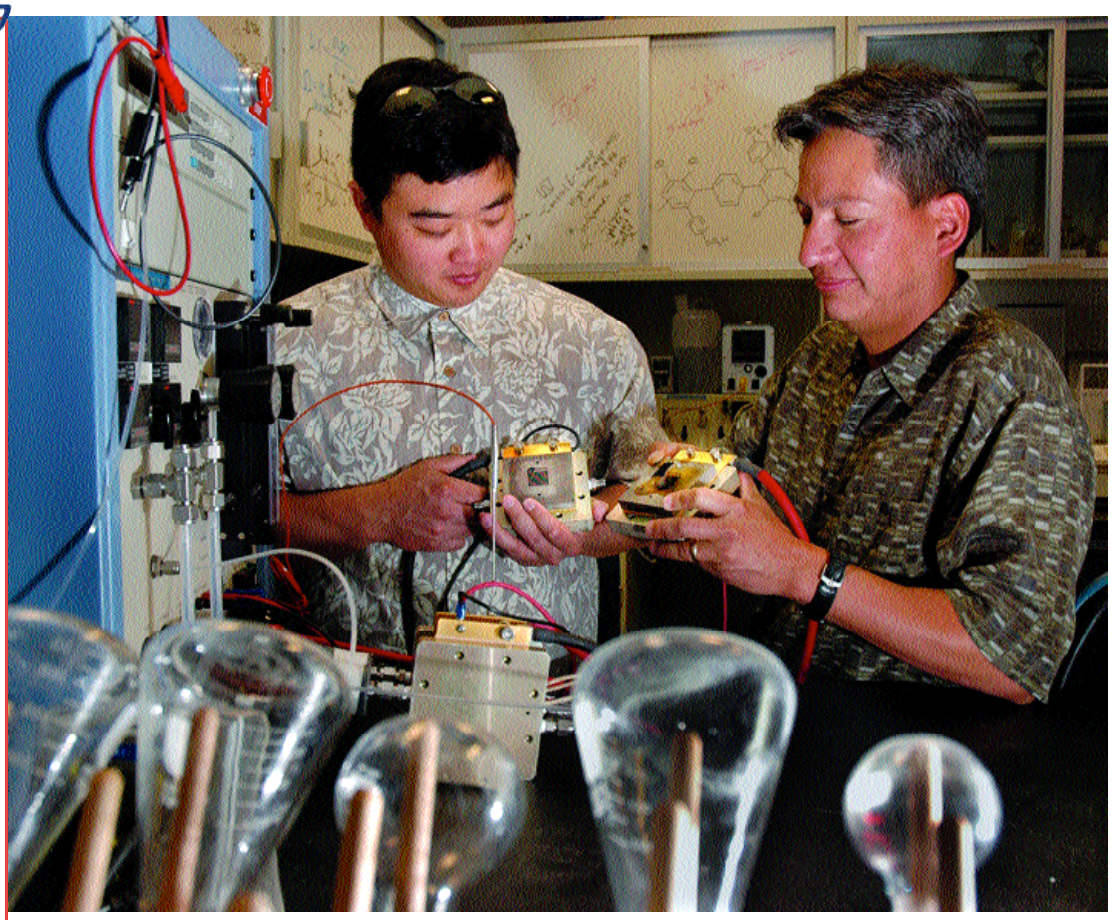


This graph, referred to in the text, plots data comparing normalized distances between galaxies (dots) and misorientations between subgrains in the annealing process (squares). Part of the achievement of such a plot, the author acknowledges, is comparing two scales that are spectacularly far apart.

New membrane
Micro fuel cell moves closer

LDRD

Sandia has developed a new polymer electrolyte membrane — a critical component for working fuel cells at a number of scales.



Sandia researchers Cy Fujimoto (left) and Chris Cornelius hold a test micro fuel cell with the Sandia membrane. Next to Fujimoto is a micro fuel test station. (Photo by Randy Montoya)

A new type of polymer electrolyte membrane (PEM) is being developed by researchers at Sandia National Laboratories to help bring the goal of a micro fuel cell closer to realization using diverse fuels like glucose, methanol, and hydrogen.

