DOE Pulse
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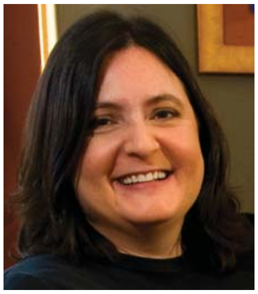

LANL's Kathy Prestridge

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Research Highlights . . .

Visualizing every breath you take

Airflow patterns in the lung not only determine how well you breathe but also how inhaled materials such as airborne pollutants or aerosolized drugs are distributed inside your body. Researchers from the Department of Energy's Pacific Northwest National Laboratory and the University of Utah have pioneered a magnetic resonance imaging method for visualizing inhaled airflow patterns. Developed at DOE's EMSL, a national scientific user facility, the method uses hyperpolarized helium-3 gas as an inert tracer for visualizing inhaled air speed and direction at each location within the complex, three-dimensional airways of pulmonary anatomy. This method provides an opportunity to assess the subtle effects of inhaled pollutants and pesticides.

[Kristin Manke, 509.372.6011, kristin.manke@pnl.gov]

New breast cancer imager/ biopsy system comes online

With help from DOE's Jefferson Lab, a system for detecting and guiding the biopsies of suspicious breast tumors is now in clinical testing at West Virginia University. The first patient was scanned with the device on Feb. 6; and by mid-March, a total of four patients had been scanned. The technology is built on traditional PET imaging, where a drug with a radiation-emitting component is injected into a patient and is then imaged. If a suspected lesion is found, a biopsy is performed with a computer and human-controlled robotic arm. The PEM/PET system was designed and constructed by scientists and engineers from WVU, JLab, the University of Washington and the University of Maryland School of Medicine.

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

Carbon boosts hydrogen production

A team of Savannah River National Laboratory researchers is studying how the relationships between blue-green algae and its environment, particularly nutrients and other bacteria, affect its ability to produce hydrogen that could be collected and used for the nation's energy needs. Results indicate that a carbon "boost" may increase the hydrogen production capacity of many strains. DOE's SRNL examined 10-12 diverse cyanobacterial strains and found that glucose stimulated hydrogen production rates and yield in the majority of strains – as much as a 40-fold increase in yields in some strains. Other carbon sources were also found to increase cyanobacterial hydrogen production. These results support the idea that organic rich waste streams from certain industrial processes could be used to stimulate photobiological hydrogen production.

[Angeline French, 803.725.2854, angeline.french@srnl.doe.gov]

Desalination becoming more affordable

Treating brackish water for human consumption "can be done and be done affordably" in various parts of the U.S., according to Sandia National Laboratories water researcher Mike Hightower. While it used to cost 50 cents per thousand gallons of water to supply freshwater, it now costs $3 to $4 per thousand gallons of water, due largely to the fact that freshwater near cities is generally already being used and utilities frequently have to pump water long distances, he said. Meanwhile, the cost of treating saline and brackish water has decreased to $2 to $3 per thousand gallons for water treated at the ocean and $4 to $6 per thousand gallons for inland treatment.

[Julie Hall, 505.284.7761, jchall@sandia.gov]

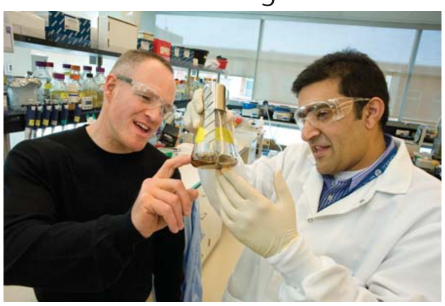
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. *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).

Driving for biofuels: A promising new fermentation microbe

In the drive to derive clean, green, renewable liquid fuels from cellulosic biomass, a critical factor will be finding microbes that can ferment complex sugars in intense heat.

At the same time, these workhorse bugs must not be inhibited by the fuel they produce – the way that the yeast strains used to make wine and beer become poisoned by the alcohol they produce, for example.

