

SNL's Karl Gross

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Research Highlights . . .

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 cuttingedge 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).



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The power of an uncommon protein

A researcher at DOE's Los Alamos National Laboratory and her colleagues have discovered that people with a less common type of proteins on their white blood cells seem to have a better immune response to HIV—the virus that causes AIDS—and tend to fight progression of the disease better than people with more common white blood cell proteins. The proteins, called human leukocyte antigens, perform key functions by helping the body fight infection and enable the T-cells that destroys virus infected cells to recognize infected cells. Destroying infected cells prevents pathogens from multiplying. The research could lead medical researchers toward a better understanding of the genetic factors related to HIV.

[James Rickman, 505/665-9203; jamesr@lanl.gov]

NETL patent holds promise for lower cost mercury removal

Researchers at DOE's National Energy Technology Laboratory (NETL) were recently awarded a patent for a process that holds promise for more costeffectively removing mercury from flue gas. The process, called the thief process, adsorbs mercury onto a thermally activated sorbent produced insitu at a power plant. The sorbent is obtained by inserting a lance (thief) into the combustion chamber and extracting partially combusted coal. Because the sorbent is produced less expensively insitu, the process becomes more cost effective than commonly used activated carbon injection. The researchers successfully demonstrated the technique at NETL's own 500-pound per hour coal combustion facility.

> [David Anna, 412/386-4646; David.Anna@netl.doe.gov]

NREL investigates ultracapacitors for fuel cell vehicles

Researchers at the DOE's National Renewable Energy Laboratory used ADVISOR, a hybrid electric vehicle simulation model, to simulate a fuel cell hybrid vehicle with an ultracapacitor energy storage system. Ultracapacitors, a type of energy storage device used in electric and hybrid-electric vehicles, can either replace or supplement conventional chemical batteries. Engineers from the Center for Transportation Technologies and Systems found the ultracapacitor is capable of capturing a sizeable amount of regenerative braking energy that would otherwise be lost, thus improving the fuel economy of the fuel cell vehicle. Industry representatives have requested more analysis of ultracapacitors in fuel cell hybrid vehicles.

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

Cleaning up natural gas

Ridding natural gas of sulfur and other impurities means cleaner air and is the focus of a project using two technologies developed at DOE's Oak Ridge National Laboratory. The goal is to build and demonstrate a low-cost regenerative desulfurizer based on the carbon fiber composite molecular sieve and electrical swing adsorption. Researchers plan to optimize the carbon fiber composite molecular sieve material's structure for adsorption of hydrogen sulfide and organic sulfides found in natural gas. Next, researchers hope to conduct dynamic adsorption experiments to evaluate and minimize the extent to which the sieve co-adsorbs other impurities in the gas stream.

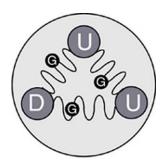
[Ron Walli, 865/576-0226; wallira@ornl.gov]

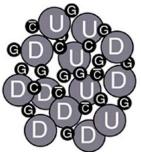
Research hints at extreme form of matter

esearchers are a step closer to creating the most extreme form of matter known to physics. Supported by a small team from DOE's Argonne National Laboratory, researchers found tantalizing clues that suggest a "quark-gluon plasma" was created by the Relativistic Heavy Ion Collider at Brookhaven.

A quark-gluon plasma is an unimaginably hot, dense stew of elementary particles thought to exist only for a few microseconds after the Big Bang and possibly in the centers of neutron stars.

"This is the only state of matter in which quarks are liberated from the inside of protons and neutrons and can roam free inside a larger volume," said Birger Back of Argonne's Physics Division, who leads Argonne's research with the Phobos detector at RHIC.





Protons and neutrons consist of three said. "It's almost custom-made quarks: two "up" quarks and a "down" quark make a proton (top image), and two downs and an up comprise a neutron. They're held together by the constant exchange of section of the detector. particles called gluons. In a quarkgluon plasma (below), this structure breaks down and quarks and gluons are freed from their confines. The "c" and "c-bar" particles created by the energy of the collision can escape as "jets" at lower energies but are trapped by the dense plasma. A quark-gluon plasma created at the Relativistic Heavy Ion Collider would last for just

of over trillion degrees.

One of four particle detectors at RHIC, Phobos was built by a collaboration that includes Argonne, the Massachusetts Institute of Technology, Brookhaven, the universities of Illinois at Chicago, Maryland, Rochester, and Krakow, Poland, and the National Central University in Taiwan. Although relatively small in comparison to its 1,200-ton brethren at the accelerator facility, Phobos provided valuable data in the quark-gluon plasma experiments.

"Phobos has a unique ability to measure all charged particles from a collision," Back for this experiment." Back and his colleagues from UIC were responsible for building and testing the "multiplicity" Technicians at Fermilab performed the intricate task of bonding micro-wires to thousands of silicon plates that measure the energies and direction of nearly all charged particles emitted from a particle collision. A second part of the detector analyzes how particles are deflected by a magnetic field.

This research was funded seconds and may reach temperatures primarily by the DOE's Office of Science, Nuclear Physics Division, with additional

funding from the NSF and a large number of international agencies. Submitted by Argonne National Laboratory

HYDROGEN FUEL RESEARCH EARNS SANDIAN A DOE AWARD

The prospect of obtaining almost limitless clean, plentiful energy from the most bountiful element, hydrogen, runs into hurdles when it comes to storing the vaporous substance aboard a vehicle. DOE's Freedom CAR initiative sets an initial goal for hydrogen storage in a vehicle of about 6 weight percent of the system.



Karl Gross

A new class of materials developed by Karl Gross and research colleagues at the California site of DOE's Sandia National Laboratories may come closest to achieving that goal, with a theoretical storage limit approaching 6 weight percent. The materials act like a sponge in which hydrogen reversibly fills spaces in its crystal lattice. They are compounds called complex-hydrides that operate at close-to-everyday temperatures and pressures.

Gross and his colleagues have spent five years studying the fundamental and engineering properties of this new class of complex hydrides - alanates and related compounds. Now they are proposing becoming a lead center for hydrogen storage material development.

"We're developing a better understanding of the hydrogen sorption mechanism," he says, adding that this breakthrough may suggest new types of complex hydrides, opening up "a whole new world of materials."

Two years ago, Gross received a Young Investigator award for this work from DOE's Office of Energy Efficiency and Renewable Energy's Office of Power Technologies.

Hydrogen's advantages over fossil fuels include its lack of polluting emissions and the fact that it can be produced anywhere from renewable energy resources such as solar electricity or biomass.

Developing a practical means to store the fuel for hydrogen-powered cars has remained a challenge, however. These new hydrides that can reversibly store and release hydrogen are a step in the right direction. Alternative storage methods involve compressing or liquefying the gas. If achieved, the FreedomCAR goal would handily accommodate a 300-mile driving range per fill-up.

Submitted by Sandia National Laboratories