SNL's Mark Grubelich

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DOE Pulse

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SRNL develops new form of porous glass

DOE's Savannah River National Laboratory recently developed a new geometric form of porous glass: hollow glass microspheres (HGMs), with unique porous walls—PWHGMs. The glass porosity of this material can be manipulated; it is in the range of hundreds to thousands of angstroms and has permitted the introduction of materials to the interior of the HGMs. The capability to control pore size of PWHGMs through heat treatment temperature and potentially composition can possibly meet various end-user needs—such as hydrogen storage, molecular sieves, drug and bioactive delivery systems, and environmental, as well as chemical and biological, indicators.

[Bruce Cadotte, 803/725-3879, bruce.cadotte@srs.gov]

Mimicking bacteria produces magnetic nanoparticles

A diverse, interdisciplinary group of researchers at Ames Laboratory is mimicking bacteria to synthesize magnetic nanoparticles that could be used for drug targeting and delivery, in magnetic inks and high-density memory devices, or as magnetic seals in motors. Several strains magnetotactic bacteria use a protein to form crystalline particles about 50 nanometers in size which the bacteria use like a compass needle to orient themselves with the Earth's magnetic field. Using a protein cloned from the bacteria, researchers have been able to synthesize magnetic nanocrystals, including cobalt-ferrite crystals which are not produced naturally by bacteria.

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

Portrait of a defect

Scientists at DOE's Jefferson Lab have snapped a clear photo of a suspected performance-killing defect inside an accelerator component. When the accelerator cavity designed for the International Linear Collider failed to perform as expected, Jefferson Lab scientists set out to find the root of the problem. Aiming a long-distance microscope inside the cavity, they found a microscopic defect. Researchers suspect that the tiny blob, about the width of a human hair, is preventing the cavity from reaching its design specifications. They hope that removing the defect will make the cavity eligible for further testing.

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

Algorithm models air quality

Because of the high stakes involved in meeting air quality targets, scientists, city officials and regulators all desire an effective and accurate way not only to measure air quality but also to predict where "hot spots" of pollution are likely to occur. Rao Kotamarthi and his colleagues at DOE's Argonne National Laboratory have developed a computer algorithm that quickly and accurately assimilates observational data into a model. "We need to forecast exactly what will happen in an air quality forecast," Kotamarthi said. "And the way to do that is by assimilating the data taken today into the forecast for tomorrow. But the data comes with certain types of uncertainty that most models are unable to accommodate." While scientists have confidence in their ability to project climate scenarios out to 2020 or 2030, data assimilation methods like Kotamarthi's will help scientists create longer-term projections that will accurately assess the consequences of climate change decision-making.

[Jared Sagoff, 630/252-5549, jsagoff@anl.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).

Quest for Sustainable Biofuels

Biologists at DOE's Brookhaven National Laboratory and colleagues at the National Renewable Energy Laboratory have been studying how plants can best be used as a sustainable feedstock to produce energy. Their ultimate goal is to find a path to a sustainable biofuels economy, potentially reducing our dependence on fossil fuels.

Specifically, the BNL researchers have been investigating how endophytic bacteria—microorganisms that live inside plants—affect biomass production and composition. These bacteria often have beneficial effects on plant growth and development.

The researchers are particularly interested in poplar trees, because they can grow on land not used for food production.

"For a sustainable biofuel economy, we must have feedstock that's not competing with food production," said Brookhaven biologist Daniel (Niels) van der Lelie. "Some bacteria naturally associated with poplar have a tremendous effect on biomass production—increasing growth by up to 40 percent. If we can make the trees grow faster, the land will yield more fuel," van der Lelie said. "Understanding the details of this symbiotic process, and how we might improve it, is an important step toward more-efficient biofuel production." To support this research, the genome sequences of five endophytic bacteria were determined by DOE's Joint Genome Institute (JGI).

"The most important target of these endophytes is the plant roots," added Brookhaven microbiologist Safiyh Taghavi. "By stimulating root formation, the endophytes create the opportunity for their plant host to better access water and essential nutrients."

At the same time, the Brookhaven researchers and colleagues at NREL are studying natural microbial communities that efficiently decompose biomass into fermentable sugars from which they hope to produce different biofuels.

"We are bio-prospecting," van der Lelie said. "We're looking for organisms that can efficiently decompose recalcitrant forms of biomass. We are looking at the enzymes produced by these organisms and how they react with biomass, alone or in synergy with others."

A number of these projects fall under the umbrella of three DOE Bioenergy Research Centers based in Tennessee (on the Oak Ridge National Laboratory campus), Wisconsin, and California (led by Lawrence Berkeley National Laboratory). These centers are devoted to the fundamental research needed to develop breakthrough technologies for harnessing the solar energy trapped in biomass and transforming it efficiently and economically for the production of biofuels.

Submitted by DOE's Brookhaven National Laboratory

Sandia's Mark Grubelich: Fireworks fascination leads to improved flash-bang

Mark Grubelich

Imagine getting paid to indulge in your boyhood pastime of playing with explosives and blowing things up. Of course, when Mark Grubelich was a boy, the explosives were a bit less powerful than the ones he experiments with today.

Mark, a mechanical engineer and pyrotechnics expert at DOE's Sandia National Laboratories, became fascinated with rockets and fireworks as a young boy growing up in New Jersey's Hudson River Valley (see "The Art & Science of Fireworks," p. 6). At Sandia, he developed an improved flash-bang diversionary device, building on original groundbreaking work by retired Sandians Paul Cooper and Ed Graeber. The new flash-bang was recently licensed to Defense Technology Corporation of America.

Flash-bang devices are less-than-lethal devices used in a wide variety of law enforcement and military operations. The device is activated by pulling a pin and creates a loud sound and bright flash to temporarily distract or disorient an adversary.

Like any other explosive device, flash-bangs can be damaged in the field, poorly manufactured, or incorrectly deployed.

"There are a number of disadvantages associated with currently available diversionary devices," says Grubelich. "Serious injuries have resulted from their improper use both operationally and in training."

Because safety is of paramount importance, the new fuel air technology was developed to address the issues associated with the severe over-pressure that is produced in the near field of older-style diversionary devices.

The new device produces a dust explosion on a very small scale — a gas generator rapidly ejects and ignites aluminum powder. The deflagrating cloud of burning aluminum powder provides an intensely bright light and "explosive" noise. The body of the diversionary device itself does not explode, making the operation safer for the person deploying the item and for anyone in the area. This lessens the likelihood of injury and also the severity of the consequences should a mishap occur.

Submitted by DOE's Sandia National Laboratories