Argonne NATIONAL LABORATORY

News Release

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Media Contact:
Catherine Foster
(630) 252-5580
cfoster@anl.gov

For immediate release

Argonne researchers win five prestigious R&D 100 awards

ARGONNE, Ill. (July 14, 2006) – Five of the world's top 100 scientific and technological innovations during 2005, as judged by R&D Magazine, came from the U.S. Department of Energy's Argonne National Laboratory.

Argonne has been consistently on the R&D 100 Awards list, having won 95 of the honors since the magazine began presenting the awards in 1964.

Argonne director Bob Rosner congratulated the winners, saying, "I am thrilled that Argonne staff members have been recognized for their important innovations with these prestigious awards. Winning such awards attests to the high quality of research at Argonne and to the caliber of our staff."

"I congratulate the researchers who have won these awards, which highlight the power and promise of DOE's investments in science and technology," Secretary of Energy Samuel W. Bodman said. "Through the efforts of dedicated and innovative scientists and engineers at our national laboratories, DOE is helping to enhance our nation's energy, economic and national security."

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This year's winners from Argonne are:

- The world's fastest commercially producible hydrogen sensor, which will be used in cars to detect unsafe levels of hydrogen.
- Anti-scatter grids for X-ray imaging and collimators for nuclear imaging, developed jointly with Creatv MicroTech, Inc.
- Materials resistant to metal dusting degradation, which will be used to make more durable equipment in plants that manufacture hydrogen.
- Multiport dryer technology for the forest industry, which will improve the efficiency of dryers used in paper mills.
- The separative bioreactor for the production and recovery of biobased products, which will enable biobased chemical products to be used in place of petrochemicals, developed jointly with Archer Daniels Midland Company.

Ultrafast hydrogen sensor

Argonne's hydrogen sensor will greatly increase safety for future hydrogen-powered buses, cars and space applications. Highly flammable hydrogen gas can not be odorized like natural gas and takes tens to hundreds of seconds to detect by other more expensive methods. The new sensor detects hydrogen quickly and at low enough levels to allow closing of safety valves before dangerous concentrations are reached. The sensors also have applications in space stations, mining and medical devices.

Argonne's technology outperforms competitors in speed, sensitivity, energy-efficiency and cost. Based on nanotechnology, the sensors could be made smaller than a grain of sand and use a simple change in electronic conductivity for detection. The sensors use siloxane (the same chemical that makes car windshields repel rain drops) to change the morphology of palladium metal. Without siloxane, evaporated palladium forms thin sheets that strongly adhere to the glass substrate and irreproducibly fracture upon exposure to hydrogen. With siloxane, palladium forms a network of nanometer-sized beads that swell and shift reproducibly, drastically changing the network's electrical resistance. Argonne's patent has been licensed and is being commercialized by Makel Engineering with the help of Edison Materials Technology Center.

Developers are Argonne's Glenn Seaborg Postdoctoral Fellow Michael Zach, Argonne postdoctoral researcher Tao Xu and physicist Zhili Xiao (joint with Northern Illinois University); both post-doctoral positions are supported by DOE's Office of Basic Energy Sciences. Specific funding for the hydrogen sensor was provided by laboratory discretionary funding, by the State of Illinois and by Makel Engineering, with funds provided by Edison Materials Technology Center.

Anti-scatter grids and collimators for nuclear imaging

This invention improves X-ray imaging, used in mammography, chest X-rays and other medical imaging applications. As X-rays interact with tissue and bones, the X-rays scatter at random angles as well as hitting their target, resulting in noise and fog in each individual image. Anti-scatter grids, placed between the X-rays and their target, yield higher-quality images.

R&D Awards – add three

Nuclear imaging using radiotracers determines the function and chemistry of organs, rather than the shape and structure as produced by X-ray imaging, and is important for detecting small tumors. Collimators, similar to grids, are used for nuclear imaging to direct only the desired radiation to the detector. These improved images will reduce both false positives and false negatives, leading to an ultimate result of saved lives and lower costs.

Developers are Derrick Mancini, Ralu Divan and Judi Yaeger at Argonne; Olga Makarova, Guohua Yang and Cha-Mei Tang at Creatv MicroTech, Inc.; and former Argonne employees Vladislav N. Zyryanov, now at Illinois Institute of Technology, and Nicolaie Moldovan, now at Northwestern University. Funding was provided by DOE's Office of Basic Energy Sciences and Creatv MicroTech.

