Bruce Hallbert

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

A Better Catalyst for "Artificial Photosynthesis"

Scientists at DOE's Brookhaven Lab are studying transition-metal catalysts for possible use in "artificial photosynthesis" reactions. The goal is mimic plant chemistry to convert carbon dioxide (CO_2) to carbon monoxide (CO)— a crucial step in transforming CO_2 to useful organic compounds such as methanol. The scientists can't use chlorophyll, nature's catalyst, because it does not strongly bind to CO_2. Also, outside the plant, chlorophyll decomposes quickly. So the Brookhaven scientists have turned to robust transition metal complexes as possible substitutes. By studying these catalysts' reactions, the scientists hope to improve their efficiency and potential for converting renewable solar energy into inexpensive fuels and raw materials.

[Karen McNulty Walsh, 631/344-8350; kmcnulty@bnl.gov]

Nerve-gas fingerprints etched in light

In 1995 hundreds of Tokyo subway rescuers were exposed to the deadly nerve-gas sarin hours before police confirmed its identity. Earlier this year, soldiers in Iraq worried about a similar fate. Scientists at DOE's Pacific Northwest National Laboratory have developed a way to warn commuters, emergency crews and troops about a toxic gas release. A device called a high-resolution infrared spectrometer can be pointed at a suspect cloud to read light emitted and absorbed. Thanks to PNNL's highly precise catalog of chemical-agent spectral signatures, the instrument detects from the light the presence of sarin, soman, VX, mustard gas and other common nerve and blistering agents. National Institute of Standards and Technology researchers collaborated on recent tests of the PNNL system at Utah's Dugway Proving Ground.

[Bill Cannon, 509/375-3732; cannon@pnl.gov]

A "camera" to pinpoint source of gamma rays

A device originally developed for nuclear physics research may find applications in homeland security and medicine. A "Compton Camera" being developed at DOE's Argonne National Laboratory could be used to create detailed images of radioactive materials, from smuggled weapons to "tracers" used in nuclear medicine. The camera uses four-inch-square sheets of germanium to detect gamma rays, a high-energy form of light produced by nuclear reactions. By using two such counters, arranged much like optical lenses, and sophisticated electronics, researchers are creating a camera that can pinpoint the origin of gamma rays to within five millimeters. This would allow scanning of shipping containers as well as efficient mapping of radiation within the body.

[Dave Jacqué, 630/252-5582; info@anl.gov]

New W and Z precision in joint publication by CDF and DZero

In the first joint publication by the CDF and DZero collaborations at the DOE's Fermilab, the two experiments have obtained the most precise W and Z boson measurements to date from the Tevatron, the world's highest-energy particle accelerator and currently the world's only source of W and Z bosons. The W mass, fundamental to the electroweak theory, is determined to better than one-in-a-thousand accuracy. The W mass is crucial in pinning down the mass of the as-yet unobserved Higgs boson, the centerpiece of the electroweak theory, affecting experiments at future accelerators.

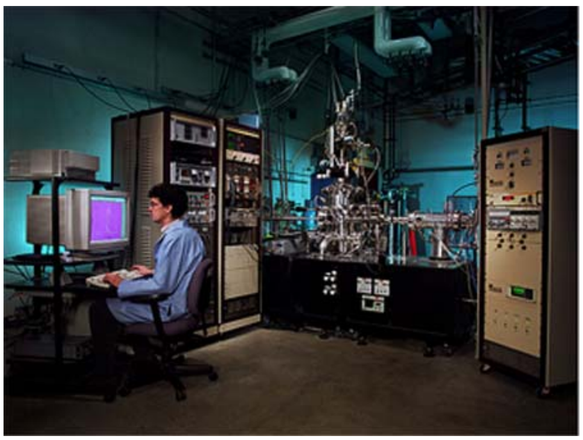
[Matthew Hutson, 630/840-2237; muhtson@fnal.gov]

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).

HiTEC for better collaborative research

As the nation accelerates toward revolutionary changes in power production, DOE's Pacific Northwest National Laboratory and the agency's National Energy Technology Laboratory have established a new mechanism—The High Temperature Electrochemistry Center (HiTEC)—to engage university participation in solving key scientific and technical issues.

HiTEC is a collaborative research program established in 2002 to make advancements in electrochemistry for next generation energy conversion systems. PNNL and NETL coordinate HiTEC, which includes a research hub at PNNL (including DOE's Environmental Molecular Sciences Laboratory) and the first satellite research center at Montana State University. MSU researchers and their collaborators at PNNL focus on separations technology for advanced power systems—with an emphasis on high temperature applications, carbon dioxide capture and hydrogen separation from coal gas.



Collaborators from Montana State University use the ion accelerator in the Environmental Molecular Sciences Laboratory at PNNL to study the oxidation mechanisms of novel electrical interconnect materials.

During HiTEC's first year, PNNL researchers developed new anode materials for solid oxide fuel cells that enable fuel cells to operate at lower temperatures and in environments with higher sulfur contents. MSU researchers identified degradation mechanisms for embedded interfaces within an operating fuel cell, making it possible to extend the lifetime of fuel cells.

Plans for the coming year include adding another university satellite center that will focus on a different technology area to widen the breadth of technical barriers being addressed.

HiTEC activities align with the President's FutureGen Initiative, as well as with the vision of DOE's Office of Fossil Energy to design and build energy plants that maximize efficiency while minimizing the environmental effects of using fossil fuels. Components of these new plants include fuel cells, turbines and hybrid energy generation systems.

Research conducted through HiTEC will be used on the test platform of FutureGen, a $1 billion venture to build a prototype of the world's first fossil fuel power plant that combines electricity and hydrogen production with carbon sequestration technologies for the virtual elimination of harmful emissions, including greenhouse gases.

Submitted by Pacific Northwest National Laboratory

Hallbert optimizes human performance

Bruce Hallbert

Bruce Hallbert strives for better living through circuitry. He is department manager for the Human Factors, Robotics and Remote Systems group at DOE's Idaho National Engineering and Environmental Laboratory. The 37-person team uses computers and other intelligent systems to optimize human performance. The group's interests span Generation IV nuclear power reactors, future combat systems and domestic emergency responses.

"I've always been interested in both engineering and psychology," Hallbert says. In 1987, he earned a master's degree in psychology from Idaho State University. Since then, he has worked on human factors aspects of nuclear safety at the INEEL, Rocky Flats and in Halden, Norway.

His department's current work aims to develop and evaluate process control systems that will optimize human performance in Generation IV nuclear reactors. Other collaborative projects with the Army, the Department of Defense and Defense Advanced Research Projects Agency focus on the human-robotics interface, future combat systems and testing of unmanned aerial and ground vehicles.

Hallbert is currently completing his doctoral work at Vanderbilt Universiy's Engineering School and Medical Center. He is exploring ways to improve coordination of responses to domestic catastrophes, such as natural disasters, human-caused disasters or failure of man-made structures.

"Many organizations will be potentially involved in a response," Hallbert says.

"Fire services, police services, federal agencies, medical organizations—these are very distinct groups. Many of these groups are not accustomed to working with one another, in terms of command, control and communication."

Hallbert enjoys being outdoors, especially with his two black labs, Duke and Daisy. However, the demands of his dissertation work leave the scientist with little leisure time. "Right now," he says, "I have negative spare time."

Submitted by Idaho National Engineering and Environmental Laboratory