Brookhaven's Joseph P. Indusi

Page 2

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

R&D 100 Awards

DOE-funded projects at 11 laboratories across the nation win 35 R&D 100 awards.

Novel manufacturing process for thin-film solar cells

A researcher at DOE's National Renewable Energy Laboratory has developed a novel process for producing lower cost thin-film cadmium telluride (CdTe) solar cells with a confirmed 14 percent efficiency. In conventional thin-film manufacture, semiconductor materials are layered between glass and a back contact and heated several times to high temperatures. The new process has only one heat-up period and includes two techniques developed at NREL that have the potential to increase performance. Further, the reduced temperature in the NREL process allows the use of inexpensive soda-lime glass, which has a low softening point.

[Sarah Barba, 303/275-3023; sarah_barba@nrel.gov]

Training border inspectors for weapons detection

Scientists at DOE's Pacific Northwest National Laboratory are training U.S. Customs and Border Protection inspectors to identify and halt smuggling of weapons of mass destruction during training courses in Richland, Wash. Nearly 400 CBP officers have completed the training program. U.S. border inspectors receive comprehensive training to detect, identify, interdict and investigate illicit movement of materials, commodities and components associated with the development or deployment of weapons of mass destruction. The curriculum includes instruction and hands-on demonstrations and exercises designed to familiarize inspectors with the materials and components associated with weapons of mass destruction and dual-use items. PNNL and the CBP share instructional responsibilities, while the National Nuclear Security Administration funds the training.

[Staci Maloof, 509/372-6313; staci.maloof@pnl.gov]

TeraGrid to link with Oak Ridge neutron science facilities

Researchers from around the nation will have access to data from DOE's Oak Ridge National Laboratory neutron science facilities because of a $3.9 million grant from the National Science Foundation. The grant to ORNL's Center for Computational Sciences will fund a network hub and high-performance network connections to the TeraGrid, which when complete will operate at 40 gigabits per second and be the fastest research network in the world. The TeraGrid will provide scientists extraordinary amounts of data from ORNL's High Flux Isotope Reactor and the Spallation Neutron Source. Grant collaborators were the universities of Tennessee and Virginia, Georgia Tech, Virginia Tech, and Duke, Florida State, and North Carolina State universities.

[Ron Walli, 865/576-0226; wallira@ornl.gov]

Ductile Intermetallics Discovered

Intermetallic compounds have long been known to possess chemical, physical, electrical, magnetic and mechanical properties that are often superior to ordinary metals. But their potential has gone untapped because they are typically quite brittle at room temperature. Now researchers at DOE's Ames Laboratory have identified 12 fully ordered, completely stoichiometric intermetallic compounds that are ductile at room temperature. The discovery, announced in the Sept. issue of *Nature Materials*, could make these promising materials more useful. The study, led by senior metallurgist Karl Gschneidner, Jr. and associate scientist Alan Russell, has focused on yttrium-silver, yttrium-copper, and dysprosium-copper. Preliminary examination of other rare earth compounds also shows ductility.

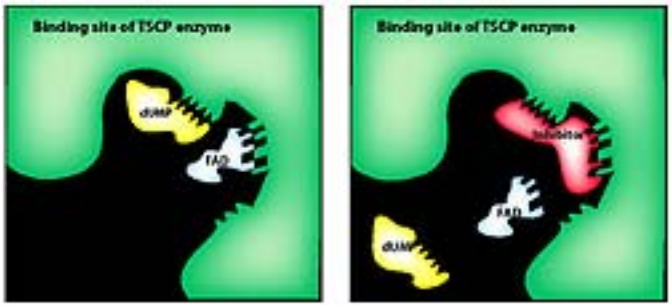
[Kerry Gibson, 515/294-1405, kgibson@ameslab.gov]

DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

SSRL scientists gain insight into blocking anthrax, other diseases

Scientists at the Stanford Synchrotron Radiation Laboratory (SSRL) operated at DOE's Stanford Linear Accelerator Center have found an Achilles heel in the brutal diseases anthrax, botulism, syphilis, diarrhea and Lyme disease.