The new membrane, the Sandia Polymer Electrolyte Alternative (SPEA), could help fulfill the need for new, uninterrupted autonomous power sources for sensors, communications, micro-electronics, healthcare applications, and transportation.

The membrane research is one part of a three-year LDRD Bio-Micro Fuel Cell Grand Challenge program.

Recently the membrane research team headed by Sandia researcher Chris Cornelius demonstrated that the new SPEA could operate as high as 140 degrees Celsius. It produced a peak power of 1.1 watts per square centimeter at 2 amps per square centimeter at 80 degrees Celsius.

Higher output

Under identical operating conditions, the SPEA can deliver higher power outputs with methanol and hydrogen than with Nafion, the currently recognized state-of-the-art PEM material for fuel cells.

The Sandia Polymer Electrolyte Alternative could be used in a fuel cell to power everything from sensors and cell phones to laptops and automobiles.

Because SPEA can operate at elevated temperatures, it enables several key benefits that Nafion cannot provide. These include smaller fuel cell stacks because of better heat rejection, enhanced water management, and significant resistance to carbon monoxide poisoning. These performance properties suggest that SPEA may be a potential alternative to Nafion.

Cornelius, who developed SPEA with Sandia researcher Cy Fujimoto, notes that a higher temperature PEM material is one of the goals of the DOE's Hydrogen, Fuel Cells, and Infrastructure Technologies Program. A milestone is to develop a polymer electrolyte membrane for automotive applications by 2005 that operates at 120 degrees Celsius for 2,000 hours with low membrane interfacial resistance.

"Validation of this material as a Nafion alternative would be a significant achievement — an accomplishment we strongly desire," says Cornelius.

Critical component

A PEM is a critical component of a working fuel cell. Its function is to conduct protons efficiently and possess low fuel-crossover properties. It must also be robust enough to be assembled into a fuel cell stack and have long life.

In developing SPEA the Sandia team looked at the success and limitations of other PEM alternatives in order to develop a set of characteristics for their model material.

"At the beginning of this project we were considering several polymer families for a PEM alternative, including a family of polyphenylenes," Cornelius says. "When the physical properties of one of the polyphenylenes being considered as a polymer electrolyte was improved and integrated into a working fuel cell, we happily discovered that it works extremely well compared to Nafion."

Cornelius says that the SPEA he and Fujimoto are developing "may be an enabling material that could have an impact on the fuel cell community and help Sandia become recognized as a fuel cell research organization."

"We have already completed initial material validation studies of our SPEA with the help of our battery group and Los Alamos National Laboratory," he says.

Next steps

The next steps, Cornelius says, are to reduce the internal resistance in the fuel cell membrane electrode assembly, optimize catalyst and ionomer composition, improve the properties of the SPEA, and conduct life cycle testing in a fuel cell environment to assess the material's potential.

Understanding the material's capabilities and limitations are necessary steps in order to potentially improve the physical properties of SPEA material and evaluate its potential value for large scale commercialization.

"We see this SPEA material as having the potential of being integrated into fuel cells ranging from microwatts to kilowatts," he says. "Such a broad power range means that the Sandia Polymer Electrolyte Alternative could be used in a fuel cell to power everything from sensors and cell phones to laptops and automobiles."

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Reliable, deployable
Demonstrating new sensor architecture

LDRD

Livermore (California) Police Department's Community Outreach Vehicle served as the command post for the Sensor Management Architecture testing.

"How can we rapidly deploy sensors, surveillance cameras, and detection equipment across a small geographic location, monitor the data they collect, and communicate amongst ourselves via multiple command stations? That's the question we're attempting to answer," said Sandia researcher Michael M. Johnson.

To find the answer, Johnson and colleagues placed multiple environmental detectors and two high resolution video cameras at Robertson Park, Livermore, California, during Fourth of July festivities this summer. They also placed a mobile sensor that monitors conditions such as temperature and wind velocity.

While some 15,000 Livermore residents and visitors enjoyed barbecues, music, picnics, and other activities, Sandia researchers and City of Livermore Police Department members were using the occasion to test a complex system of sensors and other advanced technology designed to keep revelers safe from terrorist attacks.

