DOE Pulse
Science and Technology Highlights from the DOE National Laboratories
Number 238 July 2, 2007

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Research Highlights . . .

Los Alamos ChemCam ready for Martian work

When the JPL-NASA Mars Science Laboratory rover heads for space in 2009, it will carry the Los Alamos-built ChemCam device with it. ChemCam has a laser that emits very short pulses of beam through a low power telescope, which can be focused on rocks from 3 to 40 feet away. The intense beam (10 megawatts per square millimeter) then creates a plasma of vaporized material from the target rock that can then be analyzed by ChemCam's three spectrographs. ChemCam also contains a camera for taking extreme close-up pictures of the targets to show geologic context for each sample.

[Nancy Ambrosiano, 505/667-0471, nwa@lanl.gov]

Microbial proteins improve water quality

It may sound counterintuitive to use a microbial protein to improve water quality. But some bacteria are doing just that. A team from DOE's Lawrence Livermore National Laboratory, UC Berkeley and DOE's Lawrence Berkeley National Laboratory found that bacteria from an abandoned mine excrete proteins that cause metal nanoparticles to aggregate. The bacteria are binding and immobilizing the metals in the nanoparticles and the nanoparticles themselves, which are potentially toxic to the bacteria. Using secondary ion mass spectrometry, transmission electron microscopy and infra-red spectroscopy, the scientists were able to study whether protein contributes to the formation of densely aggregated nanoparticulate zinc sulfide spheroids. They also studied whether various amino acids induce rapid aggregation in metal-sulfide nanoparticles.

[Anne M. Stark, 925/422-9799, stark8@llnl.gov]

Shining a light on the dark matter of the genome

Remember "junk DNA?" It's what biologists called the highly repetitive DNA found in heterochromatin, which makes up chromosomal centromeres and telomeres. Like dark matter in the universe, the heterochromatin's nature was unknown. Members of the Drosophila Heterochromatin Genome Project, headed by Gary Karpen of DOE's Lawrence Berkeley National Laboratory Life Sciences Division, recently reported the assembly, mapping, and functional analysis of the fruit fly's heterochromatin. It contains over 200 protein-coding genes, plus genes for small RNAs that neutralize transposons —elements similar to viruses that hop around the genome and disrupt gene function—and other key functional elements. Junk? Hardly.

[Paul Preuss, 510/486-6249, paul_preuss@lbl.gov]

New PIE equipment at INL will support GNEP

A $15 million commitment from DOE will help Idaho National Laboratory realign itself with top nuclear R&D laboratories around the world.The money will go to purchase new post-irradiation examination equipment, allowing researchers to better qualify and understand the behavior of new nuclear test fuels on a micro scale. This represents a significant investment in the technology infrastructure needed to develop advanced Global Nuclear Energy Partnership technologies. Plans include integrating some of the new analysis instruments into a shielded suite--a hot-cell environment where the instruments are installed side-by-side, allowing researchers to quickly pass samples between instruments. The suite will be integrated into INL's operation of the Hot Fuel Examination Facility.

[Teri Ehresman, 208/526-7785, Teri.Ehresman@inl.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).

PPPL participates in development of artificial muscle

Currently, prosthetics for the arm and hand are not functional unless they utilize three-pronged metal devices that are controlled mechanically. Princeton Plasma Physics Laboratory collaborator Lenore Rasmussen, owner of Ras Labs, a small NJ business, wondered if a prosthetic limb could respond directly to a neural impulse, and whether it could be made more attractive and highly functional.

Rasmussen envisions artificial muscles that are comprised of an electro-responsive polymer gel containing embedded electrodes, all encased in a flexible coating that acts as a kind of skin. The embedded electrodes serve a dual role: providing the electric stimulus, much like a nerve, and attaching the polymer to a lever, like a tendon attaches muscle to bone. When the electrodes are energized with direct current, the polymer contracts or expands, depending on the formulation. It then relaxes when the current is turned off, acting much like real muscle tissue responding to a neural impulse from the brain.

Rasmussen tested a variety of polymers and found that certain ones respond quickly to electricity and have all the other needed properties. However, after repeated cycles, the polymer detached often from the electrodes. But Rasmussen recalled that plasmas are used to sterilize medical needles, which are then coated with polymers, allowing them to slide more quickly reducing patient discomfort. Plasma treatment not only sterilizes metal, but also improves the adherence of the polymer.

Rasmussen contacted DOE's PPPL, resulting in the establishment of a Cooperative Research and Development Agreement. The project, with PPPL participants Lew Meixler and Yevgeny Raitses, revolves around PPPL's plasma sterilization equipment, an excellent apparatus in which to treat metal samples with plasma. Different ions are being studied to find a suitable metal and plasma combination that solves the detachment problem. The tests should also provide insight into the mechanism responsible for improved adhesion of the polymer.

"This collaborative effort with Ras Labs is a good example of how a DOE Lab can advance the research of a small business startup. PPPL is helping to improve the metal-polymer interface by plasma treating the actuator electrodes. We hope it will lead to superior electro-responsive actuators that will benefit disabled people," Meixler said.

Submitted by DOE's Princeton Plasma Physics Laboratory

INL PHYSICIST'S RESEARCH INFLUENTIAL WORLDWIDE

Paul Meakin

An Idaho National Laboratory fellow, Dr. Paul Meakin is the director of the DOE laboratory's Center for Advanced Modeling and Simulation, where his current research interests include computational multiphase fluid dynamics, the coupling between fracturing and chemical process in geosystems, dissipative particle dynamics, geological pattern formation and mineral dissolution.

Meakin's work has had wide applications in the scientific community, as noted by a committee of eminent scientists appointed by the Norwegian Institute for Energy Technology, who selected Meakin for the 2007 Gunnar Randers Research Prize. "His research into complex materials and processes has been pioneering and has yielded increased fundamental insights in many branches of material science. He has contributed to developing new research areas with relevance to such widely disparate fields as superstrong fibers and increased oil production."

Having published more than 350 scientific publications in more than 50 journals, Dr. Paul Meakin was the 79th most cited physicist in a worldwide survey covering papers published in physics journals from 1981 to 1997 (approximately 6,400 citations) - an additional 1,600 citations of papers published in chemistry journals were not included. Currently Meakin's journal publications have been cited more than 15,000 times, and 38 of his papers have been cited 100 or more times. He is a Fellow of the American Physical Society and a member of the Norwegian Academy of Science.

Meakin was Professor II at the Physics Institute at the University of Oslo from 1992 to 2001. He is also and Adjunct Professor of Physics at Emory University in Atlanta, and Professor II at the Norwegian Research Council Center of Excellence for the Physics of Geological processes at the University of Oslo.

Meakin was born and raised in England, and earned a Bachelor's degree in Chemistry at the University of Manchester, U.K., and a Doctorate of Physical Chemistry from the University of California at Santa Barbara.

Submitted by DOE's Idaho National Laboratory