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

Akihiko Tsutai, Director
International Affairs Division, ISTEC

Power

American Superconductor Corporation (March 14, 2011)

American Superconductor Corporation (AMSC) has signed a definitive agreement to acquire The Switch Engineering Oy, a power technologies company based in Finland. The €190 million (approximately US$265 million) acquisition is expected to be immediately accretive and to support AMSC's future growth, allowing further diversification of AMSC's customer base and channels to market. Of particular note, AMSC expects to leverage The Switch's strong background in advanced synchronous generators to commercialize superconductor generators for direct-drive SeaTitan™ wind turbines. The agreement is expected to close by August 31, 2011.

Source:
"AMSC To Significantly Expand Wind Business Through Proposed Acquisition of Power Technologies Company 'The Switch'"
American Superconductor Corporation press release (March 14, 2011)
http://www.amsc.com/pdf/AMSC%20TS%20Release%20(14March2011)%20-%20Final.pdf

Siemens (March 28, 2011)

Siemens and the Karlsruhe Institute of Technology (KIT) recently launched a research project to demonstrate that HTS technology is suitable for power generation on an everyday basis. A goal of the project will be to improve generator efficiency by 0.5% to 99.5%. Such an improvement would enable large power plants to achieve significant fuel savings while simultaneously reducing carbon dioxide emissions. The achievement of this goal, however, will be a complex undertaking because of the mechanically sensitive nature of the HTS cables within the generator's rotor. A rotation test under real-world operating conditions is being planned at KIT. The project will also study cryostat concepts, thermal insulation, and cooling processes. The project is being financed by the German Research Ministry and is scheduled to run until 2014, with the development of a prototype HTS generator capable of generating several hundred megawatts as a long-term objective. The overall project will be presented at the SuperConducting City during the Hannover Fair (April 4 – 8, 2011).

Source:
"New Project: Generator with Superconductors"
Siemens press release (March 28, 2011)
http://www.siemens.com/innovation/en/news_events/ct_pressreleases/e_research_news/2011/e_22_resnews_1109_2.htm

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Magnet

Bruker Energy & Supercon Technologies, Inc. (March 28, 2011)

Bruker Energy & Supercon Technologies, Inc. (BEST) has received a new order for three superconducting crystal growth magnets (SC-CGM) for semiconductor applications from a European crystal manufacturing company. In related news, the SC-CGM system ordered in 2010 by the Korean electronic materials company LG Siltron has passed its Factory Acceptance Test. SC-CGM systems are used in the semiconductor industry to improve the quality of monocrystalline silicon through a method known as the magnet-supported Czochralski process (MCZ). BEST is also working to demonstrate how the MCZ can positively affect the photovoltaic conversion efficiency and the manufacturing yield of single crystal silicon, potentially increasing the cost effectiveness of solar power plants.

Source:

"BEST Receives Superconducting Crystal Growth Magnet (SC-GCM) Order and Passes Factory Acceptance Test on Prior SC-CGM Order"

Bruker Energy & Supercon Technologies, Inc. press release (March 28, 2011)

http://phx.corporate-ir.net/phoenix.zhtml?c=121496&p=irol-newsArticle&ID=1543219&highlight

Scott Technology Limited, Industrial Research Limited, and HTS-110 (March 31, 2011)

Scott Technology Limited has acquired a majority shareholding (approximately 50.65%, valued at $4.4 million) in HTS-110 Limited. The acquisition will initially be debt funded, with the debt being repaid following the completion of a proposed rights issue to be concluded by the end of June 2011. Under the terms of the sale, Industrial Research Limited (IRL) and American Superconductor Corporation have agreed to dilute their shareholdings, while Endeavour Capital and several minority shareholders have sold their stakes. IRL will continue to support the development of HTS-110's products through its superconductor research programs.

Scott expects HTS-110 Limited to be both earnings and cash flow-positive from the date of the acquisition, with revenues and earnings expected to grow significantly in the medium- to long-term. Additionally, Scott's expertise in scaling up machinery is expected to enable HTS-110 Limited to further enhance its product offering. Drew Stein, Chairman of HTS-110, commented, "I am delighted that a New Zealand-based company with such a proven history in high-value manufacturing has invested in the company. Over the last few years HTS- 110 has grown significantly and it has been clear for some time that further investment was needed for this growth path to continue." Meanwhile, Shaun Coffey, Chief Executive at IRL, elaborated, "HTS-110 has been growing rapidly over recent years to develop a leading position in the global superconducting magnet market. Its success and potential to grow further mean it is now an appropriate juncture for IRL to transfer this world leading technology to an ambitious New Zealand firm. In Scott Technology we have found a company that already has a global presence and is familiar with successfully developing and selling high-tech, high-value products in New Zealand and around the globe."

