ORNL's Horning helps find peaceful use for Pu

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Quantum cryptography reaches for the sky

Building on previous successes in quantum cryptography, Los Alamos National Laboratory researchers have developed a transportable, self-contained cryptographic communication system that uses bits of light to send encrypted data keys through the air for distances of up to six miles. The free-space system is capable of continuous, automated operation in both daylight and darkness. The current six-mile distance horizontally is roughly equivalent to the amount of atmospheric interference that would be encountered in transmissions between the Earth's surface and a satellite. The system is intended to serve as a model for a highly secure global satellite communication system.

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

Material spins hope for quantum computing

While the future of quantum computing offers the potential for substantially greater data storage and faster processing speeds, its advancement has been limited by the absence of certain critically important materials - in particular, a semiconductor that is magnetic at room temperature. Now, scientists at DOE's Pacific Northwest National Laboratory, using a special synthesis technique, have created a thin-film semiconductor material made of titanium, oxygen and cobalt that has superior magnetic properties at room temperature. In collaboration with scientists at IBM, they showed that the materials required for quantum computing and the emerging area of spintronics likely can be obtained.

[Staci Maloof, 509/372-6313, staci.Maloof@pnl.gov]

Mysterious mercury may come from trash

Thousands of landfills around the nation may be serving as bioreactors, turning the inorganic mercury in discarded items into methylated—or organic—mercury. Researchers at DOE's Oak Ridge National Laboratory believe this could help explain the elevated levels of methylmercury detected in rain at remote lakes in the upper midwest. A likely significant amount of methylated mercury, which is far more toxic than inorganic mercury, is being produced in landfills as they reduce waste by generating methane. The inorganic mercury is converted by bacteria in the landfill to form dimethylmercury, which is then emitted to the atmosphere and later deposited on the earth's surface.

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NETL looks for answers in the sky

A research aircraft from the University of Maryland's Department of Meteorology has collected upper-level air-quality data (ozone, carbon monoxide, SO_2, temperature, etc.) upwind and downwind of Pittsburgh to support research on airborne fine particulate matter (PM2.5) at DOE's National Energy Technology Laboratory. The flights occurred during high-haze "events," which coincided with high-PM2.5 events. The data will be compared with similar upper-air information previously collected on a "clear air" day, and with ground-based information gathered continuously at five NETL-supported monitoring stations, including one manned by NETL's Office of Science & Technology, in and around Western Pennsylvania. This air-quality data will assist in the subsequent identification of PM2.5 source regions.

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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).

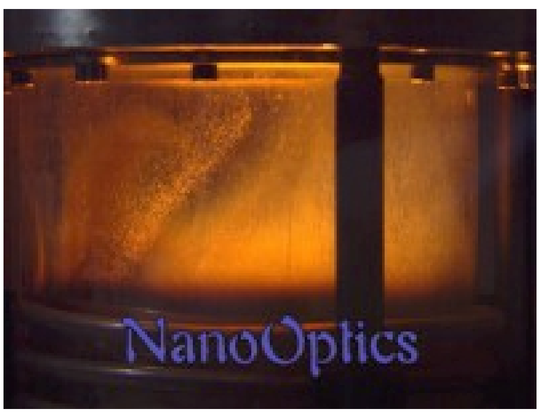
Laboratories forge New Mexico Nanoscience Alliance

In the future, the emerging fields of nanoscience, nanotechnology and nanoengineering are likely to change the way almost everything—from vaccines to computers to objects not yet imagined—is designed and made. In the world of nanoscience objects are measured in nanometers—a length equal to 1 billionth of a meter. This ability to create and modify materials at the molecular level has given scientists the ability to produce structures and even devices with fundamentally new molecular organizations and functions.

DOE's Los Alamos and Sandia national laboratories have signed an agreement that paves the way for the creation of the New Mexico Nanoscience Alliance. The Alliance, which also includes the University of New Mexico, is designed to advance nanoscience in the state by building upon the existing strengths of leading New Mexico research institutions.

Los Alamos' nanoscience strengths lie in the theory, modeling and development of nanofibers, nanopowders and nanostructured membranes and in the areas of organic electronics, quantum computing and molecular dynamics. Work at Los Alamos in quantum computing has resulted in the ability to place single phosphorus atoms—one at a time—in silicon substrates (see accompanying image) in order to create a potential quantum computer architecture.

Sandia strengths include research in nanochemistry, nanomechanics, nanooptics and research in self-assembled monolayers. Nanoscience research at Sandia has already resulted in the development of the Micro-chemlab, a handheld device designed to carry out the functions of an analytical chemistry laboratory by allowing first responders, military and emergency personnel to rapidly assess chemical and biological hazards.



The NMNA will be open to all New Mexico research, educational and commercial institutions with interests in nanoscience and will provide a forum for establishing and uniting nanoscience research efforts in the state.

Submitted by DOE's Los Alamos National Laboratory

ORNL's Horning helps find peaceful use for Pu

Tammra Horning

What was once weapons-grade plutonium stocked by former Cold War antagonists is being experimentally consumed in nuclear reactors—and thus rendered useless for weapons of mass destruction. DOE's Oak Ridge National Laboratory has had a leading role in making this complex but enormously beneficial undertaking happen.

ORNL nuclear engineer Tammra Horning took a lead role in the joint venture between the United States, Russia and Canada, called the Parallex project. The project, one of several concepts being considered, demonstrates the feasibility of converting US and Russian surplus plutonium into mixed-oxide, or MOX, fuel for Canadian nuclear reactors.

"The main goal is to turn the plutonium into something that is not attractive for weapons," Tammra says. "Making electricity while we're doing it is an added benefit to the public."

As could be expected, bringing off such an ambitious project takes much careful planning.

"It involves a large range of activities from the technical aspects of making nuclear reactor fuel with weapons plutonium, to export controls, transportation, political issues and public education," says Horning.

"The Russians pointed out to me that this was the first time weapons plutonium had been shipped outside of Russia. It was very significant to them," Tammra says.

Horning has learned that foreign cultures really aren't so different—that people once on opposite sides of the Cold War have many common values and concerns.

"In Russia, things appeared to be done very differently at first glance, but when you step back you see many of the same constraints we have, such as bureaucracy, security and funding. It's been very interesting to work with colleagues from other countries who have different cultures and language, but then find that we have many things in common," she says.

Submitted by DOE's Oak Ridge National Laboratory