The wireless data processing equipment was then linked to a dual-location, high-speed communications network that allowed Sandia and police personnel to receive information in near real-time. The cameras provided event security coordinators with a view of the stage and a remote parking area.

No real threats were anticipated (nor experienced) at Robertson Park. Still, Sandia researchers say the test deployment — which took about two hours — confirmed their hopes that the Sensor Management Architecture (SMA) system could serve an important and valuable role for regional law enforcement and emergency response.

Terrorist attacks

The idea, according to Sandia computer scientist Heidi Ammerlahn, is to prevent or mitigate terrorist attacks by having a networked, rapidly deployable system in place that will arm first responders with the information and technical infrastructure necessary to take action quickly and effectively. Any number of special events, both large and small, could benefit from such a system, she indicated.

"The benefit to local public safety is that very specialized sensing and video monitoring equipment can be quickly and securely integrated into a network, using either fixed wiring or encrypted wireless, to provide command staff, dispatch centers, and field personnel with vital

The long-term goal is to provide a system that can respond rapidly to high-profile special events with such importance that federal agencies such as the Secret Service and FBI will assume responsibility for their security.

information that has never been available before," said Greg Park, Livermore Police Department's Information Technology Coordinator.

Larger-scale events and venues that are attractive to terrorists are of particular concern to the Department of Homeland Security — the agency funding the program. Depending on the detection equipment being used, the system could be configured to detect any number of weapons of mass destruction and could also serve as a monitoring tool for law enforcement officials.

Hypothetical case

Ammerlahn posed a hypothetical case of a chemical agent release at a crowded political event. With an SMA system in place, a chem-detector could activate an alarm, and identify and characterize the agent. The communications component of the system would immediately notify emergency personnel and send back key information. At the same time, surveillance cameras, trained on the event location, would immediately zero in on the area of interest and provide potentially life-saving intelligence to officials.

Officials could swiftly determine the level of threat, the type of agent released, the environmental conditions impacting the release, and the whereabouts of any suspects, she said. The information could shave precious minutes in response time.

"Working directly with the local first responders, including both police and fire services, is a new and exciting mission for our laboratory," said Rick Stulen, a key member of the Labs' homeland security management team. "We are actively looking to broaden our impact within the region and open our doors to state and local entities utilizing technology being developed at the laboratory."

First response

First responders and those responsible for operations plans, logistics, and emergency response efforts urgently need systems that are reliable and easily deployable, said Sandia's Johnson. The Fourth of July exercise in Livermore demonstrated how well the SMA can work, he said.

Sandia has demonstrated similar detection and sensor architecture for San Francisco International Airport, and a major East Coast city's transportation authority is now considering how it might integrate Sandia's sensor management architecture into its emergency plan.