These single-celled disease organisms need a protein called thymidylate synthase complementing protein (TSCP) to replicate. TSCP is an enzyme, a type of protein that catalyzes chemical changes in the molecules that bind to it without changing itself. SSRL's concentrated X-rays revealed the 3-D structure and function of this protein, which has enabled researchers to create a computer model of a molecule that could block it and thus the organisms that rely on it to survive. The research was a cooperative effort with the Joint Center for Structural Genomics.



The molecules dUMP and FAD attach in different ways to the binding site of the TSCP enzyme (left), where dUMP is chemically converted into dTMP (a part of DNA necessary for cell replication). If an inhibitor blocks the binding site (right), dUMP and FAD cannot attach and dTMP cannot be made and the cell cannot in theory reproduce.

"The unique structure of the TSCP enzyme and its discovery last year in numerous pathogenic organisms provide an exciting opportunity for drug design," said Irimpan Mathews, a protein crystallographer at SSRL. The data was published in the June issue of *Structure*.

Mathews and his colleagues determined the key binding sites where small molecules attach to TSCP. TSCP converts a molecule called dUMP into dTMP, an essential part of DNA necessary for cells to replicate. The researchers also found that all known members of this enzyme family share the same structure at their core. This commonality allows one drug to potentially inhibit the activity of all TSCPs – and therefore stop the replication of many disease-causing organisms.

The TSCP binding site has anchorages for the molecules dUMP, FAD, and a third small molecule. Although each molecule has a different shape, it fits snugly into its attachment area, the way different computer cables – modem, power, USB – have a corresponding port to plug into. The computer model of an inhibitor designed by Mathews and his colleagues is shaped to plug up the attachment areas of *both* dUMP and FAD in order to thwart the chemical reaction and thus prevent cell reproduction.

For more information, see http://www-ssrl.slac.stanford.edu/research/highlights_archive/tscp.html.

Submitted by Stanford Linear Accelerator Center

Brookhaven's Indusi champions homeland security and classic Buicks

Joseph P. Indusi

Joseph P. Indusi, chair of the Nonproliferation and National Security Department at DOE's Brookhaven National Laboratory, is vigilant about assessing risks to national security in the post 9/11/01 era. But it was the first terrorist attack on the World Trade Center a decade ago that shifted the focus of his department.

"Since 1993, we have been focusing more of our efforts on anti-terrorism initiatives," Indusi said. "Recently, we have been working with the Department of Homeland Security to test and evaluate radiation detectors for use in the New York metropolitan area. We also are developing advanced radiation detectors that can be used to trace radiation from devices such as dirty bombs. The department has also been part of a team conducting vulnerability and risk assessments at critical infrastructure facilities in New York State."

Indusi's department provides technical assistance to promote enhanced safeguards and security systems for the protection and accountability of weapons-grade nuclear materials, in cooperation with Russian nuclear facilities. It also develops safeguards systems and arms control verification technology to stem the spread of nuclear, chemical and biological weapons.

Further, the department provides technical oversight of projects designed to strengthen the International Atomic Energy Agency's safeguards, and it addresses the environmental and proliferation concerns associated with dismantling Russian nuclear submarines. "I've been entrusted with a job at Brookhaven that is extremely important for the safety of the nation and the world," Indusi said. "I take that role very seriously, and I believe that my staff of about 40 experts and I perform it very well."

In his leisure time Indusi enjoys rebuilding classic Buicks. He owns a 1948 Buick Special Two-Door Sedanet, which he restored to showroom condition. He is currently restoring a 1953 Buick Special 2-door hardtop. Also, he has had several articles published in *The Bugle*, Buick Club of America's newsletter.

Submitted by Brookhaven National Laboratory