Alvin Czanderna studies the surfaces of solar devices Page 2.

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 39 **September 20, 1999**

Research Highlights . . .

Deadly rockfalls lead to research effort

Fatal rockfalls at Yosemite National Park this summer led to a research project by DOE's Lawrence Livermore National Lab aimed at better understanding potentially dangerous rock formations. The research, with the U.S. Geological Survey and the National Park Service, aims to learn whether seismic monitoring equipment can detect and locate cracking or small rockfalls. From this effort, it may someday become possible to understand subtle seismic patterns that precede rockfalls. Rockfalls are natural and presently unpredictable events that help generate the Park's great beauty but can be deadly to climbers and hikers, notes Livermore seismologist Steve Myers.

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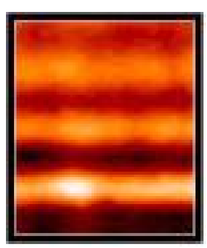
Electron vibrations as binary bits

Researchers working at the DOE's Lawrence Berkeley National Laboratory have taken a significant step towards dramatically reducing the size of magnetic data storage devices. Working at the Advanced Light Source, they have produced the first high quality images of a "quantum well" — an energy state that confines electronic motion to a single dimension. Quantum wells are thought to be the basis for GMR (giant magnetic resistance) and other effects crucial to boosting disk storage density. Understanding the physics behind quantum wells starts with high quality images and should make it possible to engineer magnetic storage devices on a nanometer (electron wavelength) scale.



Quantum well state in a copper sample imaged at the Advanced Light Source

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Neutron balm

An injection and a few minutes in a gentle beam of neutrons may someday ease the pain of severe rheumatoid arthritis. With support from DOE's Idaho National Engineering and Environmental Laboratory, Jacquelyn Yanch, a physicist at the Massachusetts Institute of Technology, has devised a new way to kill the synovium, the lining that overgrows and ruins an arthritic joint. She injects a boron-10 compound into the lining and exposes the joint to neutrons. The boron-10 captures neutrons and quickly decays, producing radiation that kills the synovium. The technique, dubbed Boron Neutron Capture Synovectomy, promises to be more effective than surgery and safer than injections of radioisotopes. Yanch is testing it on rabbits.

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Strong bones

Researchers at DOE's Los Alamos National Laboratory have discovered that enlarging the ends of small wires mixed into concrete substantially increases the material's overall strength and toughness. Extending the life of concrete will have important implications for the costs of the nation's infrastructure repair and replacement. Civil engineers and contractors use steel, fiberglass and similar materials to increase concrete's strength, but using those materials often requires costly construction techniques. Bone-shaped, wire- reinforced concrete should become a favorite technology since the process is compatible with standard construction processes and the steel used for the wires is relatively cheap.

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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).

Oceans may help reduce greenhouse gases

Researchers at Lawrence Berkeley and Lawrence Livermore National Laboratories will collaborate on a study to determine whether the oceans are an environmentally acceptable alternative for “carbon sequestration”—the capture and long-term storage of atmospheric carbon dioxide. The labs have been named co-hosts of one of two new DOE centers for global climate change research.

Two hundred years of industrialization has resulted in the emission of an enormous amount of the carbon dioxide (CO_2) emissions that promote global warming. Experts expect atmospheric CO_2 concentrations to double from pre-industrial levels by the middle of the next century. Although it is not entirely understood as to what the full impact will be, the scientific consensus is that serious environmental consequences are possible unless the management of CO_2 emissions improves.

Sally Benson, director of Berkeley Lab’s Earth Sciences Division, is the co-chair of a national task force commissioned by DOE to develop a research roadmap for investigating carbon sequestration. The goal is to prevent CO_2 emissions from reaching the atmosphere by capturing a significant amount, as much as 4 billion tons by the year 2050, and securely storing it in the oceans or in terrestrial ecosystems.

“Science has made the case that a critical factor in global climate change is the ecosystem—air-water interaction of anthropogenic carbon emissions,” says Benson. “The idea behind carbon sequestration is to capture and isolate the carbon at the source of emission or remove it from the atmosphere.”

Research at the Center for Research on Ocean Carbon Sequestration will focus on two possibilities: directly injecting carbon dioxide into the deep ocean; and fertilizing the ocean surface with nutrients that promote the growth of carbon dioxide-absorbing marine organisms such as plankton. Observations and experiments in the ocean will be combined with computer modeling of ocean currents and the diffusion of carbon dioxide.

Submitted by DOE’s Lawrence Berkeley National Laboratory

NREL scientist studies the surfaces of solar devices

Alvin Czanderna has spent his career studying surfaces, but he’s not a superficial guy. An internationally recognized surface scientist, Dr. Czanderna examines the chemistry, physics and material science aspects of the interfaces between solids, liquids and gases.

During his 22-year career at DOE’s National Renewable Energy Laboratory, Czanderna’s research has focused on addressing surface science problems in multi-layered applied solar technologies, including photovoltaic (solar electric) modules, energy-saving electrochromic windows and solar reflectors used in electricity producing concentrating solar power systems.

He recently established a new subfield of surface science dealing with interactions at metal-organic interfaces.

“My greatest joy at NREL has been working with many extremely competent colleagues to solve challenging applied research and technology problems in six different solar technology areas and to perform related fundamental surface science,” he said.

Czanderna has educated thousands through his teaching and writing. He is an adjunct professor of chemistry, physics and engineering at the University of Denver and the author or co-author of more than 250 technical publications. He also is the editor of several books and has written review chapters on surface compositional analysis.

“I first became interested in pursuing a career in surface science in the late 1950s when the field was just emerging,” he said. “The research needs and opportunities presented by this new discipline, and its relevance to a large number of applied science problems, captivated my interest. I decided early on to dedicate my career to a number of topical areas of surface science by studying surfaces and surface processes.” He earned a doctorate in physical chemistry from Purdue University in 1957.

In honor of his extensive contributions to the advancement of surface chemistry, the American Chemical Society recently selected him for the Arthur W. Adamson Award for Distinguished Service in the Advancement of Surface Chemistry. Visit the Web page at http://www.nrel.gov/hot-stuff/press/4399award.html for more information.

Submitted by DOE’s National Renewable Energy Laboratory