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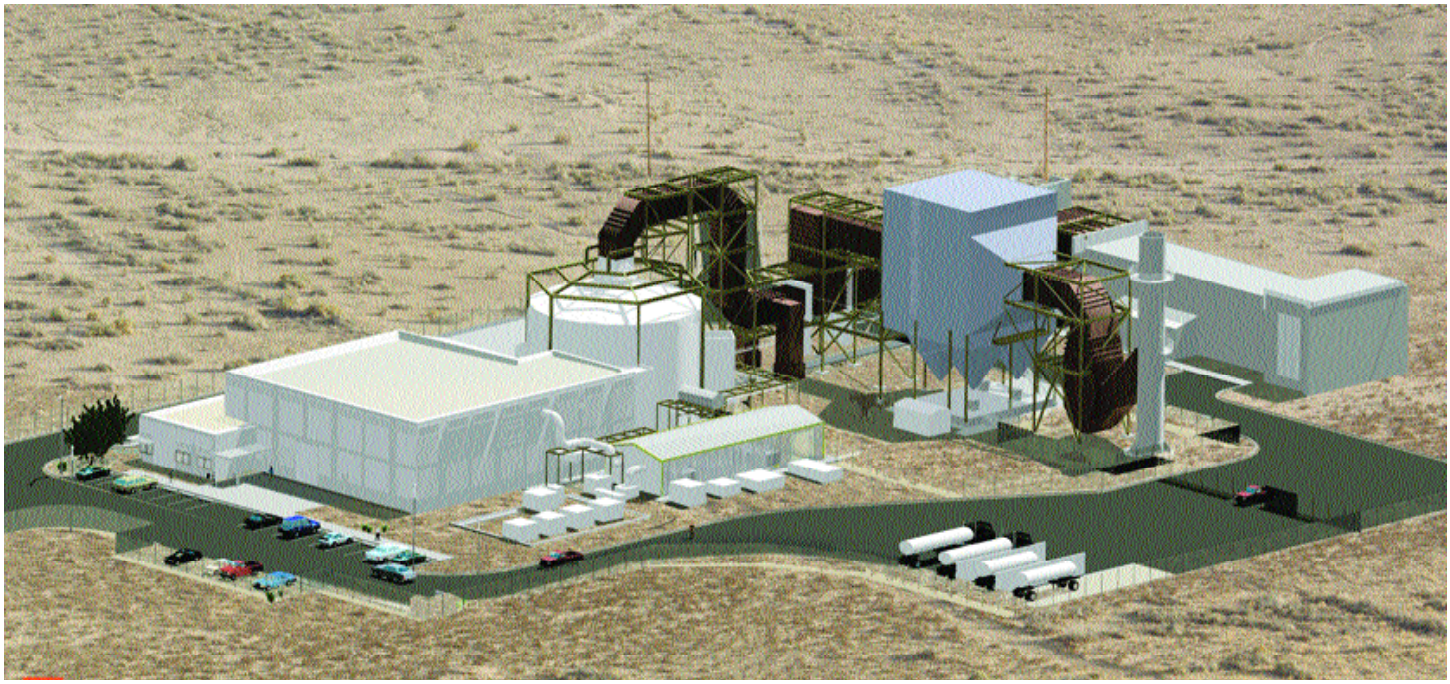
Focus on fire
Sandia–FM Global to collaborate



LDRD

New Thermal Test Complex under construction at Sandia includes offices and other facilities useful in a joint effort with FM Global. (Illustration courtesy of Dekker/Perich/Sabbatini Architects)

The goal of the agreement is to pursue research and development to reduce the consequences of adverse events such as fires.

Sandia has established a collaborative research and development agreement (CRADA) with FM Global, one of the world's largest commercial and industrial property insurance companies (www.fmglobal.com).

The goal of the agreement is to pursue research and development to reduce the consequences of adverse events such as fires. FM Global is unique as an insurer because its philosophy is that the majority of all loss is preventable and as such relies on scientific research and engineering as opposed to actuarial techniques to underwrite client risks. The CRADA sets the stage for additional progress in engineering sciences to address high consequence events, says Louis Gritzo, manager for Sandia's Fire Sciences and Technology department. The first task area under the agreement will focus on fire.

The two companies will use new, high-quality data from large fires to develop and validate computer fire models and to develop new theories to describe fire behavior. The formulation of new theories and the development of new models will allow analysis of fire hazards and predictions of fire mitigation system performance to be performed with confidence, says Gritzo.

Fire-related losses

These advances are expected to provide measurable improvements in fire safety by decreasing fire-related losses of life and property.

"Both organizations have, or will soon have, new fire test laboratories with differing, but complementary, capabilities," says Gritzo.

FM Global and Sandia have a common interest in preventing or reducing losses due to fire and other high-consequence events. A newly signed agreement aims at providing technical advances for the prevention and mitigation of these events.

FM Global recently completed construction of a $78 million world-class research and product-testing complex. The company has research laboratories that include facilities for small and intermediate-scale experiments, material flammability characterization, and open-burn rooms with calorimeter vent hoods. The largest burn laboratory, the size of an arena football field, provides a quiescent environment for replicating warehouse-size fires.

Open-fire facilities

Sandia currently has large open-fire facilities, small-scale laboratory facilities, and enclosed large fire facilities with controlled airflow to provide highly controlled conditions. Sandia will employ existing and new diagnostics and facilities included in the Thermal Test Complex presently under construction.

Experiments will serve as benchmarks for improving the knowledge of fire physics, providing validating data, and developing predictive models.

