Ames Lab's Vitalij Pecharsky

Page 2

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Research Highlights . . .

Conducting/insulating materials reveal their secrets

Physicists at DOE's Brookhaven Lab have provided new insight into why some oxide materials composed of stacks of metallic planes are conductors in the planes but insulators perpendicular to the planes. The scientists found that this dual property was due to the presence or absence of strongly interacting electrons within the planes. Below some temperature—which varies between -100 and -300 degrees Fahrenheit, depending on the material—electrons within the planes no longer interact strongly with each other, and are free to move within and between the planes, allowing the material to conduct in all directions. These results will help scientists gain new insight into superconductors—materials that conduct electricity with no energy loss.

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Signs of a new relative of the proton

Scientists at the DOE's Fermilab believe they have found signals of three-quark combinations never seen before experimentally. Protons and neutrons are the most common three-quark combinations, called baryons. They only use combinations of the up and down quarks, and there are four other quarks (charm, strange, top and bottom). The SELEX experiment has identified three candidates for baryons containing two charm quarks, a combination which might not have been produced in nature since the earliest moments after the Big Bang. However, experiment co-spokesperson Jim Russ of Carnegie Mellon University stressed, "many puzzling aspects remain" in the results.

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"Slick" coating nears commercialization

"Near-Frictionless Carbon" coating, developed in 1997 at DOE's Argonne National Laboratory, stands on the brink of commercialization. After its disclosure, 3,000 engineers expressed interest in the new coating, which has the lowest coefficient of friction ever measured. Not only is the material slick, it's extremely wear-resistant. A sample of the coating survived 17.5 million passes of a steel ball pressed against its surface—the testing machine failed, but the coating didn't. Argonne scientists then turned their efforts to converting the laboratory curiosity into something industry could use. Collaborative research with CemeCon USA adapted a coating techique, allowing hundreds of small parts to be carbon-coated.

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

Ball-milling takes away the solvents

Researchers at DOE's Ames Laboratory have found a way to combine organic materials in solid state without the use of solvents. This revolutionary solvent-free process means that environmentally harmful solvents, such as benzene, could be removed from many of the chemical processes used to produce millions of consumer and industrial products. The discovery uses high-energy ball-milling, a well-known process for producing and modifying metal alloys. Materials to be processed are placed in a hardened steel vial along with steel balls. The vial is vigorously shaken and mechanical energy transferred into the system alters the crystallinity of the solids and provides mass transfer, eventually combining the materials into new compounds.

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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).

Nuclear Physics tools for NIH

Using the tools of nuclear physics basic research for other scientific purposes is sometimes called a "two-fer," as in two for the price of one. To the benefit of the National Institutes of Health (NIH), DOE's Jefferson Lab Fast Electronics Group is using its expertise in electronics and light sensitive detectors to design, construct and deliver a system that is the heart of ATLAS. ATLAS uses Positron Emission Tomography to generate high-resolution, sensitive images of animal physiology. PET required instrumentation that exhibits a uniform spatial resolution and high sensitivity to the object.

This leading edge medical imaging research is a collaborative project with NIH, Jefferson Lab, and Unidad de Medicina Experimental in Madrid, Spain. NIH believes this new design, called ATLAS, can be more simply produced and at a lower cost than current PET animal scanners, while maintaining a high level of image resolution and sensitivity. The new ATLAS scanner will have the capability to zero in on and collect detailed imagery on specific tissues or organ groups. Preliminary test results suggest the strategy behind this scanner design will yield an effective animal scanner and an effective PET imaging platform.

Medical imaging research at Jefferson Lab

Jefferson Lab's expertise in designing and building systems that detect nuclear fragments from nuclear physics experiments have lead to this partnership. The components being used in the NIH system are a natural progression of the collaborative work being conducted at Jefferson Lab between the detector and electronics groups and the researchers conducting research into the internal structure of the atom.

Submitted by DOE's Jefferson Lab

For JLab physicist, soccer was fun, but quarks pay the bills

Vitalij Pecharsky

Science has always been an important part of Vitalij Pecharsky's life and his journey on that path was determined early on. It's a path that's led him to become a leader in the field of magnetic refrigeration research and to collaborate with colleagues at DOE's Ames Laboratory in developing a mechanochemical process for creating organic compounds without the use of solvents. But as a boy growing up in the Ukraine, he never imagined that his love of science would lead him to a U.S. federal laboratory and a land-grant, state university located smack-dab in the middle of Iowa.

Born into a family of professors—his father is a mathematician and his mother was a physicist in the Polytechnic Institute in the Ukraine—Pecharsky decided to follow in their footsteps. After graduating with a Ph.D. from Lviv State University in the Ukraine, he trained and worked as a materials scientist and crystallographer, researching the crystal structure of materials using x-rays.

Pecharsky's career path took its dramatic turn in 1989 when he took part in a scientifice exchange program between the United States and Soviet Union. During that first visit, he came to Ames Laboratory where he met and worked with senior metallurgist Karl Gschneidner. In 1993, Gschneidner invited him back to Ames Lab as a visiting scientist, and two years later Pecharsky received a permanent position at the Ames Laboratory. In 1998, he secured a tenured position in Iowa State University's materials science and engineering department.

As a member of Gschneidner's group, Pecharsky has been involved in the magnetic refrigeration technology research that has focused on fundamental issues – looking to develop new materials with better magnetocaloric properties. Pecharsky has researched the physical properties of materials, in particular, their magnetic and thermodynamic properties.

"Being a crystallographer by background helps," says Pecharsky. "I understand how the materials are built and what their structure is."—*Oksana Opsomer*

Submitted by DOE's Ames Laboratory