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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Palladium substitute key to fuel-cell operation

Researchers at DOE's Ames Laboratory are employing some modern day alchemy to find a material with properties of rare and high-priced palladium. Palladium acts as an "atomic filter" to remove impurities such as water vapor or carbon monoxide from the hydrogen gas to keep the proton exchange membrane in fuel cells from getting "gummed up." But at $11,000 a kilogram, it's cost prohibitive to use it on a commercial scale, even if there was enough available.Ames Lab scientist Alan Russell and Materials Preparation Center Director Larry Jones are working with REB Research, a Michigan firm, through a $2.8 million grant from the Department of Energy. So far the team has one particularly promising alloy and several other possibilities from the more than 60 developed thus far.

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

Study: Coal combustion waste management improves

A new report prepared at DOE's Argonne National Laboratory has the potential for far-reaching impacts on the electric utility industry. It concludes there has been improved management of coal combustion wastes in landfills and surface impoundments over the past decade. Based on the new report, the U.S. EPA is expected to reassess its previously issued determination regarding the need for national regulations to manage wastes generated by electric utilities. The report serves as the cornerstone of an upcoming notice of data availability through which EPA will make this new information available to the public.

[Catherine Foster, 630/252-5580, cfoster@anl.gov]

10 million hours to study subatomic particles

A project led by the Theory Center at DOE's Jefferson Lab has been allotted 10 million hours of computer processor time by DOE's 2007 INCITE program on the Cray XT3 at Oak Ridge National Laboratory. The researchers aim to calculate the properties of subatomic particles—from the familiar protons and neutrons in everyday matter to the pi-mesons found in cosmic rays. Specifically, researchers will more precisely predict the particles' behavior in experiments with powerful particle accelerators, such as the research to be performed with Jefferson Lab's accelerator following its upgrade, now in the engineering and design stage.

[Kandice Carter, 757/269-7263, kcarter@jlab.org]

SRNL to support international energy project

DOE's Savannah River National Laboratory will add its technological expertise in support of the ITER program, an international project to demonstrate the scientific and technological feasibility of a full-scale fusion power reactor. The U.S. ITER Program Office, located at Oak Ridge National Laboratory, selected SRNL along with Princeton Plasma Physics Laboratory as a partner laboratory for the U.S. ITER project. SRNL's role is the design, fabrication, assembly, testing, and shipment of the exhaust processing system, working in collaboration with Los Alamos National Laboratory. In addition, SRNL is providing support at the invitation of the Commissariat à l'Energie Atomique (CEA - the French Nuclear Regulatory Agency) to join the ITER International Team in Cadarache to fill the urgent position for safety and licensing activities.

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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).

Watching Ultrafast Bond Softening with X-rays

Scientists from DOE's Stanford Linear Accelerator Center (SLAC), Brookhaven National Laboratory, Argonne National Laboratory, Lawrence Berkeley National Laboratory, and Lawrence Livermore National Laboratory, along with other institutions, used advanced x-ray tools to see the first instants of change in a solid brought to the edge of melting. Their results were published in the February 2, 2007 issue of Science. At SLAC's Sub-Picosecond Pulse Source (SPPS), researchers used x-ray pulses just quadrillionths of a second long to study atomic interactions in the semi-metal bismuth.

When bismuth is struck with a laser, its electrons are excited, but not enough to actually melt the material. The x-ray pulses in the SPPS experiment allow researchers to look at the less-than-nanosecond period between the moment of the laser's expulsion to the time when the electrons return to their normal state.

The laser instantly changes bismuth's potential energy surface — a measure of the forces that hold solids together — thus weakening bismuth's atomic bonds. This puts the atom's nucleus out of equilibrium, like moving a marble from the center of a bowl up its sloped sides. To get back into equilibrium, the atom "rolls" to the center of the bowl and oscillates around the lowest point, like a marble before it comes to rest in the center of the bowl. The researchers measured the frequency of these oscillations to determine the forces that bind the atoms together. This is the first time-dependent mapping of a solid's potential energy surface. The results also back a theoretical framework used to predict potential energy surfaces for systems that are in equilibrium.

Although the SPPS has since been dismantled to make way for the Linear Coherent Light Source at SLAC, learning how to construct and operate more complex systems based on this technique could lead to advances in medicine, alternative energy, and other fields.

Submitted by DOE's Brookhaven National Laboratory

ORNL's Bardayan tracks stellar events

Dan Bardayan

Dan Bardayan, an astrophysicist at DOE's Oak Ridge National Laboratory, hails from nearby Nashville, Tenn., home of a galaxy of country music stars. However, the stars that interest him most are those in the cosmos.

Bardayan has often been cited for pioneering work at the Holifield Radioactive Ion Beam Facility, even going back to his student days, when one of his papers changed the conventional wisdom on the expected amounts of some nuclei produced in exploding stars by factors of as much as 10,000.

That paper won him the American Physical Society's 2001 dissertation in nuclear physics award, which cites the best dissertation in nuclear physics over a two-year period by a graduate student in North America.

Bardayan's research in the Physics Division explores the nuclear processes in supernovae that create many of the elements responsible for life on earth.

Bardayan developed, and continues to improve, the SIlicon Detector ARray. SIDAR detects alpha particles and other light ions emitted when radioactive ion beams collide with targets at the Holifield Facility

More recently, Bardayan and his team have completed a series of groundbreaking experiments using r-process nuclei, one of the major stellar processes that produce elements heavier than iron.

"A set of experiments anticipated worldwide is to measure the rate of neutron transfer onto neutron-rich r-process nuclei. Last fall we completed a series of three measurements to measure these rates," Bardayan says.

His group also experimented last year with a beryllium-7 radioactive beam, which mimics a process in which neutrinos are created in the sun.

"It's a lot of fun to be able to study on earth things that are occurring in supernovae and the sun, and being able to make the physics measurements to do it," Bardayan says.

His work and accomplishments in nuclear astrophysics led to his recognition last year as one of the Presidential Early Career Award for Science and Engineering winners.

Submitted by DOE's Oak Ridge National Laboratory