Both organizations share similar objectives, but to date have taken significantly different approaches. Both Sandia's Fire Sciences department and FM Global are developing new instrumentation including gauges for measuring heat transfer in very large fires. The organizations are also developing validated computer models for prediction of fire environments. Cooperation between the organizations is expected to speed-up progress to meet the needs of both parties.

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A seven-story FLAME Test Cell is a key part of the new Thermal Test Complex, now under construction at Sandia. The cell includes water-cooled walls, an airflow control system, and high-tech emission filters.

R&D 100

Sandia teams win Awards

Sandia researcher Christine Mitchell looks through a substrate that was made for the new cantilever epitaxy growth process. (Photo by Randy Montoya)

LDRD

Two Sandia National Laboratories research teams have won R&D 100 Awards in the annual competition sponsored by the Chicago-based *R&D Magazine*.

One award is for a new process of growing gallium nitride on an etched sapphire substrate. Called cantilever epitaxy, the process promises to make brighter green, blue, and white light emitting diodes (LEDS) for solid state lighting.

The other award is for the creation of the software framework and library Trilinos, which provides high-performance capabilities for solving numerical systems at the heart of many complex engineering and scientific applications.

"The research groups winning these awards at Sandia this year are truly innovative and on the cutting edge of science," says Sandia President C. Paul Robinson. "The cantilever epitaxy process offers the potential for longer-lived and better performing LEDs. Trilinos has had a major impact on Sandia's engineering modeling and simulation capabilities over the past several years, and with its public licensing we are extending that to broad national impact."

R&D Magazine annually gives the awards to the top 100 industrial innovations worldwide. This year Department of Energy (DOE) labs won 34 R&D 100 awards, says Jeannette Mallozzi, the magazine's managing editor.

High-efficiency white light

Colored LEDs are of interest for displays and even higher-power lamps like traffic lights. A national initiative is now under way to develop solid-state sources for high-efficiency white lighting. The cantilever epitaxy process of growing LEDs may help meet those needs.

"Our new process eliminates many of the problems that have limited the optical and electronic performances of LEDs, previously grown on sapphire/gallium nitride substrates," says Carol Ashby, one of the inventors on the project.

Over the past several years, LEDs have been grown with various combinations of gallium nitride alloys on sapphire substrates. However, the atoms of the two materials do not line up perfectly due to differences in natural lengths of the bonds in their crystal lattices. Regions of imperfections, called dislocations, accompany this lattice

A new Sandia process for growing gallium nitride on an etched sapphire substrate and an innovative software framework and library for complex engineering and scientific applications have both earned R&D 100 Awards.

mismatch. The dislocations limit LED brightness and performance.

The new process reduces the number of dislocations, giving the potential for longer-lived and better performing LEDs. It also means that LEDs grown on the patterned sapphire/gallium nitride substrates can produce brighter, more efficient, green, blue, and white lights than previously accomplished.

David Follstaedt, another inventor on the project, says that because of the reduction in dislocations, the process shows "great promise for making a superior substrate for light-emitting devices," and has potential for applications to a wide variety of electronic devices.

The cantilever epitaxy program at Sandia is part of an internal, three-year $6.6 million LDRD Grand Challenge. Funding for the program also comes from a grant from the DOE Office of Building Technologies for a collaborative project with Lumileds Lighting, a joint venture between Agilent Technologies and Phillips Lighting.

Trilinos

Trilinos is part of a broad effort on the part of national laboratories, industry, and academia to establish high-fidelity computational modeling and simulation as an approach to engineering and scientific understanding. Modeling and simulation become equal partners with the most basic approaches of theory and experiment.

Trilinos provides a solution to one of the most difficult problems in creating these simulations: How can one solve the massive and complex systems of equations required, and do so in a way that "scales" all the way from laptop computers to the most powerful and complex parallel computers in the world?

Trilinos has become tremendously successful at addressing this "solver problem" and has become an enabler for

the diverse simulation codes that support almost every engineering discipline within the DOE's Advanced Simulation and Computing program.

Trilinos, led by Sandia's Mike Heroux, is under development at both the New Mexico and California sites, with 24 researchers involved in the project. Trilinos offers what is probably the largest and most complete scalable solver capability in the world, and it is freely available to the public.

