NETL's Mary Anne Alvin

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DOE Pulse

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Antimicrobial fabrics to undergo testing

Scientists at DOE's Jefferson Lab are testing germ-killing fabrics for police and fire-fighter garments. Ordinary nylon fabric is transformed into a germ-resistant shield by shining ultraviolet light on it in an oxygen-free environment. The environmentally friendly process changes the chemical structure of the surface of the fabric at the molecular level but does not affect its look, feel or smell. To test the fabric's effectiveness and durability, cloth samples will be placed in high-heat environments, police vehicles and stations for months. The work is supported by a grant from the Department of Homeland Security.

[Kandice Carter, 757/269-7263, kcarter@jlab.org]

Agreement establishes energy-efficient home collaboration

DOE's National Renewable Energy Laboratory and the Sacramento Municipal Utility District (SMUD) recently signed a Memorandum of Understanding establishing a collaboration in which SMUD will participate in NREL's research and development activities on high-performance, energy-efficient homes. This agreement allows NREL researchers to evaluate cost and performance improvements in homes that are supported by SMUD and are constructed in its service territory. NREL plans to collect data, including utility bill information, impacts on SMUD's distribution system, and energy and peak demand information, to help meet the goal of a 70 percent reduction in home energy use without compromising comfort or convenience.

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SRNL develops collection devices for airborne particles

Two devices developed by DOE's Savannah River National Laboratory researchers for collecting airborne particles for analysis have recently been issued patents. Both the Aerosol-to-Liquid Particle Extraction System and the Aerosol Contaminant Extractor could have wide application in homeland security and law enforcement. The two work in different ways, the ALPES using a liquid to concentrate particles, and the ACE depositing the particles on a charged plate for off-site analysis. Both are highly efficient, quiet, portable devices that are able to collect most any aerosol, including chemical agents, radioactive particles, microorganisms, residual substances from explosives, and byproducts of manufacturing processes.

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Gauging the nation's energy and water concerns

DOE's Sandia National Laboratories recently hosted the first of three regional workshops - others will be held in Baltimore and Salt Lake City over the next couple of months - examining concerns over future energy and water issues. Information from the workshops will be used in the development of a national science and technology roadmap looking 25 years into the future to help address major energy- and water-related issues facing the country. Sandia researcher Mike Hightower pointed out the interdependence of water and energy, noting that "electric power generation in the US accounts for almost 40 percent of all fresh water withdrawals, equivalent to the amount of water withdrawn for agriculture."

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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).

Metallic fuels studied as future energy option

An ORNL researcher predicts that a car with a modified engine powered by metallic nanoparticles could drive three times as far as today's gasoline-powered internal combustion engine. Metal fuels also offer great potential for unmanned vehicles and battlefield power sources for military uses.

David Beach, leader of the Materials Chemistry Group at DOE's Oak Ridge National Laboratory, explains that, like hydrogen, a metal fuel is an energy carrier and burns cleanly. But unlike hydrogen, metal fuels-such as iron, aluminum, and boron-possess a higher energy content per unit volume, can be stored and transported at ambient temperatures and pressures, and can be combusted at high efficiency in a heat engine without the high costs of fuel cells.

Large particles of metal do not burn until heated to the metal's boiling point. At this temperature, metal vapor combusts to form metal oxides. Unfortunately, this process leads to very high combustion temperatures, fouling of the internal surfaces of the combustion chamber, and the production of oxides of nitrogen.

Metal nanoparticles, however, burn faster and more completely at lower temperatures with no gas phase combustion.

"These particles oxidize fast enough that they never reach the peak combustion temperature," Beach says.

At the American Chemical Society meeting in March 2005, Beach's group displayed transmission electron micrographs of iron nanoparticles before and after burning in oxygen. Their poster included a sharp image of iron oxide particles, showing complete combustion.

"We displayed the results of a radiometry experiment in which we measured the iron nanoparticles' peak combustion temperature, which is 1100 Kelvin," Beach says. "The temperature should be hot enough to achieve high energy efficiency but not so high that exotic materials, such as expensive ceramics, are required to contain the combustion. Cast iron can be used as the combustion chamber for nanostructured metal fuels. "

Beach says that the exhaust gas of metal fuels in a heat engine, such as a gas turbine or Stirling engine, is very clean. "We take the oxygen out of the air and have nearly pure nitrogen left," he says. "We recover most of the heat using a recuperator and get much closer to the highest efficiency theoretically achievable in an engine.

"An even better energy carrier would be boron if boron nanoparticles could be made at a reasonable cost. Boron is three times better than gasoline in terms of heat per unit weight and heat per unit volume."

Submitted by DOE's Oak Ridge National Laboratory

Researcher finds science plus arts a workable formula

Mary Anne Alvin

NETL scientist Mary Anne Alvin may understand more than most the sentiment of music laureate Ira Gershwin, who once said: "A song without music is a lot like H_2 without the O."

Alvin not only understands H_2, having recently earned a patent for describing advanced composite metal/ceramic structures for the separation of hydrogen from high-temperature process-gas streams, but also understands the intricacies of music structure, having written a master's thesis based on her computer research of European music.

"My heart and soul are into my scientific work but another part of me has a love for the arts," Alvin said, explaining her master of arts degree in music sandwiched between a bachelor of science degree in microbiology/biophysics and a master of science degree in physical chemistry.

In her world of science, Alvin has earned 22 patents over the past 30 years as an employee of Westinghouse Electric Corporation and later at Siemens Westinghouse Power Corporation. In addition, she has six more patents pending. At those companies, her research efforts focused on hot gas particulate filtration, catalytic combustion, gas separation membranes, and aerospace lubricants.

As a physical scientist in NETL's Office of Science and Engineering Research, Alvin directly applies her corporate laboratory experience to her research at NETL, where she supports material and process technology development related to gas turbines, fuel cells, gas separation membranes, and catalysis. Currently, she is concentrating in two focus areas: selective catalytic oxidation of H_2S, and thermal barrier coatings for oxy-fuel and hydrogen turbines.

In the arts, Alvin currently serves as a master gardener for Phipps Conservatory, a renowned botanical garden in Pittsburgh, Pa., and also designs and teaches stained glass. She also has a love for travel and languages, having learned French, German, and Russian in the past.

Submitted by DOE's National Energy Technology Laboratory