DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Delivering a dose of hope

Brain cancer patients at Switzerland's University Hospital are receiving a new cancer therapy that relies on waste from DOE's Hanford Site. Through a process patented at DOE's Pacific Northwest National Laboratory, an ultra-pure form of the medical isotope yttrium-90 is being extracted from strontium-90 for treatment of a variety of cancers. In this Phase 1 clinical trial, patients receive an injection of yttrium-90 linked to specially engineered peptides, which seek and bind to brain tumor cells. The therapy delivers a high dose of radiation to cancer cells while minimizing impacts to healthy tissue, causes few side effects and can be administered on an outpatient basis. Trial results are expected this summer.

[Dawn White, 509/375-3688, dawn.white@pnl.gov]

Fire detection system uses infrared light

Inventors at DOE's Jefferson Lab have patented a new type of fire detection system that detects the early start of a fire using infrared light to detect combustion products before visible flame and smoke appear. The new system can be used in many different applications. For example, if dissimilar materials that have different extinguishing requirements are stored in the same location, this system could detect which material is burning and expel the correct agent to extinguish the fire. Other applications include those where the protection of high-value or mission critical facilities such as in a museum is a priority.

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Improved shielding calculations for cancer treatment rooms

Hospital radiation rooms for cancer patients are expensive in part because imprecise measurements for stray radiation force hospitals to take a conservative approach for shielding. Hospitals are also faced with more stringent standards about allowable dose rates for staff and visitors. DOE's Stanford Linear Accelerator Center is partnering with Varian Associates to use SLAC's expertise in radiation transport modeling with Varian's expertise in the construction of radiotherapy accelerators. General results will aid the medical physics community to design more cost-effective radiotherapy rooms. Results will also be useful to other DOE facilities by reducing shielding costs.

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Sandia, Intel team toward hardened microprocessors

Intel is providing a no-fee license for the design of its Pentium® processor, which can run more software than any other chip ever designed, to DOE's Sandia National Laboratories for the development of custom, radiation-hardened microprocessors for U.S. space and defense purposes. The agreement saves U.S. taxpayers hundreds of millions of dollars in design costs and provides the federal government with a 10-fold increase in processing power over current radiation-hardened microchips. The agreement highlights a long-standing Intel-Sandia relationship in the development of advanced technologies, including the world's first teraflops computer. DOE, NASA's Jet Propulsion Lab, and the National Reconnaissance Office are already in line to use the rad-hardened chip.

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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).

Raising the standards for thin-film photovoltaics

Thanks to a team of researchers at DOE's National Renewable Energy Laboratory, photovoltaic technology took a step forward with a new world record for converting sunlight into electricity using a thin-film solar cell. The copper indium gallium diselenide (CIS) cell is 18.8 percent efficient.

NREL's Miguel Contreras uses a physical vapor deposition system to make high efficiency copper indium gallium diselenide solar cells.

NREL's CIS team in the National Center for Photovoltaics (NCPV) topped its previous world record by more than one percent. The NCPV links staff expertise and state-of-the-art research facilities at NREL and Sandia National Laboratories with solar programs at dozens of university and industry research partners across the nation.

NREL's effort was led by Senior Scientist Miguel Contreras with support from Kannan Ramanathan, James Keane, Brian Egaas, Falah Hasoon, James Dolan, Jeff Alleman, Holm Wiesner and Rommel Noufi, team leader.

"This marks a new high for polycrystalline thin-films. The cell's record breaking efficiency demonstrates to the photovoltaic industry the great potential thin-films have for terrestrial and space applications," Noufi said. "Each increase in efficiency translates into lower costs in the foreseeable future for harnessing energy from the sun. The cell's excellent performance also is significant for space applications, where high efficiency, light-weight power sources are essential."

Thin-film photovoltaics use very thin layers of semiconductor material applied to a low cost backing such as glass or flexible plastic or stainless steel. CIS thin-film technology in particular demonstrates remarkable outdoor reliability and stable conversion efficiencies over time.

DOE created the NCPV in 1996 to provide a focal point for technology development and information about photovoltaics in the United States. NREL's Larry Kazmerski was selected in November to lead the NCPV after a 21-year research career at the lab. The center, which is housed at NREL, helps the nationís photovoltaics industry improve the cost-effectiveness, performance and reliability of its products.

Researchers at Sandia National Laboratories work with industry to accelerate the development of silicon solar cells and balance-of-system components. Sandiaís Photovoltaic Systems Assistance Center provides technical information and assistance with the design of photovoltaic power systems.

Submitted by DOE's National Renewable Energy Laboratory

BERKELEY LAB MATHEMATICIAN TACKLES THE BURNING ISSUES OF COMBUSTION

Mathematicians aren't typically associated with solving burning questions, but Phillip Colella of DOE's Lawrence Berkeley National Laboratory is helping fuel DOE efforts to expand computational research in the area of combustion. Colella's Applied Numerical Algorithms Group at the National Energy Research Scientific Computing Center (NERSC) is creating more accurate computer models of the diesel combustion process aimed at increasing fuel efficiency and reducing emissions.

The internal combustion engine is a hot, dirty environment for conducting experiments. Making small changes in the valves, cylinder head or piston to influence the combustion process can be expensive and time consuming. Computer models can give researchers a virtual look into the complicated process of fuel and air intake, combustion and exhaust. Currently, combustion models can't entirely predict the combustion within an engine, but they are getting closer.

"It's a complicated problem involving computer science, mathematics and physics," Colella said. "The simulations have to respect the mathematics and physics involved, yet be easy to use."

Colella's group is working with two of the nation's leading vehicle manufacturers to develop more accurate combustion models. These models will require even greater computing resources, such as the 640-processor Cray T3E-900 supercomputer housed in NERSC at Berkeley Lab. Those models are then compared with experimental data, matching predictions with actual results.

"Applying more computing power will allow us to incorporate more details and create better models," Colella says. "You can't just throw bigger computers at the existing models, though. You have to create better models."

Last November, Colella received the IEEE Computer Society's 1998 Sidney Fernbach Award, given each year to one person who has made "an outstanding contribution in the application of high performance computers using innovative approaches." Born in New York, Colella moved west to attend UC Berkeley, where he earned his bachelor's, master's and doctorate degrees in mathematics.

Submitted by DOE's Lawrence Berkeley National Laboratory