One good candidate is the recently discovered extremophile *Geobacillus thermoglucosidasius*, which can ferment the sugars in lignocellulose. Lignocellulose is a matrix of sugars and lignin, the substance that gives strength and structure to plant cell walls; the most abundant organic material on Earth, it's a potential bonanza for biofuel production —provided effective fermentation microbes can be found. Yeast is a no-go: it can't naturally ferment many of lignocellulose's sugars. But measuring the full potential of *G. thermoglucosidasius* for biofuels production required detailed information on its metabolism.

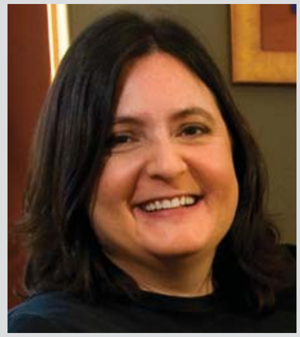


JBEI's Jay Keasling (left) and Rajat Sapra

Jay Keasling of DOE's Lawrence Berkeley National Laboratory, the CEO of the DOE's *Joint BioEnergy Institute (JBEI)* and a world authority on synthetic biology, and his colleagues Rajat Sapra of Sandia National Laboratories, a biochemist who directs the enzyme optimization program at JBEI, and chemical engineer Yinjie Tang of Washington University in St. Louis, have made essential measures of *G. thermoglucosidasius* metabolism via a new experimental route. "Our results show that *G. thermoglucosidasius*, which thrives in the high temperatures and pressures of petroleum reservoirs, can ferment the major C5 and C6 sugars"—for example, xylose and glucose—"in cellulosic biomass and can tolerate high concentrations of ethanol," said Keasling. In addition to Berkeley Lab and Sandia, JBEI, which is one of three DOE Bioenergy Research Centers, includes the Berkeley and Davis campuses of the University of California, the Carnegie Institution for Science, and Lawrence Livermore National Laboratory.

Submitted by DOE's Lawrence Berkeley National Laboratory

LANL's Kathy Prestridge explores fluid instabilities



Kathy Prestridge

Kathy Prestridge sees her work at DOE's Los Alamos National Laboratory as an exciting learning experience. "There is a lot of interesting science going on here, and I enjoy working with a technically diverse group of people," she says.

Prestridge is the principal investigator in LANL's Gas Shock Tube Project. "We study fluid instabilities and turbulent mixing in shock-driven flows, and our team has made the first simultaneous velocity and density field measurements in these flows," she says. "The main diagnostics that we use are Particle Image Velocimetry (PIV) and Planar Laser Induced Fluorescence (PLIF) to get the velocity and density fields instantaneously and in two dimensions. We can then take averages over multiple experiments and calculate the mean and fluctuating density and velocity quantities."

These quantities have never before been measured experimentally, and this year, Prestridge and her team are working on developing a stereo PIV system to measure all three components of the velocity field. The experimental data are valuable for understanding the nature of mixing, the impact of initial conditions on unsteady turbulence, and to aid the validation and calibration of turbulence mixing models used in simulations, she says.

The group also is involved in a Laboratory Directed Research and Development–Directed Research (LDRD-DR) project, "Turbulence by Design," that studies the impact of initial conditions on the evolution to turbulence of shock-driven flows. It incorporates theory, the group's experiments, and numerical modeling to understand and potentially control turbulence in Rayleigh-Taylor and Richtmyer-Meshkov flows.

Prestridge holds a bachelor's degree in aerospace engineering from Princeton University and a doctorate in applied mechanics from the University of California, San Diego. She won the Postdoctoral Publication Prize in Experimental Sciences in 2000 and was named a LANL Star in 2008 for her technical work and her achievements as a mentor, project leader, and deputy group leader.—*Tatjana K. Rosev*

Submitted by DOE's Los Alamos National Laboratory