# Story tips from the Department of Energy's Oak Ridge National Laboratory -- December 2009

EurekAlert

**SOLAR -- Bridging the gap . . .**

Titanium dioxide, the same inexpensive white pigment that protects us from sunburns, can be converted into a material that absorbs sunlight and could greatly increase the efficiency of solar energy cells. Until now, however, researchers had not been able to overcome the inherent wide band gap associated with the different energy levels, or bands, of the electrons. This limits the material to absorbing only ultraviolet light and results in less than 1 percent conversion efficiency. In a paper published by a multi-institutional team that includes theorist Zhenyu Zhang and experimentalist Gyula Eres of Oak Ridge National Laboratory, the researchers report on a conceptually novel doping method that can tune the band gap of titanium oxide to capture the more abundant visible component of the solar spectrum. This innovation to a large extent removes what has been a major materials barrier to the better utilization of the sun's energy and, in terms of cost and efficiency, has huge implications for future solar cells. This research, published in *Physical Review Letters*, was funded by the Department of Energy's Office of Basic Energy Sciences and the Laboratory Directed Research and Development program. [Contact: Ron Walli, (865) 576-0226; wallira@ornl.gov [1]]

**NUCLEAR ENERGY-- Record fuel burn . . .**

Coated particle fuel fabricated at Oak Ridge National Laboratory, in cooperation with Idaho National Laboratory, General Atomics, and the Babcock & Wilcox Company, has set a world record for advanced high temperature gas-cooled reactor fuel. In recent tests at INL's Advanced Test Reactor, the ORNL fuel achieved a 19 percent burn-up, double the previous world record and more than three times the rate of standard nuclear fuel at U.S. power plants. Robust fuel performance is a major key to enabling the operation of advanced gas-cooled reactors, which offer more efficient operation, less waste disposal, lower proliferation risks, and other benefits over water-cooled reactor designs now used at U.S. nuclear power plants. The fuel work, conducted in ORNL's Materials Science and Technology Division, is funded by DOE's Office of Nuclear Energy as part of the Department of Energy's Next Generation Nuclear Power Plant project. ORNL and INL scientists will now conduct post irradiation examination of the fuel to check the fuel for degradation, safety performance under simulated accident conditions, and other characteristics to better understand the relationship between the fuel fabrication process, fuel product properties and in-reactor performance. [Contact: Mike Bradley, (865) 576-9553; bradleymk@ornl.gov [2]]

**PHYSICS ? Exploiting strain fields . . .**

Electronic devices of the future may benefit from a fundamental discovery that allows researchers to customize the electronic properties of complex materials such as single-crystal thin-film structures. In a letter published in *Nature Physics*, lead author Thomas "Zac" Ward of Oak Ridge National Laboratory describes how electronic phase separation can be controlled through strain fields in a material. A strain field is one in which the material is stretched more in one direction than another. "By doing this, we can force metallic regions to spontaneously form along the direction of stretching," Ward said. "This means that along the stretched direction the resistance is low while along the unstretched direction the resistance is very high." Ward and co-authors John Budai, Zheng Gai, Jonathan Tischler, Lifeng Yin and Jian Shen cite differences in resistivity in some cases reaching 20,000 percent. "Practically, this discovery means that we are closer to controlling complex electronic correlations that could one day revolutionize the electronics industry in the form of new multi-functional, lower energy-consuming devices," Ward said. This research was funded by the Department of Energy's Office of Basic Energy Sciences. [Contact: Ron Walli, (865) 576-0226; wallira@ornl.gov [1]]

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