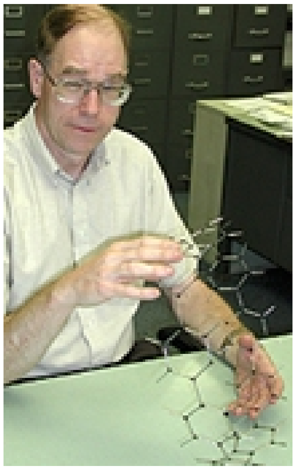

NETL's Bockrath displays a nanotube model.

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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Clean electric power from dirty coal

At DOE's Ames Laboratory, researchers have developed a thin metal filter material that could allow power plants to cleanly burn dirty, high-sulfur coal. The tough new metal filter would replace fragile ceramic filters currently used on pressurized-fluidized bed combustion and other low-emission power plant concepts. Created through a process called tap-densified loose powder sintering, the nickel-based alloy filter material experiences only a moderate drop in yield strength going from room temperature to operating temperature of 850° C. Moreover, it's about six times stronger at operating temperature than an iron-aluminide filter material that's also being studied.

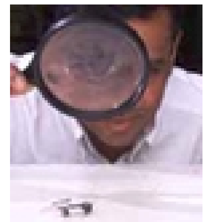
[Kerry Gibson, 515/294-1405, kgibson@ameslab.gov]

Firm applies ANL sensor to sintering process

Superior Graphite Co. of Chicago, which manufactures parts from powders of metals, ceramics and polymeric composites, needed a nonintrusive sensor for temperature control during sintering. The company asked DOE's Argonne National Laboratory for help, and the result was a sensor that converts speed-of-sound measurements to temperature readings, nonintrusively, at temperatures up to 3000ºC, with 2-3% accuracy. Argonne's technique measures the speed of pulsed ultrasonic waves as they traverse any portion of the granular medium lying directly between two ultrasonic transducers. The transmitting and receiving transducers are placed on either side of the process die so that they won't affect the sintering procedure.

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

Miniature mobile snoop



Most criminals know about robots armed with cameras and shotguns, but there's a new law enforcement weapon on the horizon. Actually, the weapon is a micro-robot about the size of a june bug, so it's only on the horizon if you're at floor level. And that's the idea, according to developers at DOE's Oak Ridge National Laboratory. The micro-robot is a battery-powered sensor that can travel under doors, for example, and detect chemical and biological agents. The micro-robot is ideal for stealth applications or for monitoring areas that are difficult to reach with conventional means. Researchers have already developed a robotic device that crawls under a door and detects chemicals.

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

Scientists push enzyme evolution into high gear

Brookhaven biologists have found a way to make a plant enzyme 100 times more efficient than similar enzymes found in nature. Using biochemical techniques, they identified the mutations that would improve the enzyme's function, then made a new enzyme with those mutations. This process of "tuning up" enzymes might one day be useful to produce large quantities of other plant products, such as medicinal compounds and oil-based raw materials for industrial processes—perhaps even taking the place of petroleum-based chemicals. The idea is to grow natural resources instead of taking them from a nonrenewable source. Now that's evolutionary thinking!

[Karen McNulty Walsh, 631/344-8350, kmcnulty@bnl.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).

Labs team to quench wildfire threat

During the 2000 fire season, wildfires burned more than 6.8 million acres of public and private lands, resulting in property loss, resource damages and disruption of community services. The daily cost of fire suppression efforts was more than $15 million. As early as May, a devastating wildfire that began as a prescribed burn swept through the area of Los Alamos National Laboratory.

Experts believe that 2000 was not an exceptional year for wildfires, but rather the beginning a new pattern: the western United States can expect ravaging wildfires to continue to destroy thousands of acres of land and to endanger human life.

