New World Record For Superconducting Magnet Set

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A collaboration between the National High Magnetic Field Laboratory at Florida State University and industry partner SuperPower Inc. has led to a new world record for a magnetic field created by a superconducting magnet.

The new record -- 26.8 tesla -- was reached in late July at the magnet lab's High Field Test Facility and brings engineers closer to realizing the National Research Council goal of creating a 30-tesla superconducting magnet. The development of such a magnet could lead to great advances in physics, biology and chemistry research, as well as significant reductions in the operating costs of many high-field magnets.

The world-record magnet's test coil was wound by Schenectady, N.Y.-based SuperPower (www.superpower-inc.com) with a well-known, high-temperature superconductor called yttrium barium copper oxide, or YBCO. SuperPower develops superconductors such as YBCO and related technologies for the electric power industry. The magnet lab's Applied Superconductivity Center has worked with the company to determine the superconducting and mechanical properties of YBCO and other materials.

"This test demonstrates what we had long hoped -- that YBCO high-temperature superconductors being made now for electric utility applications also have great potential for high-magnetic-field technology," said David Larbalestier, director of the Applied Superconductivity Center and chief materials scientist at the magnet lab.

“It seems likely that this conductor technology can be used to make all-superconducting magnets with fields that will soon exceed 30 tesla. This far exceeds the 22- to 23-tesla limit of all previous niobium-based superconducting magnets.” (Niobium is the material used to build most superconducting magnets.)

Venkat Selvamanickam, vice president and chief technology officer at SuperPower, said the YBCO wire’s potential for application outside the electric power industry has long been in the company’s sights.

“We are encouraged by the results of these tests at the magnet lab and look forward to continuing our collaboration to more completely explore the additional possibilities in high field applications,” Selvamanickam said.

Scientists have been aware of the amazing properties of YBCO and its potential for magnet technology for 20 years, but only in the past two years has the material become commercially available in the long lengths needed for magnets. Scientists at the magnet lab are interested in the material because at very low temperatures, the conductor is capable of generating very high magnetic fields.

“In principle, YBCO is capable of producing the highest-field superconducting magnets ever possible,” said W. Denis Markiewicz, a scientist in the lab’s Magnet Science & Technology division. Based on the potential of the material, he said, it’s even possible that it could one day produce magnetic fields as high as 50 tesla.

“What we learned from this test really opens the door to imagining that one day we could use superconducting magnets in place of our resistive magnets,” he said.

Resistive magnets, primarily used for physics research, are more costly

to operate because they are powered by tremendous amounts of electricity, while superconducting magnets require little or no electrical power to run once they are brought up to full field. The magnet lab's annual utility costs to run the magnets are close to $4 million, and the lab consumes 10 percent of the city of Tallahassee's generating capacity.

The National High Magnetic Field Laboratory develops and operates state-of-the-art, high-magnetic-field facilities that faculty and visiting scientists and engineers use for research. The laboratory is sponsored by the National Science Foundation and the state of Florida. To learn more, visit www.magnet.fsu.edu.

SuperPower is a world leader in developing commercially feasible second-generation high-temperature superconductors and related devices designed to enhance the capacity, reliability and quality of electric power transmission and distribution.

Source: FSU