NETL's Bill O'Connor

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

First images of hydrogen engine combustion captured

Images of hydrogen combustion have been captured for the first time in an internal combustion engine operating at real-world speeds and loads by engineers at DOE's Argonne National Laboratory. This window into the inner workings of a hydrogen-powered engine is helping to optimize the engines for street use. Hydrogen-powered internal combustion engines are a low-cost, near-term technology, and can be the catalyst to building a hydrogen infrastructure for fuel cells. Researchers use ultraviolet imaging to capture images inside the running engine, and are also determining the most efficient and cleanest way to run the engine without knock or pre-ignition, another technical challenge.

[Catherine Foster, 630/252-5580, cfoster@anl.gov]

DOE, USDA collaborate on green energy

The departments of Energy and Agriculture are funding research at DOE's Brookhaven Lab that could facilitate the production of renewable energy and materials from plants. The project falls under DOE's "Genomes to Life" initiative, which aims to use genomic data to better understand fundamental biological processes and translate that knowledge into new technologies. Brookhaven biologists will study the genes and enzymes involved in processes that make certain plant polymers less digestible, thus inhibiting the conversion of biomass to useful energy/materials. Understanding these genes and enzymes may help scientists design new ways to improve the biomass properties of plants and promote the efficiency of the biomass-to-energy conversion process.

[Karen McNulty Walsh, 631/344-350, kmcnulty@bnl.gov]

MINOS: Where did the muon neutrinos go?

The Main Injector Neutrino Oscillation Search collaboration at DOE's Fermilab has presented new neutrino disappearance results that are consistent with neutrino oscillation. In this case, muon neutrinos can change into tau neutrinos or electron neutrinos, which can then escape detection by the 6,000-ton MINOS far detector located 450 miles away—through the earth— at the Soudan Underground Laboratory in Minnesota. Without neutrino oscillation, the far detector would have recorded about 336 muon neutrinos. Instead, the collaboration observed 215 muon neutrinos. With high precision and a large data sample over the next few years, MINOS will pave the way to a better understanding of neutrino oscillations.

[Siri Steiner, 630/840-3351, siri@fnal.gov]

INL tests cancer therapy isotope

An important test demonstrating production of a promising cancer therapy isotope, cesium-131, is under way using the Advanced Test Reactor at DOE's Idaho National Laboratory. INL researchers inserted five capsules of barium carbonate into the reactor and bombarded them with neutrons. The irradiation will create cesium-131 through radioactive decay. The reactor irradiation is a key step in the isotope production process launched in December 2005, through a collaboration involving INL, IsoRay Medical, Inc. and Bannock Development Corporation. Officials expect the test to demonstrate the ATR can efficiently produce the quality and quantity of the isotope to meet IsoRay's production need.

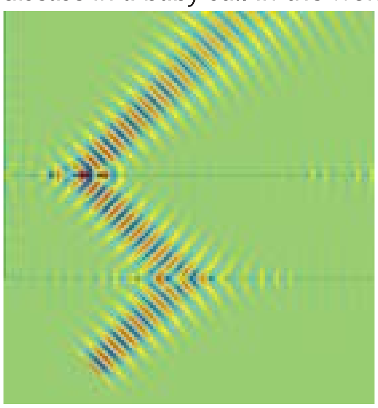
[John Walsh, 208/526-8646, John.Walsh@inl.gov]

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).

Marvelous metamaterials

Costas Soukoulis, a senior physicist at DOE's Ames Laboratory, and his collaborators at the University of Karlsruhe, Germany, are the first research group to fabricate a metamaterial that has a negative index of refraction at 1.5 micrometers—the smallest wavelength obtained to date.

Metamaterials are exotic, artificially created materials that can be manipulated to respond to electromagnetic waves in ways that natural materials cannot. They can refract light, or electromagnetic radiation, at a negative angle, allowing enhanced resolution in optical lenses, which could potentially lead to the development of a flat superlens with the power to see inside a human cell and diagnose disease in a baby still in the womb.



Negatively refracted light.

The development of a metamaterial with a negative index of refraction at 1.5 micrometers by Soukoulis and his Karlsruhe collaborators moves metamaterials into the near infrared region of the electromagnetic spectrum—very close to visible light, superior resolution and a wealth of potential applications.

Computer simulations developed by Soukoulis and his research team show how an electromagnetic wave evolves in time as it hits the surface of a metamaterial. The simulations reveal that the incoming beam is refracted in the negative direction as expected, but refraction does not take place immediately. Instead, the incoming electromagnetic wave is temporarily delayed and trapped at the boundary between the air and the metamaterial before it eventually moves in a negative direction.

Soukoulis says it is this trapping mechanism that causes the outer rays of the delayed beam to seem as though they are traveling faster than the speed of light. However, his calculations confirm that the speed of light is not violated by negative refraction. Movies developed by Thomas Koschny, an Ames Laboratory postdoctoral fellow working with Soukoulis, help clarify the interactions of electromagnetic radiation within metamaterials and can be viewed on the Web.

Submitted by DOE's Ames Laboratory

NETL's Bill O'Connor takes personal hand in sequestration

Bill O'Connor

On 10 acres outside of Albany, Oregon, about 1,000 Douglas fir trees stand as a testament to nature's own method of sequestration by "drinking up" carbon dioxide from the atmosphere. Those 10 acres belong to Bill O'Connor, a 19-year veteran geologist at DOE's National Energy Technology Laboratory Albany field office.

"Oregon is a pretty spectacular place to live," Bill says, and he knows that his tree farm, and other vegetation, adds to that geographic beauty while serving as a natural collector of CO_2. However, Bill's personal hand in addressing the sequestration issue is not limited to his tree farm. He has worked on a variety of sequestration projects in his career.

Before joining DOE and NETL, Bill's work in waste detoxification at the Albany Bureau of Mines facility seemed to be a good fit for NETL's sequestration effort. His early research at NETL involved the reaction of gaseous CO_2 and reactive minerals to convert the CO_2. into a solid as a safe method of storage without leakage. This methodology could provide niche applications for various industrial solid wastes.

Bill and the group at Albany subsequently shifted their effort to geologic sequestration of CO_2 into saline aquifers, with one focus being the improvement of cement seals at drill holes in critical, high-pressure environments. A peer review of their work with reactive minerals suggested that the research should investigate mineral additions to improve the cements.

In partnership with industry and other organizations, Bill has applied his experience to smelting processes that recover metals from spent catalysts. By using a new silicon-smelting furnace at Albany, he has worked to reduce the cost of silicon production. His efforts have been joined by companies such as Engelhard Inc. and Dow Corning, as well as national labs Hanford and Idaho.

Submitted by DOE's National Energy Technology Laboratory