Meaning "string of pearls" in Greek, Trilinos has an architecture in which object-oriented packages are strung together like pearls on a necklace. Each package provides a particular solver capability. Trilinos began as three packages, expanded to 20, and continues to grow. Computational researchers and software developers find Trilinos attractive because they need only focus on those aspects of development that are unique to their package.

Trilinos offers developers a set of tools for building on multiple platforms, generating documentation, and multi-platform regression testing.

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Small business assistance
Sandia working for New Mexico

The Cumbres & Toltec narrow gauge steam railroad remains a major tourist attraction long after its working life would otherwise be over. Sandia is helping bring high-tech solutions to some turn-of-the-20th-century problems. (Photo by Randy Montoya)

Now in its third year of providing technical assistance to New Mexico small businesses, Sandia has provided nearly 300 small businesses with assistance through a tax credit arrangement approved by the New Mexico Legislature.

Assistance has ranged widely in terms of technological challenges, from helping a company make better spark plugs to aiding in the automation of the New Mexico chile industry. Researchers from the Labs have visited and assisted small businesses throughout the state.

The Small Business Assistance program allows Sandia to use a portion of the gross receipts taxes it pays each year to provide technical advice and assistance to small businesses in the state. During 2003, Sandia received $1,796,000 in tax credits. Two-thirds of the work was aimed at small businesses in rural New Mexico and the balance went to assist small businesses in Bernalillo County, where the Labs headquarters are located.

"Assistance helps small businesses move forward through issues and helps them get their products or services into the market," said Mariann Johnston of the program. By mid-2004, this year's program was fully allocated, with other businesses on a waiting list, she said.

Driving rods

In response to a request from New Mexico officials, researchers Ted Borek and Don Susan traveled to Chama, in northern New Mexico, to help with an important project this spring. "The railroad isn't permitted to weld on trains unless the welders know the composition of the metals," explained Borek. With 10

Sandia has been working on the Cumbres and Toltec Scenic Railroad, running across the mountains of northern New Mexico. In a unique small business program, Sandia researchers have also been working on projects affecting open ranges across the state and the chile fields of southern New Mexico.

steam locomotives and only two running, railroad officials needed to move forward with repairs. Lacking a way to determine the composition of several key locomotive components, they asked the state for help.

Borek, of Sandia's Materials Characterization department, returned with drill borings from several key parts and slivers of metal removed from a massive locomotive driving rod with a cold chisel. "This was a routine analysis for us, but they were thrilled we could help them out and provide a quick turnaround," he said.

"The metallurgy was required to determine a safe and suitable welding procedure for the main driving rod on the locomotive," explained Kim Smith Flowers, Chama resident and general manager of the company operating the narrow gauge. "We had to make that determination before we could approach repairing the rod in a way that would be acceptable to the Federal Railroad Administration."

Don Susan returned to Chama with Ted a week after the samples were collected to test the materials for hardness. Information on the metals was submitted as a part of a package to the railroad administration, to get needed welding permits and keep the repairs on schedule.

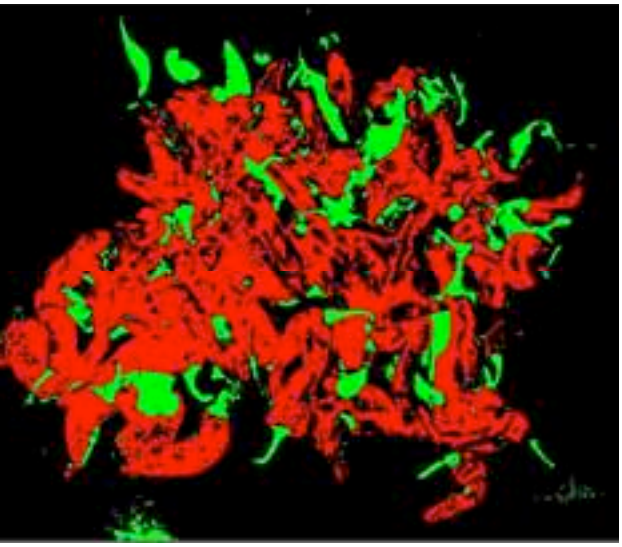
"We are always looking for principal investigators to work on projects like these," said Sandia's Johnston. "It's an opportunity for technical staff to work with small businesses outside the normal everyday projects they do and make a difference for New Mexico. In some cases, it can be technically challenging."

