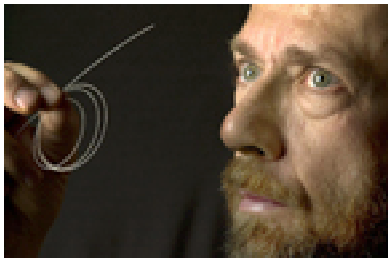

Fiber optics assist energy exploration,

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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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In command and control

A command-and-control system that automates calls for air-support is making U.S. ground troops stationed around the world safer and better connected to Army, Navy and Air Force battle management systems. Squat and tough as a bulldog and almost as pretty, the AN/TSQ-209 Communications Central is a rough and tumble field-ready communications system designed and deployed by the Department of Energy's Idaho National Engineering and Environmental Laboratory. The U.S. Air Force uses the -209 to call in air support when ground troops need them. The final system was shipped off to an Air Force National Guard unit in Illinois in March.

[Kathy Gatens, 208/526-1058, kzc@inel.gov]

NERSC, Hubble identify oldest, farthest supernova

Berkeley Lab astrophysicist Peter Nugent used an IBM SP supercomputer at DOE's National Energy Research Scientific Computing Center to establish that an exploding star dubbed SN 1997ff, caught once on purpose and twice by accident by NASA's Hubble Space Telescope, has a redshift of 1.7 and is more than 11 billion years old—the oldest and most distant Type Ia supernova ever seen. The serendipitous discovery, reported April 2 by Nugent and his NASA colleague Adam Riess, strengthens the theory of "an accelerating universe filled with dark energy," Nugent says, and shows that to learn more about distant supernovae, space-borne instruments are essential.

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

Smooth move to HDTV

Scientists at DOE's Los Alamos National Laboratory have developed a technology that could make the coming Congressionally mandated transition from current analog television to high-definition television a whole lot easier. The technology is a new transmission algorithm capable of compressing a HDTV data stream to the point where the HDTV and analog TV signals can be broadcast over the same channels. The compression algorithm offers an interim solution to the problem faced by consumers since it would permit the continued broadcast of analog signals until awareness of HDTV increases, and the costs of HDTV sets decrease. The technology, available for licensing, has created spirited discussion in the industry.

[Kay Roybal, 505/665-0582, k_roybal@lanl.gov]

Structure models shake to virtual quakes

Researchers at Lawrence Livermore Laboratory are making waves. Seismic waves, that is. Scientists are using supercomputers to generate simulated earthquakes. These virtual shakers are used by engineers to test the earthquake readiness of structures such as bridges, highways and buildings. Scientists generate virtual tremblers by feeding into computers data on earthquake physics and topographical and geological characteristics for a specific geographical area. Engineers then apply the forces produced by these simulated earthquakes to computerized models of real structures. The response of these structures to the virtual shakers can help engineers determine the best ways to improve real structures' earthquake survivability."

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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).

Chemistry at the core of nanoscience

One of the hottest topics in science today is the study of nanomaterials—crystals that measure only a few atoms across.

"At present, the wealth of experimental information on these materials stands in contrast to the incomplete understanding of mechanisms underlying their observed properties," says Marion Thurnauer, director of Argonne's Chemistry Division.

Thurnauer believes that chemistry will play a major role in understanding nanomaterials and developing practical applications. "Chemistry provides the bridge between behavior at the molecular level and the macroscopic properties of matter. At the nanoscale, properties are dominated by molecular behavior. Chemical knowledge of molecular interactions and processes is a necessary component for the growth of nanoscience."

Thurnauer and her colleagues have shown that the natural crystalline structure of titanium oxide—also known as "titania"—becomes distorted in particles less than 20 nanometers in diameter.

The experiments compared bonding between titanium and oxygen atoms under three distinct forms of titania: "bulk" or normal-sized crystals, pure nanosized crystals, and nanosized crystals with ascorbic acid—better known as vitamin C—attached.

In bulk titania crystals, each titanium atom bonds with six oxygen atoms, forming an octahedron with titanium at the center and oxygen at each corner.

A normal crystal of bulk-titania consists of this unit structure repeated millions of times. But when you come to the surface, the repetition has to end, so the titanium attaches to some other chemical group. So in a sense, the surface is a defect.

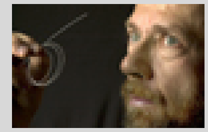
Defects are important because they are the keys to imbuing materials with new properties, including computer chips, transistors and many other commercially important electronic products based on semiconductors.

As titania crystals become smaller, the surface defects and distortions become dominant. In fact, at the nanosize scale, the defects are so pronounced that the octahedron becomes a pyramid. But when nanotitania combines with vitamin C, the bonds realign and the unit shape returns to an octahedron, Argonne's researchers learned.

This sort of basic research will help scientists learn to control the defect sites, opening up a whole new field of chemistry.

Submitted by DOE's Argonne National Laboratory

Disposable fiber optics improves well-drilling process



David Holcomb

A technique using an inexpensive disposable fiber optics telemetry system to relay real-time information about the drilling process is capturing the attention of the oil and gas industry.

"We have come up with a unique system using throwaway fiber optics that relays information about what is going on at the end of the drill string as it is happening," says David Holcomb, a researcher at DOE's Sandia National Laboratories, who devised the technique. "Information is instantaneously sent to the surface about temperatures, pressure, chemistry, and rock formation—all obtained without stopping the drilling operation."

Traditionally, drilling would have to be stopped so that instrumentation to gather this type of information could be lowered into the drill hole, Holcomb says, and stopping the drilling process can cost as much as $100,000 to $200,000 a day for offshore drilling.

Familiar with disposable fiber developed for the non-line-of-sight missile guidance systems in the 1980s, he realized the technology might be applied to well drilling.

"If the cable only has to survive for a few hours and need not be retrieved, it is feasible to use 'unarmored' fiber, which is cheap and can be wound into packages small enough to be inserted into the drill pipe without interfering with operations," he says.

Holcomb said he and other researchers successfully showed that the disposable fiber optics telemetry system works in tests last September at the GRI/CatoosaSM Test Facility, Inc., a subsidiary of the Gas Technology Institute (GTI), located in Catoosa, Okla.

"We got the fiber down and the information back all successfully," he says. "While in field tests the optical fiber was dropped only 3,000 feet, we see no limitations. The cable could easily reach 10,000 to 20,000 feet."

Early funding came from Sandia's Laboratory Directed Research and Development (LDRD) program. GTI, which has funded more recent research, is seeking a partner from within the oil and gas industry to put the system into production.

Submitted by DOE's Sandia National Laboratories