Iver Anderson's concern for environment spurs materials research, page 2

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 16 **November 2, 1998**

Research Highlights . . .

Heavy metal metamorphosis

A team of researchers who tricked bacteria from contaminated soil into cleaning up toxic heavy metal chromium received a three-year, $767,000 grant from DOE's Natural and Accelerated Bioremediation Research program to study the basic science involved. The collaborators—James Petersen, chemical engineering professor and director of the Center for Multiphase Environmental Research at Washington State University, and scientific fellow William Apel, at the Idaho National Engineering and Environmental Laboratory—spurred bacteria normally found in contaminated soils to convert toxic, carcinogenic chromate to the benign form of chromium, using selected growth conditions. Chromate is a contaminant in almost one-third of Superfund sites, and is generated almost exclusively by human activities.

[Mary Beckman, 208/526-0061, Beckmt@inel.gov]

Fastest "homebrew" supercomputer in world unveiled at Brookhaven

Physicists at DOE's Brookhaven National Laboratory recently unveiled the fastest homemade supercomputer in the world, destined for a variety of research at the forefront of physics. With a top operating speed of 600 billion calculations per second, or 0.6 teraflops, the supercomputer is the 12th fastest over all in the world. Costing only $1.8 million, it's also one of the least expensive. Called QCDSP, the supercomputer was designed and built by scientists and computer specialists from Columbia University and BNL, and funded by the Japanese RIKEN laboratory. It will help scientists create virtual simulations of smashing atoms and other phenomena.

[Kara Villamil, 516/344-5658, karav@bnl.gov]

Los Alamos helps cities cope with disaster

Researchers at DOE's Los Alamos National Laboratory are developing computer tools to help city governments, planners and emergency agencies prepare for and respond to disasters such as earthquakes, toxic spills or terrorist attacks using chemical or biological agents. The Urban Security Initiative starts with vast amounts of information about city infrastructure, environment, economics and demographics. Scientists integrate into common databases information about geography, air and water pathways, toxic releases and potential exposures, and potential earthquake damage. For example, Los Alamos is helping Southern California officials with earthquake planning, infrastructure models and response. When completed, the system will allow emergency officials to identify and deploy resources quickly and improve disaster preparedness and training.

[Jim Danneskiold, 505/667-1640, slinger@lanl.gov]

First observation of time reversal asymmetry

The KTeV (Kaons at the Tevatron) experiment, at DOE's Fermilab, has reported the first direct observation of time reversal violation in the decay of subatomic particles called kaons. Time reversal violation shows that matter and antimatter behave slightly differently, edging us closer to understanding why more matter than antimatter survived in the formation of the universe. "We think that some type of time reversal violation is a necessary condition for our universe to exist as it does today-and, indeed, for us to exist," said KTeV experimenter Brad Cox of the University of Virginia.

[Mike Perricone, 630/840-5678, mikep@fnal.gov]

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).

A better probe for cancer detection

First, Do No Harm: This physician's motto is put to a tough test when cancer is involved. Although enormous strides have been made in non-invasive diagnostic medicine—such as the magnetic resonance imagers and scanners that can pinpoint disease and other physical malfunction—surgery is often required to confirm the presence and extent of cancerous tumors. Researchers at the Department of Energy's Jefferson Laboratory hopes to tilt the odds in favor of a less physically traumatic procedure; so doing, they may vastly improve the prospects for more effective treatment of cancers of the breast, thyroid and prostate.

Members of the Laboratory's Detector Group, in collaboration with University of West Virginia Medical Center, East Carolina University Medical Center and the Duke University Medical Center, with funding from NSF and DOE and by the Nuclear and High-Energy Physics Research Center at Hampton University, are cooperating on what is known as the Intra-Operative Probe Project, or IPP. The effort is based on technology derived from the sophisticated detector equipment found within the Laboratory's electron accelerator facility.

"Probes exist. We're not the first," says Stan Majewski, head of the Lab's detector group. "But we believe we can improve on existing technology. One way is to improve the imaging."

Other surgical probes tend to simply identify the presence of malignancy. Finding cancer isn't terribly difficult; cancer cells are ravenous for energy to support rapid growth. Typically, radioactive tracers are added to sugar solutions that are injected into patients before testing begins. As the sugar rapidly migrates to the diseased sites, detectors—surgically inserted into the body and maneuvered to suspect areas—are able to generally point out areas of growth.

The Laboratory's probe is substantially more sensitive, with the added advantage of being able to paint a visually detailed picture of tumor sites. "It's like the guy on the beach with a metal detector," says Drew Weisenberger, staff scientist with the Lab's detector group. "A lot of these [detectors] just beep when you find something. Our way you can look and actually see what's there."

The first test of the IPP occurred during an experimental surgical procedure in October at East Carolina University Medical Center on a patient with cancerous melanoma . A whole body scan found suspicious spots in the patient's legs and the surgeon decided to explore the region using the IPP. After testing commercially available conventional methods-that failed to pinpoint the suspicious growth- the test IPP was used and correctly identified a cancerous growth confirmed later to be melanoma. Without the test probe, the cancerous growth would not have been found. Further tests will continued to be conducted to refine the probe.

"In terms technology transfer, I can't imagine better conditions," Majewski contends. "For us as scientists it was an obvious step in nuclear medicine. We decided that we as individuals could make a contribution."

Submitted by DOE's Thomas Jefferson National Accelerator Facility

Anderson's work with nozzles is a blast

The beauty of a waterfall awes Iver Anderson, senior metallurgist at DOE's Ames Laboratory, as much as its power as a natural atomizer.

"As a sheet of water comes over the edge of a rock, its surface starts to break up into droplets and you feel the spray. That's atomization," Anderson said.

It's an unusual—but appropriate—view for Anderson, director of Ames' Metallurgy and Ceramics Program since 1997. Concern for the environment heightened his interest in sustainable materials development, especially in reducing the amount of waste generated in manufacturing processes.

Chief among his efforts has been the development of a series of highly efficient nozzles that blast molten metal with extremely cold gases at supersonic speeds in order to turn the liquid metal into fine powders.

"The nozzle that we've developed over the years is about three times more efficient at producing fine powders than other commercial nozzles," Anderson said. "There's a lot of commercial interest in our technology right now."

Producing parts through powder metallurgy—putting metal powder into a die, compressing it and then sintering it—eliminates waste associated with casting and machining methods. "Powder metallurgy makes a lot of sense because it uses nearly all the material set aside for the process. There's no scrap," he said.

And because fine powders densify readily into a fine-grained material with a uniform composition, the resulting consolidated parts are stronger and more resistant to fracture.

Anderson's nozzle is a departure from the approach used by most powder makers, who generally use more gas to get finer powders. However, Anderson's nozzle uses about one-third less gas than other atomizers—a substantial cut in production costs for manufacturers. Also, the nozzle's configuration can be altered to change particle size.

"I think this generation of nozzle is near the optimum in terms of producing powders of different sizes," he said. "This technology gives manufacturers the economic and environmental incentives to convert to powder metallurgy."

Submitted by DOE's Ames Laboratory