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What's New in the World of Superconductivity (July, 2011)

Shinya Hasuo, Director
Superconductivity Research Laboratory, ISTEC

Wire

Zenergy Power plc (July 26, 2011)

Zenergy Power has announced further progress in its development of second-generation HTS wire plus the award of a new €3.5 million grant to be used for the improvement and up-scaling of its continuous (reel-to-reel) chemical deposition process for the manufacturing of second-generation HTS wire. Using this method, Zenergy is now consistently producing 100-meter lengths of second-generation wire with a quality sufficient for use in Zenergy's magnetic billet heaters and fault current limiters. The grant from the German Federal Ministry of Economics and Technology (BMWi) will be used for further improvements to the wire and the development of the online monitoring, standardization and quality control techniques that are required for future mass manufacturing. The total cost of this project is estimated to be €6 million, and the project is expected to take up to 3 years to complete.

Source: "2G HTS wire performance progress and €3.5m grant from German Government"
Zenergy Power plc press release (July 26, 2011)
http://www.zenergypower.com/images/press_releases/2011/2011-07-26-2g-performance-progress-and-grant-from-german-government.pdf

Award

Air Products (July 7, 2011)

Air Products has won the "Innovation for Growth 2010" award as part of the Royal Philips Electronics Supplier Awards program for its efforts in collaboration with Philips to reduce helium use at Philips' manufacturing facility in Latham, New York. Through this collaboration, Philips was able to benefit from an operations and cost standpoint, while Air Products was able to retain a satisfied customer. This successful collaboration is expected to enable Air Products to grow its helium business beyond that of superconducting magnetic resonance imaging (MRI) applications and to increase demand in several other product markets. Air Products and Philips are also making further investments into the MRI manufacturing process to construct new equipment that will enhance helium recovery and recycling processes within the factory. Once operational (in the summer of 2012), this equipment will significantly reduce the amount of helium purchased by Philips. In selecting the winner of the above-mentioned prize, Philips noted that "…in a tough market situation with strong upward helium price pressure, Air Products worked together with Philips to mitigate this price pressure by restructuring the Latham Factory operations and investing in new equipment, resulting in the significant reduction in helium consumption."

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Source: "Air Products Wins Royal Philips Electronics Supplier Award"
Air Products press release (July 7, 2011)

Settlement

American Superconductor Corporation (July 11, 2011)

American Superconductor Corporation (AMSC) has announced that its financial statements for the fiscal quarters ending September 30, 2010, and December 31, 2010, can no longer be relied upon, as AMSC has determined that revenues associated with unpaid shipments to Chinese customers (excluding Sinovel Wind Group Co., Ltd.) after August 31, 2010, should not be recognized until AMSC is paid or payment for such shipments can be reasonably assured. Regarding Sinovel, AMSC has determined that a cash-based method of accounting should have been applied to shipments made after September 30, 2010. AMSC had previously recognized revenues in the second and third fiscal quarters based upon customer receipt of shipments but prior to the actual receipt of payment for such shipments. No shipments to Sinovel and no payments from Sinovel were made during the first quarter of fiscal 2011.
As a result, AMSC now expects that its revenues for the fiscal quarters ending September 30, 2010, and December 31, 2010, will be reduced to approximately $98 million and $43 million, respectively. For the fiscal year ending March 31, 2011, the expected revenue is approximately $307 million. These amounts are subject to further adjustment pending financial restatements and auditing.

Source: "American Superconductor to Restate Financial Statements for Second and Third Quarters of Fiscal 2010"
American Superconductor Corporation press release (July 11, 2011)

Electronics

HYPRES (July 7, 2011)

HYPRES Inc. has received approval from the U.S. General Services Administration (GSA) to offer its digital superconductor integrated circuits. These circuits, which operate at clock speeds of 20 – 30 GHz, are the fastest digital circuits in the world and can realize extreme performance benefits as a result of their unparalleled sensor and computing capabilities. HYPRES is now offering its high-density, niobium-based digital superconductor integrated circuits, which can feature more than 12,000 Josephson junctions per standard chip, through GSA Advantage!® The GSA provides centralized procurement for the U.S. federal government, offering products, services, and facilities that federal agencies need to serve the public.

Source: "HYPRES Earns Status as GSA Vendor for Digital Superconductor ICS"
HYPRES press release (July 7, 2011)

Quantum Computing

National Institute of Standards and Technology (July 6, 2011)

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Scientists at the National Institute of Standards and Technology (NIST) have demonstrated a flexible, broadly applicable technique for steadily reducing the vibrations of an engineered mechanical object down to a quantum "ground state", representing the lowest possible energy level. Using a microscopic aluminum drum made of about 1 trillion atoms, the beating motion of the drum was nearly stopped by placing it in an environment governed by quantum mechanics with an energy level below that of a single quantum. The pressure of microwave radiation was used to calm the motion of the drum, which was embedded in a superconducting circuit. This circuit is designed so that the drum motion influences the microwaves inside an electromagnetic cavity. The cooling method takes advantage of the microwave light's tendency to change frequency so as to match the frequency at which the cavity naturally resonates. The NIST drum has a high quality factor, meaning that individual packets of energy can be stored long enough to enable the device to serve as a temporary memory for a quantum computer. Together, the drum and cooling technique promise the development of new machinery for quantum computing and tests of quantum theory. The results were described in *Nature* in a paper posted online.