In response to the threat of continuing wildfires, DOE's Lawrence Livermore National Laboratory with Los Alamos National Laboratory have been working on an initiative for a National Wildfire Prediction Program. The national resource would combine and leverage components of a multi-year wildfire model effort at LANL and the existing capabilities of the National Atmospheric Release Advisory Center at LLNL to predict the behavior of wildfires and prescribed burns.

The program's main objective would be to save lives and property. It would be designed to provide around-the-clock guidance to fire management planners and also could predict fires of strategic interest around the globe. The NWPP would provide guidance to fire managers to help them most effectively use their limited firefighting resources.

The researchers have already developed wildfire models and the LANL team has accurately simulated the behavior of two historic fires—the 1994 South Canyon wildfire in Colorado, which claimed the lives of 14 firefighters, and the 1996 Corral Canyon wildfire near Calabassas, CA, in which a firefighter was severely burned. The simulation results can be viewed in animated video sequences. For both cases the models successfully reproduced the unexpected (and devastating) progression of the fires.

The LLNL team is currently coupling the fire model with a regional weather prediction model and doing weather/fire simulations to reconstruct the early stage of the tragic 1991 East Bay Hills fire in the San Francisco Bay Area. That fire, which claimed 25 lives and destroyed 3,000 homes, will provide yet another test of the modeling system's accuracy. Follow-on studies will look at the behavior of hypothetical fires in nearby canyons that escaped the 1991 fire. These latter simulations have been requested by local emergency management and planning officials to improve their preparedness for future wildfires.

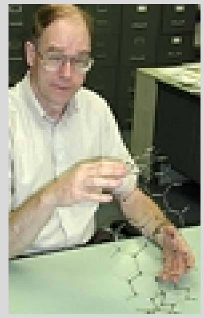
Michael Bradley, LLNL atmospheric scientist and principal investigatorsaid this project has the potential to help move the nation into a new era of scientifically-based wildfire and vegetation management.

As Bradley sees it, one day fire trucks would carry laptop computers that fire managers could use to tap into a national wildfire behavior prediction center so they could direct their troops where to go to contain the fire. Eventually, the models could even predict the effects of the firefighters' activities, helping them to choose the safest and most effective firefighting techniques for specific fires.

Submitted by DOE's Lawrence Livermore National Laboratory

Bockrath Analyzes Storing Hydrogen in Nanotubes

Bradley Bockrath hasn't been this excited in years. The reason? Nanotubes, carbon nanotubes.



Bockrath's nanotube model is a billion times larger than an actual carbon nanotube

A research chemist at DOE's National Energy Technology Laboratory, Brad examines the possibility of using nanotubes to store hydrogen, an important fuel because of its use in fuel cells, considered to be one of the cleanest, most efficient ways of producing energy. Hydrogen is now stored in tanks.

Discovered in 1992, nanotubes are tubular structures found in carbon that are visible only with an *electron* microscope; an ordinary microscope isn't strong enough. Made from carbon atoms joined together, nanotubes resemble a long drinking straw, and are about a million times smaller than the width of a human hair.

"Carbon nanotubes are one of the strongest materials we know about," Brad noted. How many hydrogen molecules can be stored in a single tube? "That's the question," he said. And the focus of his research at NETL for the last three years.

Brad tries to adapt them for storing hydrogen, which is adsorbed by the carbon. Using a pulse mass analyzer, which weighs the nanotubes and hydrogen, he studies the tubes to see what structural features could be changed to optimize hydrogen storage. And he can see them. Brad works with nanotube clusters that resemble fly-away soot.

The ultimate goal: To make nanotubes a candidate for automotive fuel cells. This means making sure cars and other transportation vehicles can use the same size fuel tanks they now have and get the same mileage range from them on hydrogen.

"What makes for a good storage device is a unit that releases hydrogen as pressure is increased, and when pressure is decreased, the hydrogen release stops" Brad explained. This is pretty much the way a standard fuel tank operates, except hydrogen would be the fuel in a fuel cell car.

Submitted by DOE's National Energy Technology Laboratory