Jefferson Lab's Christine Langton

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

What, oh, what are those actinides doing?

Researchers at DOE's Pacific Northwest National Laboratory are uniting theory, computation and experiment to discover exactly how heavy elements, such as uranium and technetium, interact in their environment. The results obtained from the calculations are an invaluable supplement to very expensive and often hazardous experimental studies and could have wide impact, from radioactive waste and cleanup challenges to the design and operation of future nuclear facilities. The insights were achieved in collaboration with scientists from Idaho National Laboratory and Wichita State University, employing the supercomputing resources of the William R. Wiley Environmental Molecular Sciences Laboratory at PNNL.

[Geoffrey Harvey, 509/372-6313, geoffrey.harvey@pnl.gov]

Sandia, FEMA collaborate on new public alert system

DOE's Sandia National Laboratories and the Federal Emergency Management Agency are designing and deploying an alert and warning system that will provide a multi-faceted path to ensure effective public communications during emergencies. The Integrated Public Alert and Warning System, being piloted in several states and local jurisdictions of the Gulf Coast region, is designed to transform national emergency alerts from audio-only messages delivered via radio and television into a system that can reliably and efficiently send alerts by voice, text and video to all Americans, including those with disabilities or who cannot understand English. FEMA's current Emergency Alert System, in place since 1994, replaced the Emergency Broadcast System that was launched in 1963.

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Groovy solution to cloudy problem

Recent experiments using the PEP-II accelerator at DOE's Stanford Linear Accelerator Center have shown that beam pipes with grooves can snare unwelcome electrons, greatly reducing the formation of electron clouds that can disturb the beam. Such clouds can form when free electrons inside an accelerator strike the chamber walls, which releases more electrons in a cascade effect. These clouds could pose a major problem for future projects. A team of ILC researchers monitored four segments of beam pipe installed in a straight section of the PEP-II accelerator. Two segments had smooth interior walls, and two had lengthwise grooves formed into the interior walls. Results showed that the grooved pipes had 20 to 30 times less current from electron clouds than the smooth segments.

[Heather Rock Woods, 650/926-2605, hrwoods@slac.stanford.edu]

Truly sick or simply scared?

Pacific Northwest National Laboratory scientists have discovered a way to increase the sensitivity of test strips that will enable creation of a portable biosensor to address the need to quickly distinguish between individuals who have been exposed to nerve agents and the "worried well." Components of the nano-based sensor resemble a pregnancy test strip and a small glucose testing meter. The five-year biosensor effort is funded by a $3.5 million grant from the National Institutes of Health Countermeasures Against Chemical Threats (CounterACT) Research Network through the National Institute of Neurological Disorders and Stroke. A key research resource is the Environmental Molecular Sciences Laboratory, a DOE national scientific user facility located at PNNL.

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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).

New catalysts may create more, cheaper hydrogen

A new class of catalysts created at DOE's Argonne National Laboratory may help scientists and engineers overcome some of the hurdles that have inhibited the production of hydrogen for use in fuel cells.

Argonne chemist Michael Krumpelt and his colleagues in Argonne's Chemical Engineering Division used "single-site" catalysts based on ceria or lanthanum chromite doped with either platinum or ruthenium to boost hydrogen production at lower temperatures during reforming. "We've made significant progress in bringing the rate of reaction to where applications require it to be," Krumpelt said.

Most hydrogen produced industrially is created through steam reforming. In this process, a nickel-based catalyst is used to react natural gas with steam to produce pure hydrogen and carbon dioxide.

These nickel catalysts typically consist of metal grains tens of thousands of atoms in diameter that speckle the surface of metal oxide substrates. Conversely, the new catalysts that Krumpelt developed consist of single atomic sites imbedded in an oxide matrix. The difference is akin to that between a yard strewn with several large snowballs and one covered by a dusting of flakes. Because some reforming processes tend to clog much of the larger catalysts with carbon or sulfur byproducts, smaller catalysts process the fuel much more efficiently and can produce more hydrogen at lower temperatures.

Krumpelt's initial experiments with single-site catalysts used platinum in gadolinium-doped ceria that, though it started to reform hydrocarbons at temperatures as low as 450 degrees Celsius, became unstable at higher temperatures. As he searched for more robust materials that would support the oxidation-reduction reaction cycle at the heart of hydrocarbon reforming, Krumpelt found that if he used ruthenium – which costs only one percent as much as platinum – in a perovskite matrix, then he could initiate reforming at 450 degrees Celsius and still have good thermal stability.

The use of the $LaCrRuO3$ perovskite offers an additional advantage over traditional catalysts. While sulfur species in the fuel degraded the traditional nickel, and to a lesser extent even the single-site platinum catalysts, the crystalline structure of the perovskite lattice acts as a stable shell that protects the ruthenium catalyst from deactivation by sulfur.

Krumpelt presented a keynote talk describing these results during the 234th national meeting of the American Chemical Society in Boston in August.

Submitted by DOE's Argonne National Laboratory

For SRNL's Langton, cement's not a hard topic


Christine Langton

To many, cement may be a mundane subject, a substance you see every day but never really notice. At DOE's Savannah River National Laboratory, however, Dr. Christine Langton knows that cement, concrete and grout are versatile materials, useful in stabilizing and disposing challenging wastes.

Dr. Langton is a leading expert in concrete, grout construction materials, and low temperature isotope stabilization. She has developed numerous specialized construction fill materials with unique properties, including development of special concrete, grout, or controlled low strength material to support many tank and basin closures including the first two high-level waste tanks closed in the DOE Complex.

A Fellow of the American Ceramic Society, she has authored more than 35 technical publications related to facility closures, waste form development, stabilization of radioactive materials, and materials longevity, and has advanced the fundamental science in the areas of hydrated calcium aluminosilicate cements, magnesium silicate cements, acidbase cement (magnesium phosphate). She has multiple patents in the areas of radioactive and hazardous chemical stabilization, enhancement of the retention of radionuclides, pretreatment processes for wastes, innovative macroencapsulation of debris and mixed lead metal treatment, and hydrated magnesium silicate cements for geothermal well applications.

She has also taken her skills abroad, taking a leave of absence from SRNL in 2005 to work on a Washington Group International project related to restoring and rebuilding water resources in Iraq, where she was lead consultant in an effort to evaluate and assess a wet-process Portland cement plant.

Submitted by DOE's Savannah River National Laboratory