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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

By the numbers

How many randomly generated arithmetic problems can a person answer in 60 seconds? Find out by visiting "The ArithmAttack," a free software program offered to children and other arithmetic students around the world by DOE's Argonne National Laboratory. ArithmAttack can be played on the World Wide Web at "http://www.dep.anl.gov/aattack.htm" or downloaded free for use on individual computers. The game randomly creates problems using numbers between 0 and 12. Students or teachers can instruct the game to focus exclusively on addition, subtraction, multiplication, or division, or can let it choose among them at random. The entire program takes up only about 14 kilobytes of memory.

[Donna Jones Pelkie, 630/252-5501, djpelkie@anl.gov]

Turning trash into valuable products

A process developed by researchers at DOE's National Renewable Energy Laboratory turns common organic waste into fuel, energy and other useful products. The high solids anaerobic digester is a closed system that uses naturally occurring microorganisms to convert waste into a fuel gas that is 55 percent methane and 45 percent carbon dioxide. The gas can be used for heat, to run a turbine to generate electricity or as a transportation fuel. The technology, successfully demonstrated at a pilot-scale plant in Stanton, Calif., is capable of generating methane gas at up to 10 times the volume of conventional systems.

[Patrick Summers, 303/275-4050, patrick_summers@nrel.gov]

Hypersonic aircraft

A revolutionary design for a hypersonic aircraft that could fly between any two points on the globe in less than two hours has been developed at DOE's Lawrence Livermore National Laboratory. Called HyperSoar, the craft would fly at approximately 6,700 mph while carrying roughly twice the payload of subsonic aircraft of the same takeoff weight.

A HyperSoar aircraft would boost into space, then coast back to the surface of the Earth's atmosphere, where it would refire its engines and skip back into space. Twenty-five such skips would take the craft from the midwestern U.S. to Japan in 90 minutes, designers estimate.

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Reliable quantum computing

Scientist from DOE's Los Alamos National Laboratory and MIT have shown that a quantum computer can make reliable calculations. Traditional computers use zeroes and ones as bits; a quantum computer instead uses the quantum properties of trapped ions, or qubits. Quantum computers eventually will be much faster at factoring huge numbers, searching databases and encrypting electronic messages. But quantum computers can't correct errors. The Los Alamos team first used repetitive processing to reduce the probability of errors and then used nuclear magnetic resonance to test that reduction by manipulating the atomic spins of the nuclei. This method allows testing of quantum error correction with just three qubits, and demonstrates that errors can be controlled in a quantum computer.

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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).

Researchers find pattern evolution in metals and alloys

For the ninth summer, materials scientist Darcy Hughes spent a month in Denmark with collaborators working on metal microstructure.

Hughes, of DOE's Sandia National Laboratories site in Livermore, Calif., and her research pals met at a scientific conference almost a decade ago, and just four years ago, while working with a Chinese colleague in Denmark, they found a way to more quickly measure the materials' crystalline pattern. This pattern resembles a 3-D mosaic of cells with different crystal orientations.

"We're trying to measure and quantify what we see in a structure," she says, "so we can put it into an equation. We need to capture differences and similarities that influence behavior."

This is important because the process of forming metals changes microcrystalline patterns that impart mechanical properties, such as strength and ductility, to the metal piece. Metalworking to improve grain structure and texture has long been studied and practiced. Eventually, the microstructure might be predicted so that desired material properties can be engineered.

Hughes, who has studied aluminum and aluminum alloys, nickel and nickel- cobalt, copper, iron, and stainless steel (such as that used in gas bottles or table flatware), is entering the third year of a Laboratory-Directed Research and Development grant to study recrystallization of metals in a multiscale materials model.

Part of this work is also being conducted under DOE's Center of Excellence for the Synthesis and Processing of Advanced Materials with Los Alamos, Oak Ridge, and Pacific Northwest national labs.

In Denmark, Hughes works with Qing Liu in a group led by Niels Hansen, head of the materials department at Risø National Lab. She also collaborates with Daryl Chrzan, a former Sandian now working at Lawrence Berkeley National Laboratory at the University of California at Berkeley; John Wert and Doris Kuhlmann-Wilsdorf of the University of Virginia; and Julian Driver of the Ecole Nationale Superieure des Mines de St. Etienne in France.

Submitted by DOE's Sandia National Laboratories

Sandia's Darcy Hughes studies microstructures of metals and alloys.

A POSSIBLE CURE FOR COCAINE ADDICTION

Stephen Dewey, a neuroscientist at DOE's Brookhaven National Laboratory, entered the media spotlight on August 5 as the leader of the team that announced it had found a possible new cure for cocaine addiction.

Reporters clamored for interviews with him, eager to find out how a European epilepsy drug called GVG might also stop addiction to cocaine or other substances from heroin to nicotine. The press conference, Dewey's first, was jammed with TV cameras.

But even as the news hit the air-waves and the headlines, Dewey found himself besieged with requests from another quarter—the families and friends of drug addicts, desperate for anything that would help their loved ones.

Hundreds of letters, e-mails, faxes and phone calls poured in; heart-breaking stories of lives thrown away because of drugs mixed with pleas to sign up daughters, sons and brothers for the first clinical trials of the new therapy. He responded personally to them all.

It's now been over a month since the team of scientists from BNL and several universities published their exciting findings, which capped many years of careful animal studies. And though the first clinical trials will only take a few carefully selected patients, they are close to starting. In several months, they will provide the first indications of whether GVG will work.

Meanwhile, Dewey has returned to his laboratory at Brookhaven's Center for Imaging and Neurosciences, working with others to find out more about how GVG and similar strategies could stop other addictions.

The father of two also finds time to speak at local schools, using the vivid scans of addicts' brains made at BNL to show students the physical damage that using drugs could do to them. It's an ounce of prevention that's worth just as much as the pound of cure he's also working to provide.

Submitted by DOE's Brookhaven National Laboratory