Source: "NIST mechanical micro-drum cooled to quantum ground state"
National Institute of Standards and Technology press release (July 6, 2011)
http://www.nist.gov/pml/quantum/drum-070611.cfm

Basic

National Institute of Standards and Technology (July 7, 2011)

Scientists at the National Institute of Standards and Technology (NIST) have created a tunable superconducting circuit on a chip that can place a single microwave photon in two frequencies, or colors, at the same time. This "superposition" (a hallmark of the quantum world) is a chip-scale, microwave version of a common beam-splitting optics experiment. The new circuit can be used to create and manipulate different quantum states, acting as a prototype for an "optics table on a chip." The circuit combines components used in superconducting quantum computing experiments: a single photon source, a cavity that naturally resonates or vibrates at particular frequencies, and a SQUID coupling device. The SQUID is tuned so as to couple two resonant frequencies of the cavity, and a photon is then manipulated to make it oscillate between different superpositions of the two frequencies. This experimental setup traps photons in a "box" (the cavity) instead of sending them flying across an optical table. José Aumentado, a physicist at NIST, explains, "This is a new way to manipulate microwave quantum states trapped in a box. The reason this is exciting is it's already technically feasible to produce interesting quantum states in chip-scale devices such as superconducting resonators, and now we can manipulate these states just as in traditional optics setups." The group's results have been described in *Nature Physics*.

Source: "NIST prototype 'optics table on a chip' places microwave photon in 2 colors at once"
National Institute of Standards and Technology press release (July 7, 2011)
http://www.nist.gov/pml/optoelectronics/table-070611.cfm

Lawrence Berkeley National Laboratory (July 14, 2011)

Researchers at Lawrence Berkeley National Laboratory (Berkeley Lab), in collaboration with the University of Colorado at Boulder and Argonne National Laboratory, have discovered that a special

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manganese oxide, or manganite, can change its stripes—regions where a material's electrical charges become concentrated. Materials with such stripes are known as correlated-electron materials and include many high-temperature superconductors with a layered crystal structure. The researchers used angle-resolved photoelectron spectroscopy (ARPES), performed at Berkeley Lab's Advanced Light Source, to demonstrate this surprising new feature in lanthanum strontium manganese oxide. At the right temperature, the material can change its stripes from a fluctuating to a static state and back again. This ability allows the material to switch from a metal to an insulator, a material phase that is known as fluctuating bi-stripes. The ability to turn the conductivity of a properly doped bilayer manganite on and off just by adjusting the temperature a few degrees is very promising: the bi-stripes act like electronic valves and could be used to tune various materials, possibly even high-temperature superconductors, by altering the material's stripe structure. Such advances, however, will require a deeper understanding of the physics of highly correlated materials. The group's findings were published in the *Proceedings of the National Academy of Sciences*.

Source: "A manganite changes its stripes"
Lawrence Berkeley National Laboratory press release (July 14, 2011)
http://newscenter.lbl.gov/feature-stories/2011/07/14/manganite-stripes/

X-ray camera

Science and Technology Facilities Council (July 27, 2011)

The U.K. Science and Technology Facilities Council (STFC) has announced the development of an innovative X-ray camera capable of recording bursts of images at an unprecedented speed of 4.5 million frames per second. The camera will be delivered in 2012 to the European X-ray Free-Electron Laser (XFEL) facility presently under construction in Hamburg, Germany. The European XFEL is a 2-mile long facility that will use superconducting accelerator technology to accelerate electrons, generating X-ray flashes that are a billion times brighter than those produced by conventional X-ray sources. These short, intense flashes will make it possible, for example, to obtain three-dimensional X-ray images of single molecules. Once the facility opens in 2015, the specially designed X-ray camera being developed at STFC will be used for drug discovery and other vital research.

Source: "New X-ray camera will reveal big secrets about how chemistry works"
Science and Technology Facilities Council press release (July 27, 2011)

Accelerator

U.S. Department of Energy (July 25, 2011)

The U.S. Department of Energy (DOE) and the Indian Department of Atomic Energy (DAE) have partnered together to help advance scientific discovery in the field of accelerator and particle detector research. The agreement will build on a long history of cooperation between the parties and will leverage scientific, technical, and engineering expertise to facilitate basic science R&D. Specifically, the agreement aims to expand research collaborations in superconducting radiofrequency accelerator technology, heavy

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ion physics, and particle detector development at the DOE's Fermi National Accelerator Laboratory, Thomas Jefferson National Accelerator Facility, and Brookhaven National Laboratory.

Source: "US Department of Energy and India partner to advance accelerator and particle detector R&D"
U.S. Department of Energy press release (July 25, 2011)
http://energy.gov/articles/us-department-energy-and-india-partner-advance-accelerator-and-particle-detector-research

CERN (July 28, 2011)

The Japanese-European ASACUSA experiment has reported a new measurement of the mass of an antiproton that is accurate to about one part in a billion. This level of accuracy means that the measurement of antiproton mass is now almost as accurate as the measurement of proton mass. In future experiments, the accuracy is expected to be even further improved. Any difference between the mass of protons and that of antiprotons would mean that the laws of nature may differ for matter and antimatter, signalling a new physics. Thus, such precise measurements provide an important opportunity to investigate the apparent preference of nature for matter over antimatter. To enable these measurements, antiprotons are first trapped inside helium atoms and then "tickled" with two laser beams moving in opposite directions. The laser frequency is tuned until it causes the antiprotons to make a quantum jump within the atoms; the frequency at which this occurs can then be used to calculate the mass of the antiproton. The results of the ASACUSA experiment have been reported in *Nature*.

Source: "CERN experiment weighs antimatter with unprecedented accuracy"
CERN press release (July 28, 2011)
https://press.web.cern.ch/press/PressReleases/Releases2011/PR10.11E.html

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