Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Sharing THE Excitement OF Science AND Technology

Breakthroughs for the Northwest

Richland, Washington

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Canadian trade delegation visits PNNL

Nearly 25 Canadian trade delegation members participated in a Fuel Cells and Hydrogen Workshop in March at Pacific Northwest National Laboratory. The group, comprised of government policy makers, industry partners, National Research Council members, and researchers from universities and related organizations, was in Richland to develop a plan to facilitate and accelerate the development of fuel cells. Other participants were partners from U.S. industries currently conducting business in Canada, representatives from industries related to fuel cells, the U.S. Department of Energy and policymakers from Washington state.

The delegation expressed interest in working with PNNL to develop a roadmap for a U.S.-Canada hydrogen highway that could possibly stretch from Vancouver, B.C., to Los Angeles by 2010. Canada envisions using the 2010 winter Olympic games in Whistler to showcase a series of proposed hydrogen-fueling stations that would be located on routes between Vancouver, Victoria and Whistler.

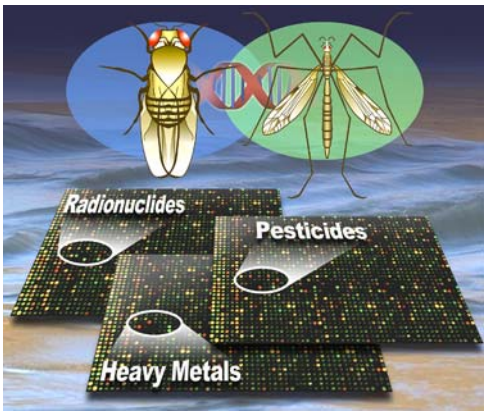
PNNL will continue to actively work and partner with members of the Canadian delegation and formulate a committee to create a five- to 10-year roadmap that will accelerate the development and deployment of fuel cells and, ultimately, contribute to a hydrogen economy.

For more information, contact Dr. Prabhakar Singh, **prabhakar.singh@pnl.gov**.

A genetic sleight-of-wing

Ecologists have come to rely on a tiny fly, called the midge, as an environmental sentinel. They have learned that a variety of midge species thrive in healthy streams, whereas in polluted water, like that near a lead mine, midge species can dwindle to nothing. So by skimming and analyzing the skins that pupating midges shed as they enter adulthood, ecologists can attain information about a stream's living conditions.

Raw numbers, though, reveal nothing about changes in progress that portend environmental peril. What if stream degradation could be detected and corrective action taken before it is too late for the bio-indicator organism and other creatures living in the stream?



Knowing that cells under environmental stress will express proteins differently from healthy cells, scientists studying the skins at Pacific Northwest National Laboratory supposed pollutants could be quickly identified by using the midge genome to scan for cell damage. Unfortunately, there is no midge genome map so they substituted that of a distant relative: the thoroughly mapped fruit fly Drosophila.

The researchers found that a chip containing the midge-cousin's genetic material will bind to protein-precursor RNA from ground-up midge larvae and yield a pattern specific to heavy metals, radionuclides, hormone analogues and pesticides to which the midges were exposed. They will continue refining the tests so that they can catalog the expression patterns that match all major classes of pollutants.

For more information, see **http://www.pnl.gov/breakthroughs/winter04/special_report5.stm#sleightWing**.

Coaxing soil to soak up carbon

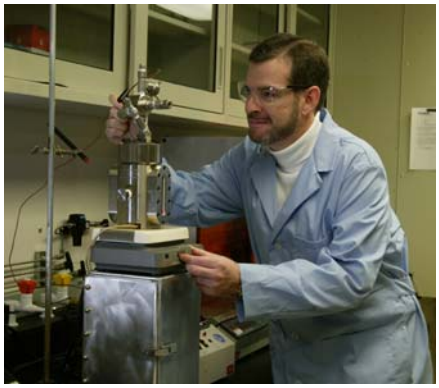
In a novel approach to stalling global warming while reinvigorating nutrient-depleted farmland, chemists have found they can promote soil's natural ability to soak up greenhouse-gas carbon dioxide from the surrounding air.

Experiments at Pacific Northwest National Laboratory show that maintaining a proper alkalinity plus frequent wetting and drying cycles can coax soil to retain more carbon. Globally, soils contain four times as much carbon as the atmosphere, and half of the soil carbon is in the form of organic matter.

Until about 30 years ago, soil tillage released more carbon dioxide to the atmosphere than burning of fossil fuels. Some agricultural soils have lost a third of their carbon from tillage. These carbon-depleted soils are a tremendous potential reservoir for carbon that can help slow the increase in atmospheric carbon dioxide.

For more information on this research, visit PNNL's Web site at **http://www.pnl.gov/news/2004/04-25.htm**.

Cleaning up energy production



Scientists at Pacific Northwest National Laboratory are playing a lead role on a combined Department of Energy and industry effort to build a 275-megawatt coal-fired plant that will gasify coal to produce electricity and hydrogen. In that gasification process, carbon dioxide would be captured and sequestered.

The program, called FutureGen, aims to design and build energy plants that maximize the efficiency of fossil fuel energy generation while minimizing the environmental effects such as global warming. PNNL has partnered with the National Energy Technology Laboratory, which is owned and operated by DOE, to develop technologies in support of the FutureGen vision. As part of the High Temperature Electrochemistry Center (HiTEC) team, PNNL researchers are applying their expertise in material science, solid state electrochemistry and surface chemistry to develop new materials and new ways to form and manufacture them to meet the cost and performance goals of the FutureGen plant.

For more information about this program, see **http://www.pnl.gov/breakthroughs/winter04/special_report4.stm#cleanEnergy**.

Spectral library sheds light on chemicals

Just as a person's signature is unique, a chemical's spectral signature is a reliable form of identification. Such revealing information is becoming more vital in a world where detection of toxic substances could save lives and the environment.

At Pacific Northwest National Laboratory researchers have been funded by the Department of Energy's Office of Nonproliferation to study the light that is absorbed or emitted by certain vapor phase chemicals—and to tie those characteristics to a unique spectral signature that can be read by both active and passive sensor devices. The result of the work is the DOE-PNNL Infrared Spectral Library, which contains signatures of more than 300 vapor phase chemicals and is growing by about 75 per year. Some of the chemicals are the "dual use" variety that have legitimate uses in industry but also could be used to make weapons. The research is conducted in the William R. Wiley Environmental Molecular Sciences Laboratory, a cutting-edge DOE research facility located at PNNL.

The library data, coupled with a sensing device, can determine if a smokestack is belching harmful emissions. The data also can be used to create more effective detection technologies that could be used to respond to terrorist threats.

The DOE-PNNL Infrared Spectral Library Web site is available to the public and is located at **http://nwir.pnl.gov**.

Editor's note: Beginning with this issue, Sharing the Excitement of Science and Technology will be published quarterly.

For more information about these items or about Pacific Northwest National Laboratory, contact:

Joy Stiles, Editor
Phone: 509-375-2334
Fax: 509-375-2491
E-mail: joy.stiles@pnl.gov

Pacific Northwest National Laboratory
P.O. Box 999, K1-55, Richland, WA 99352
Toll-free: 1-888-375-PNNL
Web address: http://www.pnl.gov

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