NETL's Kent Casleton

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DOE Pulse

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Research Highlights . . .

Gold "nanoplugs" wire up enzymes

Scientists from DOE's Brookhaven National Laboratory and Hebrew University in Israel have devised a way to use gold nanoparticles as tiny electrical wires to plug enzymes into electrodes. The gold "nanoplugs" help align the molecules for optimal binding and provide a conductive pathway for the flow of electrons. By measuring the current flowing through these tiny plugs, scientists can accurately gauge the number of biological molecules involved in reactions catalyzed by the enzymes. The research could yield more sensitive, inexpensive, noninvasive detectors for measuring such things as blood glucose levels and, potentially, agents of bioterrorism.

[Karen McNulty Walsh, 631/344-8350; kmcnulty@bnl.gov]

Cold, hard look at crystal structures

A new, custom-built piece of equipment is set to give a group of researchers at DOE's Ames Lab an unprecedented look at the effects of low temperature and high magnetic field on the crystal structure of materials. The idea integrates a cryostat with a powder x-ray diffractometer. "Low temperature facilities exist in many places," principal investigator Vitalij Pecharsky said, "and x-ray diffraction can be done with units like this or at a synchotron facility. But the ability to study materials at both low temperature and high magnetic field is truly unique and should greatly further our understanding of rare earth and magnetic materials." Combined cost of the equipment, and the work to integrate the components is roughly $750,000, including $116,000 for the custom-built cryostat. Funding has been provided through the Department of Energy Office of Science's Materials Science Division.

[Kerry Gibson, 515/294-1405; kgibson@ameslab.gov]

Cutting off cancer tumor's 'lifeline'

Proteins that could lead to drugs that stop tumor growth and cancer have been identified by biologists studying capillary formation, or angiogenesis, at DOE's Argonne National Laboratory. Argonne researchers are the first to study the earliest steps in capillary formation in tumors. They identified 280 proteins that endothelial cells—cells that form blood vessels—secrete in large quantities during capillary growth. Because proteins are responsible for cellular structure and communication, biologists want to learn which ones to block to develop a treatment that arrests tumor growth by halting angiogenesis.

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

LHC collaboration gathers for an update at Fermilab

DOE's Fermilab hosted LHC 2003, the fourth annual Large Hadron Collider Symposium: Physics and Detectors, on May 1–3 with more than 200 participants from around the world. They were updated on the status of accelerator components, magnets, detectors, software and physics planning for the collider under construction at CERN, the European Particle Physics Laboratory in Geneva, Switzerland. Scheduled to begin operations later this decade, LHC will take over the energy frontier at seven times the level of the Tevatron. Among the presentations was an overview of the LHC program from CERN Director of Research Roger Cashmore. "The physics programs at the Tevatron and the LHC have a large overlap," said John Womersley, cospokesperson of Fermilab's DZero collaboration and an LHC collaborator. "We all have common interests."

[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).

Supernovae-searching tech boosts fight against terrestrial terror

Detection technologies developed to search for black holes and supernovae in space have a new down-to-earth application—helping to fight terrorism.

The same technologies used to study astrophysics phenomena at the edge of the universe are also being adapted to search for faint emissions from nuclear materials or nuclear devices.

"Our collaborative team has been working on the forefront of technology for detecting weak emissions from outer space," said Simon Labov, who heads the Radiation Detection Center at DOE's Lawrence Livermore National Laboratory. "We've been able to take these advanced technologies and adapt them for national security uses, such as detecting radiation from nuclear materials.

"In both cases," Labov added, "the emissions are faint and there is a lot of background noise. Having advanced high-sensitivity detectors can solve both problems."

For years, Livermore researchers have collaborated with scientists from the California Institute of Technology, the Goddard Space Flight Center, UC Berkeley, Columbia and Harvard to develop the latest technologies for detecting and imaging space phenomena.

Now, the research for space is assisting in the detection of nuclear materials or nuclear devices, Labov said. "Experimental astrophysics is a large enterprise and many top-notch people are devoting themselves to this effort. Their experience, their achievements and their help can now also be used for countering terrorism and other homeland security projects," Labov said.

In effect, the research efforts of about 50 researchers and $20 million spent during the past five years is being leveraged for detecting nuclear materials, Labov explained.

One Livermore space detection project is the launch later this year of the High Energy Focusing Telescope, which has been developed jointly by LLNL, CalTech, Columbia University and the Danish Space Research Institute. The telescope will be released near Fort Sumner, N.M., and will ascend to 120,000 feet aboard a high-altitude scientific balloon.

A key objective of the High Energy Focusing Telescope, consisting of a telescope, mirrors and detectors, will be to study how supernovae create and distribute most of the elements heavier than helium. As an example of the improvement in detection technologies, Labov cited that a decade ago gamma rays could not be efficiently focused.

When launched this fall, the High Energy Focusing Telescope will fly with an array of mirrors that will focus gamma rays onto imaging detectors that provide 10 to 100 times more sensitivity than is achievable with conventional nonfocusing systems.

Integrated circuits work in conjunction with cadmium-zinc-telluride crystals to measure gamma ray signals at hundreds of different points, producing clear pictures with high spectral resolution, while operating at low power in a compact package that can be produced at low cost.

These detectors will be the heart of both future satellite missions to study black holes at the edge of the universe and hand-held detector/cell phone instruments to find and analyze nuclear materials here on Earth.

Submitted by DOE's Lawrence Livermore National Laboratory

NETL RESEARCHER TUNES IN TO HUM OF COMBUSTION

Kent Casleton

After Kent Casleton conquered the academic rigors associated with attaining a Ph.D. in physical chemistry at MIT and post-doctoral work in laser energy transfer at Columbia University, he began a 25-year science career at the DOE's National Energy Technology Laboratory that ultimately led to research seemingly less vigorous—the hum of combustion.

However, the hum in this case has significant research implications. It is that distinguishable sound produced when additional pressures and fuel flows indicate strain on combustion hardware. Assessing the effect of that sound (acoustics)—along with pressure, temperature and flow—is critical to future development of advanced power systems.

Kent, a research chemist in NETL's Combustion and Engine Dynamics Division, has devoted much of his career to improvements in combustion performance leading toward advanced systems with high efficiency and low emissions. As the division's combustion science team leader, he manages a project called SimVal (Simulation Validation), which uses NETL's existing high-pressure combustion facility as a foundation to promote improvements in combustion simulations. Along the way, Kent has also gained research experience on reaction kinetics, pollutant control, gas turbine combustion, and advanced concepts, such as oxy-fuel combustion.

As the nation moves toward advanced, clean-burning power systems and engines that use hydrogen, gasified biomass, coal gas, or a combination of these with natural gas, the development of combustors that can handle a variety of fuels becomes increasingly important. That's where Kent and his staff make a significant contribution. By simulating combustor performance under demanding pressure and temperature conditions, while precisely controlling thermal, flow, and acoustic boundary conditions, they can numerically assess combustion behavior.

Submitted by DOE's National Energy Technology Laboratory