DOE Pulse
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INL's David Petti

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Research Highlights . . .

Writing at the nanoscale

At DOE's Brookhaven National Laboratory, scientists have developed a new chemical "writing" technique that can create lines of "ink" only a few tens of nanometers, or billionths of a meter, in width. Each line is just one molecule thick, but the researchers can produce multilayered patterns by writing over the existing pattern to create three-dimensional nanoscale "landscapes." The technique, called "Electro Pen Nanolithography," opens up many new possibilities for creating nanoscale patterns and features on surfaces and may significantly impact developing nanotechnologies that involve nanopatterning, such as molecular electronics — tiny circuits built using organic molecules.

[Laura Mgrdichian, 631/344-8191, mgrdichian@bnl.gov]

Energy production by ocean microbes

Many scientists dream of harnessing the tiny microbes responsible for methane hydrates—vast, icelike deposits found in the deep ocean and at the poles. Frozen hydrates represent a potentially enormous source of energy, but little is known about the organisms responsible. Now scientists at DOE's Idaho National Laboratory have estimated the rate at which microbes generate methane. Geobiologists took a census of the gas-generating microbes in an underwater mountain range and grew methane-producing cells in the lab. Researchers will present their results in October at the Geological Society of America annual meeting.

[Hannah Hickey, 208/526-4595, hannah.hickey@inl.gov]

A deadly trio

Researchers at DOE's Los Alamos National Laboratory, working in collaboration with scientists from the University of Arizona, Northern Arizona University, the U. S. Geological Survey, and four additional universities, believe that severe drought, coupled with high temperatures and a bark beetle infestation, caused the death of millions of piñon pines throughout the American Southwest. The demise of the piñons will adversely affect Southwestern ecosystems for decades to come. The discovery is the result of the Laboratory's work in large-scale climate modeling and the findings suggest that global climate changes can produce large, abrupt, and devastating changes to ecosystems.

[Todd A. Hanson, 505/665-2085, tahanson@lanl.gov]

CDF seeks massive particle that could top the Top quark

Scientists at DOE's Fermilab are testing for the existence of a new particle up to five times more massive than the top quark. With data collected from the CDF detector at Fermilab's Tevatron, a University of Florida group searched for the particle by reconstructing the invariant mass of top quark pairs and looking for a peak in the mass spectrum. Results hinted at a peak at about 500 GeV and analysis indicated that it was consistent with an extra 30 percent contribution from resonance to the top pair production cross section. Scientists are collecting more data for the analysis to find out if the hypothesis of the new particle holds up.

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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).

DOE labs' teamwork credited for fusion energy milestone

The drawings for major hardware were in German. Tens of thousands of electrical and mechanical components had to operate correctly in unison. The required high-voltage power supplies, designed for an arid climate, had recently been pelted with months of rain. A dead coyote, quite a few lizards, and a colony of mice had to be removed from the outside equipment cabinets.

These are just some of the challenges faced by the team responsible for bringing the radio-frequency (RF) fast-wave systems back online for the DIII-D fusion experiment at General Atomics (GA) in San Diego. After a five-year hiatus, the refurbished systems began operation in April

From the left are Elmer Fredd (PPPL), Wally Baity (ORNL), Nevell Greenough (PPPL), Tony Horton (ORNL), Ward Martin (GA), and Bob Pinsker (GA). Not pictured is Glenn Barber (ORNL).

with the injection of 3 million watts of RF energy into a plasma — a hot, ionized gaseous fuel used for fusion energy production. RF waves are used to heat plasma to the temperatures required for fusion and to drive and control the required plasma current. DIII-D is a tokamak device in which a donut-shaped plasma is confined by magnetic fields.

The first challenge was to put together an effective multi-institutional team, which, in addition to GA, included staff from two other DOE facilities: the Princeton Plasma Physics Laboratory and Oak Ridge National Laboratory. "PPPL is the high-power RF sources expert, and ORNL specializes in RF antennas and antenna controls. GA folks are the project managers and are determining the kinds of fast-wave experiments that will be run on DIII-D. The individual team members have lots of experience in their areas of responsibility," noted PPPL's Elmer Fredd

The potential of the tokamak as a fusion reactor configuration depends on whether the plasma current can be maintained continuously. If the efficacy of fast waves for current drive and control is confirmed on DIII-D and other experiments, fast waves are likely to be used for this purpose on ITER, a major international tokamak experiment scheduled to begin operation in 2016. The U.S. would likely have responsibility for major components of the ITER fast-wave system.

Submitted by DOE's Princeton Plasma Physics Laboratory

Worldly researcher split between fission and fusion

"David Petti used to think 80,000 miles was a lot to travel in one year. Now he logs double that distance: 150,000 miles a year.

David Petti

A nuclear engineer at Idaho National Laboratory, Petti works on nuclear safety and materials. The road-weary traveler is surprisingly energetic, his eyes sparkling as he describes his work.

"This is the thing that everybody's working on right now," he says, pointing to a poster of the International Thermonuclear Experimental Reactor, a prototype fusion reactor to be built in France. By 2016, this 10-story building will house the first large-scale test of fusion power. Petti leads INL's Fusion Safety Program and acts as a technical safety consultant to ITER.

The project has member countries—and meetings—around the globe, presenting challenges for Petti, such as the French language report sitting on his desk. Petti says he doesn't speak conversational French, but he can read technical documents. He's relieved, he jokes, the report is not written in Japanese.

In separate work, Petti develops coated fuel particles for the new gas-cooled fission reactors. What looks like a jar of poppy seeds on his desk are the particles themselves, coated to ensure their radioactive centers would stay separate even in a worst-case scenario.

Petti first came to INL in 1980 as a straight-A intern from the Massachusetts Institute of Technology. Nuclear research attracted him because it combines physics and engineering. These days—despite stuffy airports—the international aspect is his favorite part of the job.

It's also part of his safety philosophy: "Given the complexity of the task, I have this personal belief that [nuclear engineers] all ought to work together," he says, sharing knowledge to prevent mistakes.

When he's home, Petti spends time with his wife and two children, and sits on the school board. He enjoys skiing and following his kids' pastimes: softball, baseball and swimming.

Submitted by DOE's Idaho National Laboratory