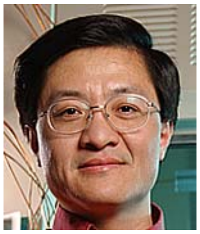

PNNL's Yong Wang

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Research Highlights . . .

Number 202 February 6, 2006

SLAC to analyze comet material

Researchers at the Stanford Linear Accelerator Center joined the astronomy community in eager anticipation of the NASA probe Stardust, which landed safely in Utah in mid-January. The cosmic voyager collected material from the tail of a comet that will shed light on the origins of the solar system. "All reports are that it is an extremely successful mission with years of research ahead of us. It's very exciting," Sean Brennan, a SLAC synchrotron researcher said. "Stardust collected hundreds of visible particles, and that means there will be thousands of particles that can be analyzed."

[Erik Vance, 650/926-8703, evance@slac.stanford.edu]

MicroBlower adds to cleanup tool kit

Savannah River National Laboratory's MicroBlower continues the DOE laboratory's long tradition of developing and deploying technologies that clean up contaminated soil or groundwater without requiring large power demands or unduly disrupting the surrounding environment. The MicroBlower uses a small, low-powered vacuum blower to extract or inject gases into the subsurface for characterization or for removal of solvents from the subsurface soils. Because it uses only 20 to 40 watts of power, it can be powered by small batteries, small photovoltaic panels, or wind generators. The device's small size and low power demands mean that, for the first time, the simple technique of soil vapor extraction can be applied to much smaller areas than were previously possible. Perhaps the greatest potential for the MicroBlower is in removing residual contamination from an area where an expensive, large blower system had been used to remove the bulk of the contamination.

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Nuclear imaging reveals plaque

A small animal imager built by scientists at DOE's Jefferson Lab has demonstrated that nuclear functional imaging techniques can image plaque in mice. Plaque, a buildup of fatty deposits on the inside walls of arteries, contributes to heart disease. Columbia University Medical Center researchers are studying the life cycle of a type of plaque in hopes of developing improved diagnostics and treatments for humans. But seeing the plaque as it evolves inside live mice proved a stumbling block. Using a compact planar gamma imager from JLab, the researchers showed that nuclear imaging could reveal the growing plaque.

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

Making safer, longer-lived lithium-ion batteries

As part of the DOE-funded FreedomCAR program, the agency's Sandia National Laboratories is researching ways to make lithium-ion batteries work longer and safer. The research could lead to these batteries being used in new hybrid electric vehicles in the next 5-10 years. A lithium-ion battery has four times the energy density of lead-acid batteries and two to three times the energy density of nickel-cadmium and nickel-metal hydride batteries, and is potentially one of the lowest-cost battery systems. The FreedomCAR program, initiated by President Bush in 2002, focuses on developing hydrogen-powered electric vehicles to help free the US from dependence on foreign oil supplies.

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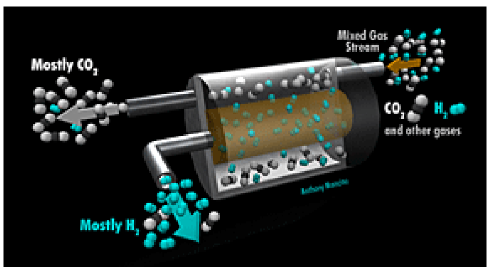
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***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).

Collaboration Aims to Reduce Greenhouse Gas Emissions

While alternative energy sources will gradually increase their contribution to the world's energy supply, most projections agree that conventional fossil energy generation will continue to dominate for at least the next 15 years. U.S. energy demand alone currently results in billions of tons of carbon dioxide emissions annually creating a variety of environmental challenges. A new and economical technology for the separation and capture of carbon dioxide from fossil fuel conversion processes could lead to a significant reduction in greenhouse-gas emissions.

To meet this need, scientists at DOE's Los Alamos National Laboratory, in collaboration with researchers from Pall Corporation, University of Colorado, and Idaho National Laboratory, are working on the development of polybenzimidazole (PBI)-based polymeric-metallic composite materials and structures for utilization as advanced high temperature separation membranes for hydrogen purification and carbon capture.



This simplified model of the single tube membrane module shows a mixed gas stream (composed of hydrogen, CO_2, and other gases) entering the outer tube. The membrane blocks most of the CO_2 but allows hydrogen to pass through to the inner chamber where it can be collected and used as fuel. The separated carbon-rich stream exits the outer tube at high pressure, ready for transport to a carbon storage repository.

The collaborative research effort, led by Los Alamos principal investigator Kathryn Berchtold, is focused on both the continued development of an existing generation of PBI-based composite membranes as well as the design and development of new PBI-based compounds. By building upon the base PBI framework, new materials with enhanced gas separation properties can be developed while maintaining the desirable properties of the base material, such as chemical, mechanical, and thermal stability. The team is also developing a unique methodology to understand, predict, and optimize the materials' long-term behavior under challenging operating conditions.

The composite membranes developed by the team can purify hydrogen and capture carbon at significantly higher temperatures—in excess of 400°C—than currently available polymeric membranes. In addition, composite membranes provide improved performance while exhibiting long-term stability, sulfur tolerance, and overall durability over a broad range of industrially relevant operating conditions.

This work supports the DOE Office of Fossil Energy/National Energy Technology Laboratory's and Los Alamos National Laboratory's Carbon Sequestration Program.

Submitted by DOE's Los Alamos National Laboratory

Yong Wang makes catalysts work harder, better


Yong Wang

Without catalysts, you wouldn't be driving a car, using a computer, or tying your shoelaces. Catalysts—materials that speed up a reaction but aren't consumed by it—are vital to refining crude oil and producing plastic for computer casings and even for manufacturing the plastic tips on your shoelaces. Unfortunately, catalysts are typically designed with a "one size fits all" mentality.

At Pacific Northwest National Laboratory's Institute for Interfacial Catalysis, chemical engineer Yong Wang is taking a revolutionary approach to tailor catalysts, making them more efficient and safer.

By making catalysts more effective, engineers can miniaturize systems. Wang and his research team develop a catalyst for a desired reaction first. Then they engineer it onto an innovative support structure. Finally, they design the application around the supported catalyst.

Wang pioneered this approach when the team developed a catalyst that transforms hydrocarbon and steam into hydrogen and oxygen in milliseconds, rather than seconds. The result is a catalytic fuel processing reactor system that is smaller than a dime.

"Technologies such as this have the potential to transform the way we live and to reduce our dependence on imported oil," Wang said. "We are looking at more efficient ways to convert natural gas to gasoline and diesels. We are also looking at generating hydrogen—a clean and efficient source of power—from both fossil and renewable sources."

His work has led to 60 patents, with 30 more patents pending, plus the formation of a company that is one of the leading developers of microchannel technology systems. Recently named the 2006 Asian American Engineer of the Year Award by Chinese Institute of Engineers-USA, Wang has also earned two R&D 100 awards and the Presidential Green Chemistry Award.

Submitted by DOE's Pacific Northwest National Laboratory