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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 123 January 6, 2003

Building an intuitive machine

Like a good employee, an ideal robot would follow orders and work independently when left undirected. Now, a robot created by DOE's Idaho National Engineering and Environmental Laboratory researchers fits the bill. The robot sways between obedience and autonomy based on input from its operator. "Our system takes advantage of the robot and the human—allowing the two to work as a cohesive unit," computer scientist David Bruemmer says. The robot functions solo with the aid of its sophisticated perceptual ability—achieved by fusing information from several sensors. Their human-robot interface could be applied in many high-risk situations, from landmines detection to the search for survivors of urban disasters, Bruemmer adds.

[Kendall Morgan, 208/526-3176, morgkk@inel.gov]

Proteins in blood hold promise for disease diagnosis

In a significant scientific advance, researchers at DOE's Pacific Northwest National Laboratory have identified or confirmed 490 proteins in human blood serum—nearly doubling the number of known serum proteins, according to a paper accepted for publication in the December issue of *Molecular and Cellular Proteomics.* The study represents the most extensive identification of proteins in serum to date. Understanding what proteins exist in serum may allow scientists to determine which ones could be used to predict disease susceptibility, monitor disease progression and diagnose disease. Plasma provides a unique opportunity for scientists to identify clues to all the major processes in our bodies and whether they are functioning properly or improperly.

[Staci Maloof, 509/372-6313, staci.maloof@pnl.gov]

Big-rig science on the road

Twenty-five thousand big rigs rumbling through Knoxville, Tenn., every day will help researchers from DOE's Oak Ridge National Laboratory and the University of Tennessee get a better handle on real-world vehicle emissions and their effects on the environment. Two meteorological stations are operational on Interstate 40 and other equipment will be added—when complete, the instrumentation will create a world-class field lab. Large trucks are of particular interest because they are responsible for 40 percent of nitrogen oxide emissions and about 60 percent of particulate matter emissions. Data will help determine, for example, how effective trucks' stricter emission regulations are.

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

Photochemical removal of mercury from flue gas

Scientist Evan Granite explains that UV-C light drives the reaction.

Researchers at DOE's National Energy Technology Laboratory have developed a new method to remove mercury from coal-fired power plant flue gas. Experiments with simulated flue gases suggest that a high level of elemental mercury removal—as mercurous sulfate and mercuric oxide - can be achieved by irradiation with 253.7 nm ultraviolet light. Dubbed the GP 254 Process, the system uses simple equipment similar to that used in water treatment plants for the eradication of microbes. A preliminary analysis suggests that annual operating costs for the GP 254 Process will be lower than for activated carbon injection systems.

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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).

Argonne system takes salt from syrup

Each year, industry generates millions of gallons of toxic chemical waste while producing food, fuel, textiles, cosmetics and pharmaceuticals. Efforts to improve these expensive and dirty processes have been delayed by technical barriers—until now.

Researchers at DOE's Argonne National Laboratory have developed a cleaner, cheaper salt-removal process that cuts chemical use by 90 percent while matching the existing technology's output. Researchers successfully demonstrated the process that removes salt, a natural byproduct of corn-syrup production, in a high-fructose corn syrup refinery in Lafayette, Ind.

Chemical Engineer, Paula Moon inspects the EDI wafer stack.

The improved EDI technology was named one of this year's top 100 inventions by *R&D* magazine. Argonne's EDI device could replace conventional ion-exchange technology and reduce energy costs and potential pollution by eliminating the need for chemical regeneration. This innovative device may have applications in cleaning radioactive and bio-based wastes.

The key to this process is an Argonne-designed porous wafer and gasket system coupled with a refinement to an existing purification process called electrodeionization (EDI). EDI combines electricity and ion exchange, which is a chemical process that separates charged molecules.

Every year, the United States pumps out more than 9 million tons of corn syrup to sweeten candy, soft drinks and ice cream. To make high-fructose corn syrup, salt-based enzymes are added to corn starch—a chain of glucose molecules—to convert it into a syrupy mixture of water, dextrose and fructose sugars.

Argonne's Energy Systems Division scientists Seth Snyder, Paula Moon, Michael Henry, Yupo Lin, James Frank and Carl Landahl joined forces with EDSep Inc., based in Mount Prospect, Ill., to develop a cleaner, more energy-efficient alternative. EDSep works with scientists to commercialize proprietary technology.

Submitted by DOE's Argonne National Laboratory

King of covers

Lynn Boatner

Lynn Boatner could be called the "king of covers," but he's not a supermodel. "Covers" in this instance refers to the front covers of scholarly journals.

Images generated by Boatner and his colleagues at DOE's Oak Ridge National Laboratory have graced many nationally and internationally distributed scientific publications, and in some instances, they have been featured in books and on calendars.

"Scientifically interesting and aesthetically pleasing" is how Boatner, a Corporate Fellow researcher, describes the beautifully multi-hued microscopic images. Professional society journals that have featured these images include the *Journal of the American Ceramic Society, Advanced Materials & Processes* and *Science* . They've also been included in a book about scientific images, in the traveling Nikon "Small World" exhibit and on calendars distributed by a manufacturer of metallographic equipment.

The color micrographs demonstrate the inherent beauty in nature, even at microscopic resolution. But the eye appeal is a bonus.

Their real value is in the science they reveal. The pictures of striking geometrical shapes—from orbs to polygons to fractals—are valuable investigative tools that help Lynn and fellow researchers analyze experiments and understand the processes responsible for their outcomes. They can show why an experiment didn't work, and they can reveal the mechanisms behind a new material's properties.

The journal editors who select the ORNL images for their covers sometimes see them at poster-paper presentations and micrograph competitions held at scientific professional society meetings. But Boatner, who may have acquired his appreciation for beautiful pictures from his father, a master photographer, has no doubt earned a reputation as a supplier of quality scientific images that are also fun to look at.

Submitted by DOE's Oak Ridge National Laboratory