Magnet Lab to Investigate Promising Superconductor

October 13 2009

(PhysOrg.com) -- The Applied Superconductivity Center at the National High Magnetic Field Laboratory has received $1.2 million in funding from the U.S. Department of Energy to understand and enhance a new form of superconducting material that could be used to build more-powerful magnets used in a wide range of scientific research.

The grant is part of a larger $4 million award over two years to a collaboration -- the Very High Field Superconducting Magnet Collaboration -- for which David C. Larbalestier, the magnet lab's chief materials scientist and director of the Applied Superconductivity Center, and Alvin Tollestrup of Fermilab are the project leaders.

Superconductivity is a phenomenon observed in several materials. When cooled to extremely low temperatures, superconductors have no electrical resistance, meaning electrons can travel through them freely. Because of this, superconducting materials can carry large amounts of electrical current for long periods of time without losing energy as heat.

The DOE funds will enable Larbalestier, Eric Hellstrom, Jianyi Jiang, Ulf Trociewitz and others at the magnet lab to investigate a complex superconducting material with the unwieldy name of bismuth strontium calcium copper oxide, or BSCCO-2212.

This material is unique among all of the so-called high-temperature superconductors because it can be made into round wires, a form that is much more flexible for making magnets. The goal of the new magnet lab research is to thoroughly understand BSCCO-2212's performance limits and to construct superconducting research magnets far more powerful than those currently made with niobium-based materials. (Bismuth and niobium are both metals that exhibit superconducting properties when exposed to extremely low temperatures.)

"This material is very promising, but it's very complex and not very strong," Larbalestier said. "The DOE has entrusted us with the funds to make a broad U.S. collaboration that directly addresses both the fundamental processing and grain boundary science of these fascinating materials and their application to new generations of magnets, both at the magnet lab and in the DOE high-energy physics laboratories."

Developing higher-field superconducting magnets would transform high-field research, significantly reducing the costs to operate the magnets. Non-superconducting electromagnets, called resistive magnets, consume massive amounts of electricity. At the magnet lab, the average cost to run a resistive magnet is $774 per hour -- 40 times more than a 20-tesla superconducting magnet, because once a superconducting magnet is brought to full field, it can operate perpetually. That would allow scientists to remain at high fields for hours and even days, since operating costs would be dramatically lower than they are now.

The other institutions participating in the collaboration are Brookhaven National Laboratory, Fermilab, Lawrence Berkeley National Laboratory, Los Alamos National Laboratory, the National Institute of Standards and Technology, and Texas A&M University.

Traditional, niobium-based superconducting materials cannot generate magnetic fields above about 24 tesla, but in October 2008, magnet lab engineers constructed a BSCCO-2212 test coil that achieved 32 tesla. (Tesla is the scientific unit of measure of magnetic field strength; 32 tesla is more than 3,000 times stronger than a refrigerator magnet.)

“This collaboration provides major DOE support toward a central goal of the National Science Foundation,” Larbalestier said. “It’s a great example of multiple stakeholders working together to push high field magnet development to the next level.”

More information: www.magnet.fsu.edu/magnettechn … ch/asc/overview.html

Provided by Florida State University (news : web)