INEEL's Kathryn McCarthy

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DOE Pulse

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Research Highlights . . .

Ion trek through polymer offers better batteries

Cell phones, CD players and flashlights wear batteries down far faster than we might wish. But researchers at DOE's Idaho National Engineering and Environmental Laboratory have overcome another barrier to building more powerful, longer-lasting lithium-based batteries. A team led by inorganic chemist Thomas Luther has discovered exactly how lithium ions move through the flexible solid membrane that meters power in their rechargeable lithium battery. The ions are most mobile when interacting with nitrogen, the chemical "backbone" of the membrane. Armed with new understanding of lithium transport through the membrane, the team is making new membrane versions to optimize lithium ion flow.

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First paper from Tevatron Run II submitted

On March 19, scientists of the CDF collider detector experiment at the Department of Energy's Fermilab www.fnal.gov submitted the first scientific publication of Tevatron Collider Run II to the science journal Physical Review D. The paper, titled "Measurement of the Mass Difference m(Ds+)-m(D+) at CDF II," summarizes the results of an analysis carried out by CDF scientists Christoph Paus and Ivan Furic, of MIT, describing the mass measurement of particles containing charm quarks. The paper lists all members of the CDF collaboration as authors. "It's bread-and-butter physics," said Paus. "Even more important, the paper indicates: 'Hello, CDF is back.'"

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Determining the structure of heterogeneous surfaces

Scientists have refined a technique that uses the very intense light emitted by the National Synchrotron Light Source at DOE's Brookhaven National Laboratory to determine the structure of chemically heterogeneous surfaces with a submillimeter resolution. By probing points separated by half-a-millimeter along the surface of the sample, the scientists have successfully reconstructed its expected molecular structure. According to Jan Genzer, a chemical engineer at North Carolina State University in Raleigh and the lead author of the study, the new technique, called combinatorial NEXAFS, will be used to probe a large diversity of heterogeneous materials, such as catalysts, which are used to speed up chemical reactions.

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Tiny organisms into tiny machines

Building on tiny organisms, researchers at DOE's Argonne National Laboratory are helping to create a new generation of tiny machines for electronic and photonic devices. Working with colleagues from NASA and the SETI Institute, the researchers built bioengineered nanoscale arrays, using genetically engineered proteins as templates to create honeycomb-like patterns of gold and a semiconducting material. Each cell in the array is just 20 nanometers across. The resulting precise, regular arrays of biological nanoparticles closely resemble similar patterns used in the microelectronics industry—only much smaller. Such arrays of nanoparticles could have future applications in computer memories, sensors or logic devices.

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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).

PNNL, partners work toward nonproliferation

In collaboration with U.S. industry and weapons centers in the former Soviet Union, DOE's Pacific Northwest National Laboratory is helping to reduce the risk of proliferation of weapons of mass destruction in Russia and neighboring countries. The alliance, under DOE's Initiatives for Proliferation Prevention (IPP) program, is coordinating the transformation of biological, chemical and nuclear weapons knowledge into efforts focused on peaceful, commercially viable products.

The breakup of the Soviet Union in the early 1990s significantly destabilized the Russian economy, specifically leaving about 60,000 of the country's scientists and engineers without stable jobs. To prevent Russia's wealth of scientific expertise from getting into the wrong hands, the U.S. created the IPP in 1994 to help create stable, non-defense jobs for former weapons designers and scientists. Those experts' research knowledge will be used to create commercial products valuable to the former Soviet Union, Europe and U.S. markets.

"The program's success lies in the fact that all parties get something out of it," says Ron Nesse, PNNL program manager for IPP. "U.S. businesses benefit from these scientists' knowledge of making novel and better products. On the other hand, those experts benefit from stable jobs, while the U.S. is assured there is less chance of transferring capabilities and knowledge to rogue countries."

PNNL has a majority of all biological and chemical weapons projects within IPP. "Our researchers monitor proposals and projects to ensure each is scientifically sound and has commercial potential," Nesse says. "We also help connect commercial firms in the U.S. with weapons institutions in the former Soviet Union through a Cooperative Research And Development Agreement (CRADA)." The projects, funded by DOE, last two to three years. "The hope then is that the project becomes a commercial venture," Nesse says.

The annual budget for IPP in FY 03 is approximately $23 million. PNNL oversees between $4 and $5 million of that total. "All of us working on the program feel there are many additional projects that are worth funding," says Nesse.

With those IPP dollars, PNNL and its collaborators have achieved a number of successes, most notably the creation of unique humanized antibodies to gamma interferon, a protein that triggers and exacerbates various autoimmune conditions. A CRADA was recently signed by PNNL, Advanced Biotherapy Inc. of California, New Horizons Diagnostics Inc. of Maryland, and the Institute of Immunological Engineering of Moscow toward developing more effective treatments based on research by Russian scientists. "More than 50 million Americans suffer from autoimmune diseases such as rheumatoid arthritis and multiple sclerosis," says Dick Weller, project manager. "This project is a major step toward creating a much improved treatment for certain autoimmune diseases."

Other IPP collaborative successes include testing microbes for remediation of oil contaminated fields; development of a plant growth stimulator that increases the growth rate of grasses and many broad-leaf plants by 40 percent; and creation of a quick and easy-to-use analyzer to identify neurotoxins that are harmful to human and animal health.

Submitted by DOE's Pacific Northwest National Laboratory

POWER PLAN: INEEL's McCARTHY TALKS NUCLEAR ENERGY

For Kathryn McCarthy, department manager of nuclear engineering design and research at DOE's Idaho National Engineering and Environmental Laboratory, nuclear energy holds a central place in the past and present. She is responsible for two laboratories where fission and fusion-related work is carried out and is tasked with developing new business for the laboratory. Because of the world's need for energy security, she predicts, nuclear energy will become a vital part of all of our everyday lives.

Kathryn McCarthy

"As concerns about the environment and global warming grow, nuclear is the only way to go," McCarthy says. That's because unlike fossil fuels, nuclear energy doesn't eject greenhouse gases into the atmosphere and its use is more flexible than alternative energies such as solar and wind power, she adds.

Yet raising the status of nuclear energy, which now accounts for 20 percent of electricity in the United States, will take work.

Today's light water reactors generate electricity from the heat released as uranium atoms are split, a process known as fission. Many next generation fission reactor concepts under study at INEEL—ranging from designs cooled with supercritical water to lead—promise to stretch fuel resources and cut down on the production of waste. In the longer term—perhaps by the middle to end of the 21st century, McCarthy speculates—reactors that rely on the fusion of smaller atoms might further reduce spent fuel-derived waste.

In addition to scientists' ingenuity, sustained funding and public support will be critical to the realization of nuclear energy's vast potential, McCarthy says.

Advancing the science will take planning and persistence, however. "There is always a lag time between the research and the development of new technologies," McCarthy says. "That's why it's so important to do the research necessary to design the next generation of reactors now—before we have an energy crisis."

Submitted by DOE's Idaho National Engineering and Environmental Laboratory