Extra September, 2010 Date of Issue: September 1, 2010

超電導 Web21 Superconductivity

Superconductivity Web21

Published by International Superconductivity Technology Center
1-10-13 Shinonome Koto-ku, Tokyo 135-0062, Japan Tel:+81-3-3536-7283, Fax:+81-3-3536-7318

What's New in the World of Superconductivity (July, 2010)

Akihiko Tsutai, Director
International Affairs Division, ISTEC

Power

Niels Bohr Institute (July 8, 2010)

A group of researchers from the University of Augsburg (Germany), the University of Florida, and the Niels Bohr Institute (University of Copenhagen, Denmark) have created a theoretical model explaining the effects of microscopic defects in superconductors. As a result of this theoretical work, the researchers were able to determine that the accumulation of electrical charge at the boundary between different misoriented crystal axes is the main cause of drastic drops in electrical current. Such theoretical understanding is expected to serve as a foundation for future research on methods of improving the transport of energy in copper oxide materials. The group's work has been published in *Nature Physics.*

Source:
"Improvement of superconductors within reach"
Niels Bohr Institute press release (July 8, 2010)
http://www.nbi.ku.dk/english/news/news10/improvement_of_superconductors/

University of Cambridge (July 9, 2010)

Using new techniques to manufacture large single grains of YBCO bulk superconductors, engineers at the University of Cambridge have produced samples capable of carrying record electrical currents (for the sample's type and size). The new techniques involved heating the initial material to a temperature of 1,000 °C, causing it to melt partially, and adding various elements, such as depleted uranium, to generate artificial flux pinning sites within the single grain. The group has also patented a new type of seed crystal that can be used to fabricate large, single grains of bulk superconductors in air; this technique allows the partial-melt process to be optimized in a variety of ways. Together, these techniques have enabled the production of samples with record energy densities and magnetic fields for their size. The research is expected to represent a step toward the development of powerful samples that can be manufactured using a commercially compatible process, thereby reducing the production costs for applications such as MRI scanners and fault current limiters.

Source:
"Superconductor breakthrough could power new advances"
University of Cambridge press release (July 9, 2010)
http://www.admin.cam.ac.uk/news/dp/2010070901

Nexans (July 27, 2010)

Nexans has successfully tested the world's first HVDC HTS power transmission cable designed for use at 200 kV. The testing of the cable and a termination, which including operation at 360 kV (1.8 times the 200 kV operating voltage) for a several-hour period, was completed at the Nexans high voltage laboratory

in Germany. The cable was also subjected to superimposed overvoltages, such as may occur during lightning or switching events, without encountering any difficulties. The successful testing of this cable represents an important step in demonstrating the capability of underground HVDC HTS cables for the transfer of gigawatt levels of power required by supergrid projects, such as the Tres Amigas renewable energy market hub in the U.S. Next, Nexans plans to further adapt this HTS cable system so that it is capable of carrying very high currents (up to 12,500 A). The company also plans to develop cable joints that will enable the installation of long lengths of HTS cable or allow repairs.
Source:
"Nexans completes successful test of world's first HVDC superconducting power transmission system"
Nexans press release (July 27, 2010)
http://www.nexans.com/eservice/Corporate-en/navigatepub_142482_-26633_297_40_2579/Nexans_completes_successful_test_of_world_s_first_.html

American Superconductor Corporation (July 29, 2010)

American Superconductor Corporation (AMSC) has reported its financial results for the first quarter of fiscal 2010, ending June 30, 2010. The company reported revenues for the first quarter totalling $97.2 million, representing a 33 % increase from the $73.0 million reported for the first quarter of the previous fiscal year. The gross margin for the first quarter was 40.1 %, compared with 30.9 % for the same period in the previous fiscal year. The net income for the first quarter was $9.2 million, compared with $1.8 million for the same period in the previous fiscal year. The Non-GAAP income was $13.0 million, compared with $5.5 million for the same period in the previous fiscal year. Greg Yurek, AMSC's chief executive officer, commented, "American Superconductor has achieved six consecutive quarters of rapid, profitable growth, and we are now well positioned to exceed our original forecasts for revenues and earnings for full fiscal 2010. We achieved a record level of backlog in our first quarter, which gives us very good visibility to continued profitable growth over the next several years. The bulk of our sales during this period are expected to continue to be to Asian wind turbine manufacturers who are building out capacity to meet increased domestic demand and who are also preparing to export wind turbines to Western markets. We also expect our sales to customers in Western countries to start ramping significantly during that time." As of June 30, 2010, AMSC had $120.7 million in cash, cash equivalents, marketable securities and restricted cash and a reported backlog of approximately $952 million.
Source:
"AMSC Reports First Quarter Fiscal Year 2010 Financial Results"
American Superconductor Corporation press release (July 29, 2010)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1453649&highlight

Magnet

Oxford Instruments (July 13, 2010)

Oxford Instruments has received two orders, one from the High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory in the U.S. and one from the Australian Nuclear Science and Technology Organization (ANSTO), for high-field superconducting magnets utilizing Oxford Instruments' helium recondensing cryostat technology. The recondensing technology used by these cryostats enables a considerable reduction in helium consumption, while allowing the stringent magnet designs required by neutron scattering applications to be met. Oxford Instruments has installed four similar systems at two other neutron scattering facilities in the past year.

