Oak Ridge's Carol Wood

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DOE Pulse

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Research Highlights . . .

Making "pure" hydrogen for fuel cells

Brookhaven Lab chemist Devinder Mahajan at DOE's Brookhaven Lab has developed a novel, low-temperature process for producing "pure" hydrogen for fuel cells. The hydrogen that feeds fuel cells often contains high levels of carbon monoxide (CO), which "poisons," or degrades, the expensive catalysts that convert hydrogen into electricity. Mahajan's process uses a metal catalyst, nitrogen, methanol, and water to convert nearly 100 percent of the CO in the hydrogen feed into carbon dioxide and additional hydrogen. The resulting hydrogen feed contains only a few parts per million of CO, which could greatly extend the life of the catalysts that make fuel cells work.

[Peter Genzer, 631/344-3174; genzer@bnl.gov]

Researchers manipulate light at nanoscale

Optical engineering has had a tremendous impact on our everyday lives. However, manipulating light on the nanoscale level can be a Herculean task, since the nanoscale level is so incredibly tiny—less than one tenth the wavelength of light. Researchers at DOE's Argonne National Laboratory are making strides towards understanding and manipulating light at the nanoscale by using the unusual optical properties of metal nanoparticles, opening the door to microscopic-sized devices such as optical circuits and switches.

The study, published in the *Journal of Physical Chemistry B*, used powerful high-resolution imaging and modeling techniques to detail how light is localized and scattered by metal nanoparticles.

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

Growth of self-organized metal islands

Researchers at DOE's Ames Laboratory have found an unusual growth mode never before observed that may prove critical in developing atomic structures of unusual uniformity for nanotechnology applications. They have discovered the self-organized growth of lead (Pb) deposited on silicon (Si) at low temperature, 185 Kelvin to 220 Kelvin. With scanning tunneling microscopy and quantitative electron diffraction, they have observed uniform-height islands (5, 7, or 9 steps, depending on temperature) with flat tops and steep edges. Their investigations show that the selected height of these nanostructures is related to their electronic structure because certain heights are energetically more stable than others.

[Saren Johnston, 515/294-3474; sarenj@ameslab.gov]

Nucleons go two-by-two

Just as people behave differently as couples than as individuals, protons and neutrons inside the nucleus of the atom behave differently in pairs. Scientists at DOE's Jefferson Lab measured the behavior of these pairs. While most people pair up, only about a quarter of nucleons exist in pairs at a time. Human relationships can endure for decades, but nucleon pairs last a fraction of a second. However, like some people, at great distances nucleons seemingly ignore each other, at medium distances they attract, and when they get too close, they violently repel each other. See more complete information at www.jlab.org or view an animation of a collision.

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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).

Lab-industry chip collaboration continues to gather momentum

One of DOE's most ambitious multi-lab/industry partnerships, created in 1997 to develop the technology that will enable the next generation of computer chips, continues to win national and international applause as its products move toward the marketplace.

The latest recognition of the value of multi-laboratory collaboration came this past October, when representatives of DOE's "Virtual National Laboratory" (VNL) and their industry partners were honored not once, but twice by *R&D Magazine* for their Extreme Ultraviolet Lithography (EUVL) Full-Field Step-Scan System.

The researchers from DOE's Lawrence Livermore, Sandia, and Lawrence Berkeley national labs received one of three "Editor's Choice" awards for most outstanding achievement among the 2003 R&D 100 award winners.

The EUVL team, which included Northrop Grumman Space Technology/Cutting Edge Optronics, was recognized for making the "greatest improvement upon an existing technology."

The Editor's Choice award actually marked at least the seventh time EUVL-related technology has been recognized by *R&D Magazine*. A process developed at Lawrence Livermore that creates nearly defect-free surfaces for use in the EUVL system, the Ion Beam Thin Film Planarization process, also received an R&D 100 award last year. Related technology developed by Lawrence Livermore and Veeco Instruments Inc. was honored in 1997, 1999 and 2002. And a Livermore-developed tool for accurately measuring the EUVL's precise optics, the phase-shifting diffraction interferometer, was also recognized in 1997.

Because of the successful demonstration of the EUVL step-scan system and other advances, EUVL has been selected by international semiconductor organizations as the best candidate technology for producing the next generation of computer chips. EUVL, which prints 50-nanometer (billionths of a meter) features over the full field size of computer chips, can pack nearly twice as many circuits on a chip as current photolithography techniques. This will allow the production of microprocessors 100 times more powerful and memory chips that can store a thousand times more information than those in use today.

An industry consortium led by Intel Corp. is working with the VNL in a six-year, $250-million Cooperative Research and Development Agreement (CRADA) – DOE's largest CRADA to date – to develop the technology.

DOE's lithography VNL was established to take advantage of the three member labs' experience in organizing multi-disciplinary teams to tackle large, complex problems under tight deadlines.

Lawrence Livermore supplies its expertise in optics, precision engineering, and multilayer coatings. Sandia provides systems engineering, the photoactive polymer thin film exposed by the light, and the light source. Lawrence Berkeley contributes the ability of its Advanced Light Source synchrotron to generate EUV light to measure the performance of components used in the tools.

Submitted by DOE's Lawrence Livermore National Laboratory

ANIMAL LOVER SPINS CAREER IN TOXICOLOGY

Carol Wood

During part of the day you might find Carol Wood at her computer analyzing data to determine the risk of chemicals to human health. During another part of the day you might find her feeding her llamas, goats, sheep and alpaca. Or you might find at her spinning wheel magically spinning raw wool from her animals into yarn.

By profession Carol is a toxicologist at DOE's Oak Ridge National Laboratory. She analyzes data collected from experiments with laboratory animals and human volunteers for the effects of chemicals on developmental and reproductive health.

"I have always been interested in how cells function and how that function contributes to the well being of the organism," the board-certified toxicologist says.

Much of Carol's work is on the toxicity evaluation of pesticides. A new pesticide must undergo more than 100 different scientific studies and tests before it can be registered. "A pesticide has to be tested for potential developmental, reproductive, nervous system and many other health effects," Carol says, "before the Environmental Protection Agency will approve it for use."

Carol and others at ORNL also work with the National Advisory Committee for Acute Exposure Guideline Levels, which are developed to help emergency planners in case of an accident involving chemicals. One of her recent publications dealt with AEGLs for methyl isocyanate, a chemical that made history in 1984 because of a release from a chemical plant in Bhopal, India.

In addition to pesticides and AEGLs, Carol has worked on toxicity evaluations of chemical warfare agents, high production volume chemicals and endocrine disruptors.

When she moved to Tennessee, she bought a small farm. On the way to her job at the Lab, she visited friends in Minnesota. "My interest in spinning," Carol says, "started with my friend in Minnesota who taught me how to spin. I've always liked animals."

Submitted by DOE's Oak Ridge National Laboratory