Vince Cianciolo

Page 2

Research Highlights . . .

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Diagnostic tools survey solar cells at sub-micron level

Steven Smith, a researcher with DOE's National Renewable Energy Laboratory, and his co-workers recently developed three tools capable of "seeing" and mapping the grains of polycrystalline for use in solar cells. Gaining a better understanding of the topography of this material is essential to the engineering and manufacturing of the best possible cells. The three tools developed at NREL include a low-temperature near-field microscope, a scanning solid immersion lens microscope and an optical parametric oscillator. Thanks to these new tools, researchers can study the fundamentals of individual grain boundaries and ultimately design more efficient polycrystalline solar cells.

[Sarah Holmes Barba, 303/275-3023, sarah_barba@nrel.gov]

Mass spectrometer weighs in on proteomics

A new mass spectrometer developed at DOE's Pacific Northwest National Laboratory may significantly advance scientists' abilities to comprehend the role proteins play in cellular function and disease development. The system, called PROMS for Protein Mass Spectrometer, is almost 100 times more sensitive in detecting proteins that exist in small quantities. These low-level proteins often play important roles in key cellular functions, such as cell regulation, and can be important in disease development. PNNL scientists are using PROMS to characterize the proteome of cytomegalovirus, known for causing retinitis, in hopes of determining which proteins cause the infection and devising ways to counteract it. PNNL based the Fourier-transform ion cyclotron resonance mass spectrometer on a 9.4 tesla system built by Bruker Daltonics.

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

Compression reformer squeezes out the good stuff

The Fuel Processing Team at DOE's National Energy Technology Laboratory has developed a concept for a reciprocating compression reformer capable of converting a variety of fuels, including pipeline natural gas and transportation-quality liquid fuels, into forms suitable for operation of a fuel cell. The novel processor concept, recently submitted to the U.S. Patent Office, uses contaminant-laden fuel sources to produce a synthesis gas of concentrated H2 and some CO. The invention offers favorable economics and portability since it does not require external heat transfer and eliminates several unit operations required in conventional fuel processing technologies. NETL is working with Pennsylvania State University to develop a mechanical design analysis of the concept.

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Telerobotics aids cleanup activities

Researchers at DOE's Oak Ridge National Laboratory are developing robotics technology that can aid in the cleanup of hazardous waste sites while helping to protect humans from serious injury in the process. The telerobotic manipulation system performs cleanup chores at a distance that would have to otherwise be done on site by humans. The current focus of the project is plasma arc cutting of metal structures to dismantle contaminated equipment. Testing of the equipment comes during a time when there is an increasing need for remote systems and robotics for cleanup of DOE facilities.

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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).

Another eye on the sky

The largest and most comprehensive DOE-funded climate data collection project ever undertaken recently dedicated a new facility in Darwin, Northern Territory, Australia, adding a third such facility in the Tropical Western Pacific (TWP) region of DOE's Atmospheric Radiation Measurement (ARM) program.

Tropical Western Pacific region operations are managed by DOE's Los Alamos National Laboratory and are part of the ARM triad that includes instrument sites on the Southern Great Plains and the North Slope of Alaska. Pacific Northwest National Laboratory in Richland, Washington manages the ARM program for DOE. Los Alamos and the Australian Bureau of Meteorology will jointly operate the Darwin facility as an Atmospheric Radiation and Cloud Station (ARCS).

The other ARCS facilities in the TWP region are located on the tropical islands of Manus and Nauru just north and northeast of Papua New Guinea, near the equator. The first of those stations, on Manus, began taking data in 1996.

ARCS facilities are designed to gather the standard types of weather data such as temperature, humidity, wind speed, etc. They also measure naturally-occurring solar and ground radiation, ground heat and cloud reflectivity. The Darwin site houses a number of instruments, including cloud radar, a micropulse LIDAR, a ceilometer, a Total Sky Imager and a Whole Sky Imager.

The primary goal of ARM is to collect, over a lengthy period of time, a comprehensive database of weather and cloud information and make it available to scientists. The idea is to develop a climate change model and use that tool to improve our understanding of how climate change happens, and possibly our ability to predict how and when climate change will occur.

The Darwin, Manus and Nauru ARCS are located in an area of the western Pacific that experiences a wide variety of weather. The region typically sees yearly weather extremes from dry continental conditions to an active monsoon season, and those conditions - along with all the standard transitional weather in between that give rise to plenty of "convective cloudiness"- make the region a rich environment for gathering an elaborate set of weather data.

The addition of the Darwin site brings with it an important collaborative effort between the ARM program, the Australian Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organization. The additional collaborative agreements with the Papua New Guinea National Weather Service, the Nauru Department of Industry and Economic Development and the Australian Special Services Unit make Darwin a truly international scientific endeavor.

The Tropical Western Pacific region management has the additional responsibility of dealing with foreign governments and their agencies and so is actively involved in diplomacy and educational issues in the countries of Papua New Guinea and The Republic of Nauru. The regional management has developed and implemented educational workshops to help children in those countries learn about the global implications of climate change and the impact of weather on the Earth and its inhabitants.

Submitted by DOE's Los Alamos National Laboratory

Cianciolo focuses high energy nuclear collisions into focus

Vince Cianciolo

Roughly 15 billion years ago our universe was born in a firey explosion humbly known as the Big Bang. For roughly one microsecond after the Big Bang—before the Universe cooled enough to freeze them into familiar protons and neutrons—particles called quarks and gluons roamed free.

Vince Cianciolo, an early career award-winning researcher at DOE's Oak Ridge National Laboratory, is one of those attempting to re-create this exotic matter—on an extremely tiny scale—in the laboratory. They are colliding heavy ions—atoms such as lead or gold with all of their electrons stripped off—at nearly the speed of light.

The Relativistic Heavy Ion Collider, a particle accelerator at Brookhaven National Lab, creates these Little Bangs many times per second. Says Vince: "Our job is, essentially, to photograph each of them and write the interesting ones to permanent storage for later analysis. Sounds simple, but the PHENIX experiment (our 'camera') weighs more than 3000 tons, is much larger than a house, and has more than 500,000 separate detection elements.

Unlike a normal camera, which only sees light particles (photons) of a limited energy range, PHENIX's "camera" sees a zoo of different particles over a wide energy range that are emitted when the energy of the colliding ions is converted to mass according to Einstein's famous formula, $E=mc^2$.

"Identifying a particle's type and energy is analagous to bringing a picture into focus and distinguishing between red, green and blue light, and thus gives us a clear and detailed picture of each collision," Vince says.

"By looking at many pictures containing this information we hope to come to a more complete understanding of how the laws of physics change under such extreme conditions," Vince says.

Submitted by DOE's Oak Ridge National Laboratory