Metal dusting

Metal dusting is a type of degradation that occurs at elevated temperatures in hydrocarbon-containing atmospheres in which carbon activity is high. Such environments are prevalent in chemical and petrochemical industries such as hydrogen-, methanol-, and ammonia-reformers and in synthesis gas production plants. The degradation of metallic component materials into powder form and the resulting damage make it difficult to maintain equipment used in these industries. Fifty years of previous research could not solve this problem, and the only available solution was to quench the high-temperature gases by lowering the working temperature, which results in energy loss and decreased product yield.

Argonne scientists Ken Natesan and Zuotao Zeng developed alloys that resist this type of degradation and can be used to build equipment for these industries. Such equipment could save 107 million standard cubic meters of hydrogen production each day, which is equivalent to 13 million standard cubic meters of natural gas each day. Application of these alloys in the future may also enable a complete redesign of the reforming systems with improved efficiency.

Financially, this innovation could save $220-290 million per year in the hydrogen industry alone, and could increase industrial productivity by enabling machinery to function with fewer maintenance shutdowns. Such savings will become increasingly important as hydrogen is used more as a source of energy.

The research was funded by the Industrial Technologies Program of DOE's Office of Energy Efficiency and Renewable Energy.

Multiport dryers

The basic technology used for drying paper dates back to 1821 when T. B. Crompton patented a method of drying the paper continuously, using a woven fabric to hold the sheet against steam-heated drying cylinders. After it had been pressed, the paper was cut into sheets by a cutter fixed at the end of the last cylinder. Paper is still dried on heated cylinders today, but at a much faster rate, passing over 30 to 100 large diameter steam-heated cylinders. This process requires a lot of energy and associated capital investment.

R&D Awards – add five

Argonne's multiport dryer may become a major innovation in drying. This concept promises to dramatically increase the effectiveness of heat transfer from steam to the paper, increase productivity, and save energy. The multiport dryer has a series of longitudinally oriented passages, or "ports," near the inner surface of the drying cylinders. Steam flows through these ports, in close contact with the dryer cylinder surface. This increases the rate of heat transfer and the resulting rate of water evaporation.

Argonne's multiport dryer is being designed so that it may be installed in existing dryer cylinders, at a cost that may be less than 20 percent of the installed cost of a new dryer.

Developers at Argonne are Stephen U.S. Choi and Ralph Niemann. Other institutions involved in this project are the University of Illinois at Chicago and Kadant Johnson in Three Rivers, Michigan. Funding was provided by DOE's Office of Energy Efficiency and Renewable Energy through its Industrial Technologies Program.

Separative bioreactors

The U.S. Department of Energy's Biomass Program analysis indicates that organic acids are among the most likely candidates for biobased chemicals to replace petrochemicals.
The Separative Bioreactor enables the efficient production of these organic acids, reducing the cost of producing biobased products by half from previous methods.

The Separative Bioreactor combines the selectivity of fermentation reactions, the technical advantages of heterogenous catalysis (where a substance is used to speed the reaction of another substance in a different phase) and the energy efficiency of electrically driven separations with the performance advantages of chromatography in a single operation.

R&D Awards – add six

Developers at Argonne are Seth W. Snyder, YuPo J. Lin, Michael P. Henry, Michelle B. Arora, Edward J. St. Martin, Jamie A. Hestekin (now at Kraft Foods) and James R. Frank. Developers at Archer Daniels Midland Company are Thomas P. Binder, Rishi Shukla, K.N. Mani, Ahmad Hilaly, Wuli Bao and William F. Ellis. Argonne has one patent granted and five additional patent applications related to development of the Separative Bioreactor. The project development has been jointly sponsored by the DOE Biomass Program and Archer Daniels Midland.

The nation's first national laboratory, Argonne National Laboratory conducts basic and applied scientific research across a wide spectrum of disciplines, ranging from high-energy physics to climatology and biotechnology. Since 1990, Argonne has worked with more than 600 companies and numerous federal agencies and other organizations to help advance America's scientific leadership and prepare the nation for the future. Argonne is managed by the University of Chicago for the U.S. Department of Energy's Office of Science.

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