Hot-iron branding

In another project, a Sandia researcher helped a former New Mexico state brands supervisor develop software that instantly matches hot-iron brands with cattle owners and ranch locations. The software, expected to be commercially available this fall, comes at a time when the government is seeking faster, more detailed information about livestock, particularly during disease outbreaks.

Nickel Brand Software allows a user to find the owner of a brand by sketching the brand on the screen of a computer palm pad with an electronic stylus or by scanning the brand with a hand scanner. It would allow brand states to keep a system that has worked well more than 100 years and move into the 21st century.

Software developed with the help of Sandia engineers is helping ranchers adapt a system of branding used for more than 100 years to the demands of the 21st century.



Segmenting is the process of determining what is product, what is debris, and what is background on a conveyor belt. Picture above shows product in red, stems and debris in green, and conveyor belt in black. Pixels can then be counted to arrive at product percentages.

Loretta A. Martinez, founder of Moriarty-based Nickel Brand Software, said matching brands with ranches can be tricky. In New Mexico alone, there are about 28,900 brands representing thousands of working ranches, each of which may use several brands. (New Mexico ranks sixth in the U.S. for number of brands, after Texas, Montana, Colorado, Nebraska, and Wyoming.)

John Browning, of Sandia's Reliability Assessment and Human Factors department, helped the fledgling company by applying a reliable single-pass, three-level artificial neural network to the problem of matching brands. This and some human factors suggestions to help eliminate human error moved the product forward.

The network operates similar to neurons in the brain, Browning explained. You train it to establish certain connections, so that when it sees a certain input it will fire. The system eliminates obvious brands and arrives at a dozen or fewer choices for a human to make, instead of looking through a book-full of possibilities. "Humans are very, very good at matching under these circumstances," Browning said.

The system can evaluate new cleaning technologies and may also be of use to processors in the future...

High-tech chile

New Mexico's Chile Task Force, a partnership of growers, producers, and research institutions founded six years ago, has as a goal the improvement of New Mexico chile production and competitiveness.

Chris Wilson, of Sandia's Intelligent Systems Sensors and Controls department, has been working with task force members on a project to develop mechanical cleaning and de-stemming for chile producers. "The industry is moving from manual harvesting and cleaning toward more automated systems," explained Wilson. "We looked at the mechanical devices under development and decided we could help most with a measuring system." The system will measure red chile on a conveyor belt after mechanical cleaning, quantifying percentages of chiles, and "trash," which consists of sticks, leaves, and other natural debris.

The system can evaluate new cleaning technologies and may also be of use to processors in the future, Wilson said. Based on investigations of different imaging technologies last year, the system analyzes the chile and debris on a conveyor belt based on color differences. A digital camera connected to a portable computer takes still images of the conveyor. Software analyzes the image and provides feedback to the operator on percentage of product and waste. The operator can then adjust the cleaner and again check the output plots to see the effect.

Right now, most quality measurements are made by "eyeball," Wilson said. His system is expected to be put to the test during this season's harvest in October, measuring results from a new cleaning machine developed by other members of the task force.

Sandia is applying technologies used in robotics research labs in New Mexico, but "with a lot of variables" in terms of outdoor conditions outside of a controlled lab environment, Wilson said. "It builds on and adds to what we are doing. We are stretching ourselves in some different directions, but I think it will make us stronger."