Source:
"Superconducting magnet orders"
Oxford Instruments press release (July 13, 2010)
http://www.oxford-instruments.com/news/Pages/news.aspx

Basic

National Institute of Standards and Technology (July 8, 2010)

Scientists at JILA working together with Italian theorists have discovered an interesting similarity between ultracold atomic gases and high-temperature superconductors, suggesting that the behaviors of these two very different systems may be attributable to a common explanation. These research efforts provide further evidence that studies on superfluidity (flow with zero friction) in atomic gases may help to explain the more complicated mechanism of superconductivity in high-temperature superconductors. Specifically, the researchers used an adaptation of photoemission spectroscopy to study how atoms in a Fermi gas behave when they "cross over" from acting like a Bose Einstein condensate (in which the atom pairs form tightly bound molecules) to behaving like the pairs of separated electrons that are observed during superconductivity. Similar to previous observations in superconductors, the JILA team obtained evidence of atom pairing above the critical temperature required for superfluidity, demonstrating the existence of a "pseudo-gap region" where the system retains some pairs of correlated fermions but does not exhibit all the characteristics of superfluidity. The group's work has been published in *Nature Physics*.

Source:
"JILA team finds new parallel between cold gases and 'hot' superconductors"
National Institute of Standards and Technology press release (July 8, 2010)
http://www.nist.gov/physlab/div848/jila_070610.cfm

Binghamton University and Brookhaven National Laboratory (July 14, 2010)

A group of researchers from Binghamton University, Cornell University, the Brookhaven National Laboratory, the University of Tokyo (Japan), the Advanced Institute of Science and Technology (Korea), the RIKEN Laboratory (Japan), and Japan's Institute of Advanced Industrial Science and Technology have discovered a difference in the behaviors of electrons at two distinct oxygen-atom sites within each copper-oxide unit of a high-temperature superconductor. This difference in behaviors appears to be a specific property of the non-superconducting pseudogap phase. Using spectroscopic imaging scanning tunneling microscopy, the group measured the relative ease with which electrons could jump from the surface of an individual copper and oxygen site to the tip of the microscope needle. The researchers observed that the number of electrons able to "tunnel" to the microscope tip differed according to the position of the oxygen atom relative to the copper atom. Understanding this asymmetrical behavior may lead to breakthroughs in our ability to control high-temperature superconductors. As part of the group's efforts, some members worked to establish new theoretical approaches to help explain the observed electron behavior. The group plans to continue studying the pseudogap by examining similar asymmetries in other copper-oxide superconductors and will attempt to determine how directional asymmetry in electronic behavior affects the flow of electrons, how this directional dependence might inhibit superconductors, and eventually how such obstacles can be overcome, thereby enabling high-temperature superconductors capable of functioning at warmer temperatures. The group's research has been published in *Nature* of July 15, 2010.

Sources:

"New superconductor research may solve key problem in physics"

Binghamton University press release (July 14, 2010)

http://www2.binghamton.edu/news/news-releases/news-release.html?id=1024

"Key advance in understanding 'pseudogap' phase in high-T_c superconductors"

Brookhaven National Laboratory press release (July 14, 2010)

http://www.bnl.gov/bnlweb/pubaf/pr/PR_display.asp?prID=1155

Rice University (July 28, 2010)

Researchers at Rice University, in collaboration with German and Austrian physicists, have reported an unexpected simple "scaling" behavior in electronic excitations measured in a magnetic heavy-fermion metal ($YbRh_2Si_2$, or YRS), providing direct evidence of the large-scale electronic consequences of "quantum critical" effects. In YRS, the transition from one quantum phase to another, also known as the 'tipping point', is marked by a flip between magnetic and nonmagnetic states. When YRS is cooled to a temperature near absolute zero and the applied magnetic field is adjusted, the points along the magnetic continuum that mark the onset and end of the collapse of the Fermi-volume (representing the combined momenta, or wavelengths, of all the electrons in a crystalline solid) can be identified. In the present study, this method was systematically applied over a broad range of temperature and magnetic field settings. The resulting observations confirmed that the Fermi-volume change is robust and occurs in basically the same manner even in different types of samples. Furthermore, when the cross-over width (the distance between the beginning and ending points of the Fermi-volume change) was plotted as a function of temperature, a straight line passing through the origin was obtained. Qimiao Si, a physicist at Rice, commented, "The linear dependence of the Fermi-volume crossover width on the temperature reveals particular quantum-critical scaling properties regarding the electronic excitations. It is striking that the electronic scaling is so robust at a magnetic quantum critical point." Si added, "…these results provide further support to the idea that correlated electron effects—including high-temperature superconductivity—arise out of quantum critical points." The group's research was reported in the *Proceedings of the National Academy of Sciences*.

Source:

"Quantum fractals at the border of magnetism"

Rice University press release (July 28, 2010)

http://www.media.rice.edu/media/NewsBot.asp?MODE=VIEW&ID=14560&SnID=1613823214

Top of Superconductivity Web21