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DOE Pulse

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Research Highlights . . .

Turning syngas into ethanol

Researchers at DOE's Ames Laboratory are combining an old energy technology with new, nanoscale catalysts to produce ethanol from a variety of sources including crop residue, wood pulp, animal waste and garbage. Gasification is an old method used to convert carbon-based feedstocks under high temperature and pressure in an oxygen-controlled atmosphere into synthesis gas, or syngas, made up primarily of carbon monoxide and hydrogen (more than 85 percent by volume) and smaller quantities of carbon dioxide and methane. To convert the syngas to ethanol, Ames Lab chemist Victor Lin developed nano-scale catalyst particles dispersed widely within the structure of mesoporous nanospheres, maximizing the surface area of the catalyst where the conversion reaction takes place.

[Kerry Gibson, 515.294.1405 kgibson@ameslab.gov]

Improved cancer therapy device

Physicists at DOE's Brookhaven Lab have patented the design of a "medical synchrotron" capable of delivering precision doses of proton radiation to cancerous tumors with minimal damage to surrounding healthy tissue. Unlike conventional x-rays, proton beams deliver cell-killing energy with extreme precision — like surgery, but without a knife. The new device, with more tightly focused beams, would be even more precise than existing proton-therapy systems. It would also be less costly, potentially increasing the availability of this treatment for cancer patients worldwide. The Brookhaven scientists are seeking industrial partners to license and commercialize the technology.

[Mona S. Rowe, 631.344.5056, mrowe@bnl.gov]

Slurry chills vital organs

Recently researchers have begun to develop a new technique that can reduce the brain and other organs' demand for oxygen, giving doctors precious extra time to diagnose and treat critical patients in emergencies. Scientists at the DOE's Argonne National Laboratory have created an ice slurry—a slushy substance that somewhat resembles a 7-11 Slurpee. This slurry can be pumped easily into the body through a small intravenous (IV) catheter directly into a patient's bloodstream. Argonne is working with the several different groups of University of Chicago surgeons to develop procedures for cooling and protecting vital organs. This research is being conducted under a newly formed University of Chicago-Argonne Bioengineering Institute for Advanced Surgery and Endoscopy (BIASE).

[Jared Sagoff, 630/252-5549, jsagoff@anl.gov]

Bright light-dark matter

The Free-Electron Laser at DOE's Jefferson Lab has searched for dark matter in the first demonstration that high-intensity light sources can perform experiments complementary to high-energy particle physics machines. The experiment tested whether a predicted dark matter particle, the axion, could be found using the "light shining through a wall" technique. In the experiment, laser light photons passed through a strong magnetic field, where some photons were predicted to convert into axions. Beyond an aluminum wall, another magnetic field converted any axions back into photons. While no evidence of axions was seen, the result places new limits on theories in particle physics, cosmology and astrophysics.

[Kandice Carter, 757.269.7263, kcarter@jlab.org]

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).

South Carolina teams toward ethanol

To reduce the Southeast's dependence on oil, DOE's Savannah River National Laboratory and its partners in the South Carolina Bioenergy Research Collaborative have undertaken a $1.2 million bioethanol research project to find the best way to produce plant-based fuels in the region. The purpose of the research is to assess the potential of switchgrass and sweet sorghum as "feedstocks" that can be processed into ethanol.

The project includes development of a small-scale biofuel processing plant at Clemson University's Restoration Institute in North Charleston, S.C. The pilot plant is designed to scale up new biofuel technologies, a crucial step between small laboratory experiments and full-scale production. The facility could assist energy producers interested in energy-crop bases in the Southeast to build regional ethanol-production facilities.

Ethanol made from cellulosic feedstocks, such as switchgrass, or agricultural residues such as corn stover, has the potential to reduce greenhouse gas emissions by as much as 86 percent compared to gasoline. Biofuels have the added benefit of providing a "carbon sink."As crops grow to produce the feedstocks for making the biofuel, they absorb carbon dioxide from the atmosphere.

Switchgrass could become a significant source for ethanol fuel produced in South Carolina, producing as much as 800 to 1,000 gallons of ethanol per acre. Even more striking, the energy content—which is the ratio of energy delivered to the customer compared to the fossil energy used—could be as high as 10 for switchgrass, compared with 0.81 for gasoline.

The South Carolina Bioenergy Research Collaborative has been formed to demonstrate the economic feasibility of using plants, such as switchgrass, trees and sorghum, to make ethanol. The collaborative includes scientists at SRNL, Clemson University and South Carolina State University, as well as industrial partners who are committed to building a biofuels-research pilot plant in the state.

Submitted by DOE's Savannah River National Laboratory

ANL RESEARCHERS TWEAK ECONOMIC SIMULATIONS

Macal and colleague

As the stock market continues its dive, economists and business columnists have blamed many factors for the ongoing financial calamity. While their hindsight might be clear as day, researchers at the DOE's Argonne National Laboratory are creating new economic models that will generate more realistic pictures of different types of markets so that policymakers can better avert future economic catastrophe.

Traditional economic models rely heavily on "equilibrium theory," which holds that markets are influenced by countervailing balanced forces.

Because these models assume away the decision-making processes of individual consumers or investors, they do not represent the market's true internal dynamics, said Charles Macal, an Argonne systems scientist.

Macal and his Argonne colleagues have created a new set of simulations called "agent-based models" to better anticipate how markets behave. By gaining a more precise understanding of the behavior patterns of individual actors in a market —for example, how willing they are to accept risk, how strongly they value the future or how much time and effort they are able to spend making decisions—researchers and economists can better predict and avoid future meltdowns.

Agent-based models separately calculate likely decisions for each individual actor in a model, then take the results of these decisions and see what impact they have on other agents. By doing so, they have the potential to foresee a panic, a protracted "hot streak," herd mentality or a number of other market phenomena that purely rational-actor models would tend to miss.

Argonne researchers have valuable experience creating these agent-based models. At the request of the Illinois Commerce Commission, Macal's group generated a model of the Illinois electrical power market. As Illinois prepared to deregulate the electrical power industry in early 2007, policymakers in Springfield asked Argonne's Decision and Information Sciences Division to examine the likely effects of differential pricing of electricity around the state and other issues associated with deregulation.

Macal's expertise in behavioral economics and agent-based modeling also attracted the attention of Procter and Gamble (P&G), one of the world's largest producers of consumer products. P&G asked Macal to use models similar to those he used for the Illinois Commerce Commission in order to anticipate likely trends in consumer behavior. Macal's group used information from P&G's consumer surveys to create simulated shoppers who would react to changes in their marketing strategies and advertising campaigns.

Submitted by DOE's Argonne National Laboratory