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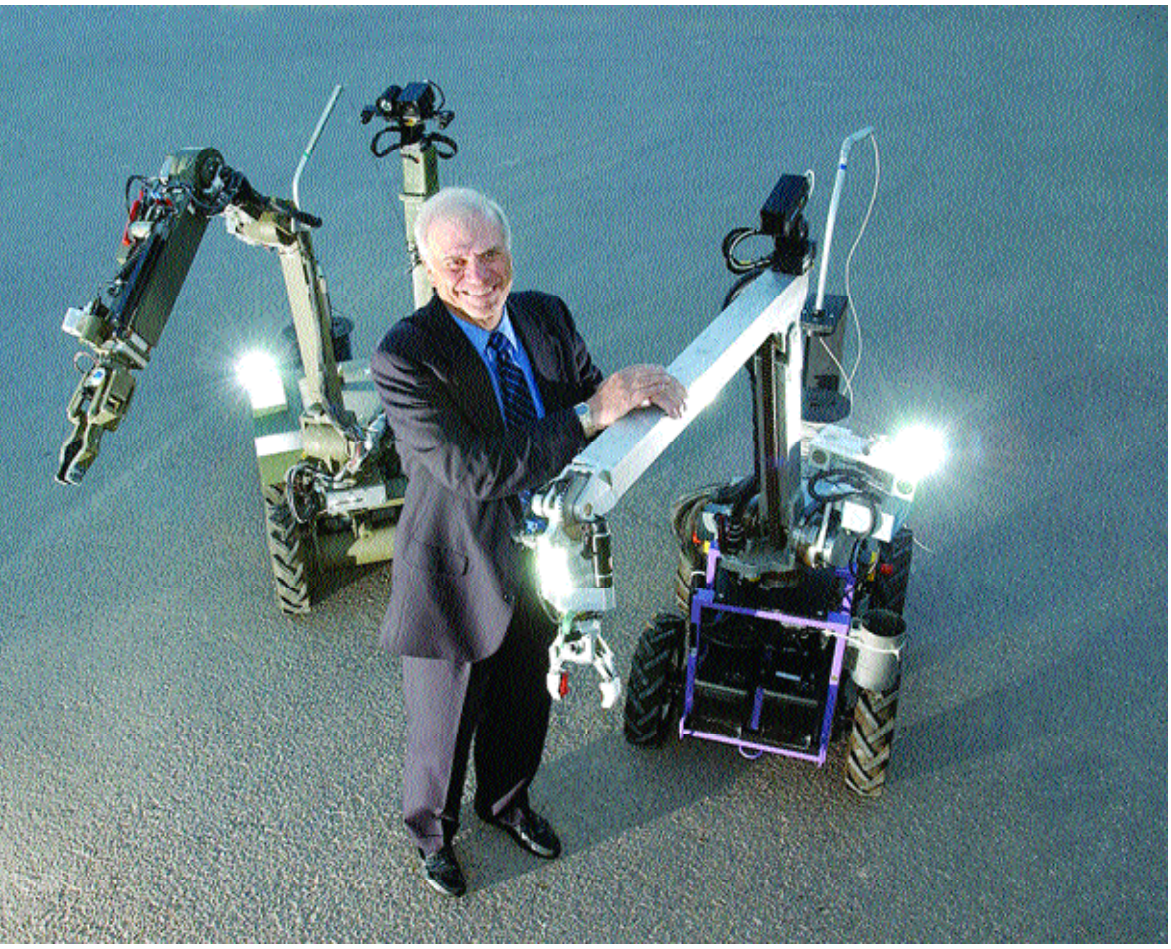
Army Science Board

Tegnelia named to ASB



Jim Tegnelia, vice president of Defense Programs at Sandia and chairman of Army Science Board.

Jim Tegnelia, vice president for Department of Defense Programs at Sandia National Laboratories, has been appointed chairman of the Army Science Board (ASB).

The board provides the U.S. Army with independent and unbiased advice on science and technology issues that are strategic in nature and important to large segments of the Army. "This appointment has two direct benefits for Sandia," Tegnelia says. "The first is that the board serves in the national interest, and second is that it gives Sandia an opportunity to be more responsive to the military."

Three other Sandia employees are members of the ASB: Executive Vice President Joan Woodard; CFO and Vice President of Business Management Frank Figueroa; and Director of Manufacturing Science and Technology Gil Herrera.

Senior Advisors

The ASB is the Department of the Army senior scientific advisory body. Chartered in 1977 to replace the Army Scientific Advisory Panel, the ASB advises and makes recommendations to the secretary of the Army, the chief of staff of the Army, the assistant secretary of the Army (Acquisition, Logistics, and Technology), the Army staff, and major Army commanders on scientific and technological matters of concern to the Army.

The board is composed of individuals from the private sector, academia, and non-Department of Defense government agencies. Members are selected according to their preeminence in their respective fields and appointed by the Secretary of the Army.

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