Sources:

"Acquisition of Majority Shareholding in HTS-110 Limited & Proposed Rights Issue"

Scott Technology Limited press release (March 31, 2011)

http://www.scott.co.nz/system/files/NZX_310311_Acquisition+of+Major+Shareholding+in+HTS.pdf

"Investment in IRL associate boon for high-tech manufacturing"

Industrial Research Limited press release (March 31, 2011)

http://www.irl.cri.nz/newsroom/media-release/investment-irl-associate-boon-high-tech-manufacturing

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"Scott investment in HTS-110 secures leadership for NZ Inc."
HTS-110 Limited press release (March 31, 2011)
http://www.hts110.co.nz/wp-content/uploads/2011/03/hts-110_scott_release_310311.pdf

Quantum Computer

National Institute of Standards and Technology (March 9, 2011)

Researchers at the National Institute of Standards and Technology (NIST) have demonstrated an electromechanical circuit in which microwaves can be used to communicate with a vibrating mechanical component (or drum) 1,000 times more vigorously than previously achievable. Compared with previous experiments, the coupling ability of the present device is much stronger, the mechanical vibrations last longer, and the device is much easier to fabricate. This microscopic circuit may be useful as a new tool for information processing, with the potential to control the motion of a relatively large object at a quantum scale, and is regarded as a key achievement in NIST's efforts to develop components for superconducting quantum computers and quantum simulations. The group's work was reported in the March 10 issue of *Nature*.
Source:
"NIST electromechanical circuit sets record beating microscopic 'drum'"
National Institute of Standards and Technology (March 9, 2011)
http://www.nist.gov/pml/quantum/drum-030911.cfm

Basic

National Institute of Standards and Technology (March 2, 2011)

Researchers at the Joint Quantum Institute (JQI), in collaboration with the National Institute of Standards and Technology (NIST) and the University of Maryland-College Park have, for the first time, caused a gas of atoms to exhibit a quantum phenomenon known as spin-orbit coupling. Their technique has created new possibilities for studying and understanding fundamental physics and has potential applications in the fields of quantum computing, next-generation "spintronics" devices, and "atomtronic" devices built from ultracold atoms. Furthermore, applying this technique to fermions could enable research on new kinds of interactions between two particles, such as the interactions leading to novel "p-wave" superconductivity, possibly enabling a long-sought form of quantum computing known as topological quantum computation.
Source:
"JQI physicists demonstrate coveted 'spin-orbit coupling' in atomic gases"
National Institute of Standards and Technology (March 2, 2011)
http://www.nist.gov/pml/div684/spinorbit-030211.cfm

University of Illinois College of Engineering (March 2, 2011)

Physicists at the University of Illinois College of Engineering have shown how charged black holes can be used to model the behavior of interacting electrons in unconventional superconductors. Building on the work of string theorist Juan Maldacena, the physicists have devices a model for electrons moving in a

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curved spacetime in the presence of a charged black hole with two striking features of the normal state of high-temperature superconductors: 1) the presence of a barrier for electron motion in the Mott state, and 2) the strange metal regime in which the electrical resistivity scales as a linear function of temperature, as opposed to the quadratic dependence exhibited by standard metals. Surprisingly, the boundary of the spacetime consisting of a charged black hole and weakly interacting electrons exhibits a barrier for electrons moving in that region, similar to the Mott state. This is the first time that the Mott problem has been solved in a two-dimensional system, the relevant dimension for high-temperature superconductors. The group's work was published online in *Physical Review Letters* on March 1 and in *Physical Review D* on February 25.

Source:
"Black holes: a model for superconductors?"
University of Illinois College of Engineering press release (March 2, 2011)
http://physics.illinois.edu/news/story.asp?id=1214

Lawrence Berkeley National Laboratory and SLAC National Accelerator Laboratory (March 21, 2011)

Researchers at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and the University of California at Berkeley are collaborating with researchers at Stanford University and the U.S. Department of Energy's SLAC National Accelerator Laboratory to examine the nature of the pseudo gap in Pb-Bi2201 using three experimental approaches applied to the same sample. A sample of Pb-Bi2201 was studied using angle-resolved photoemission spectroscopy (ARPES) to monitor the kinetic energy and momentum of emitted electrons over a wide temperature range so as to map the low-energy electronic band structure (which determines much of the material's electrical and magnetic properties). The sample was also studied using the magneto-optical Kerr effect, enabling the net magnetization of the sample to be measured at different temperatures. Finally, the sample was studied using time-resolved reflectivity, which allows changes in reflection at different temperatures to be revealed. The results of these various studies suggest that the pseudogap phase in Pb-Bi2201 does not represent a gradual transition to superconductivity but is, in fact, a distinct phase of matter, with a phase transition occurring at the pseudogap phase boundary. The conclusion represents a paradigm shift in our understanding of high-temperature superconductivity. Zhi-Xun Shen of the Stanford Institute for Materials and Energy Science elaborate, "Our findings point to management and control of this other phase as the correct path toward optimizing these novel superconductors for energy applications, as well as searching for new superconductors." The group's work was published in the March 25 issue of *Science*.

Sources:
"Closing in on the pseudogap"
Lawrence Berkeley National Laboratory press release (March 21, 2011)
http://newscenter.lbl.gov/news-releases/2011/03/24/pseudogap/
"High-temperature superconductor spills secret: A new phase of matter"
SLAC National Accelerator Laboratory press release (March 24, 2011)
http://home.slac.stanford.edu/pressreleases/2011/20110324.htm

Massachusetts Institute of Technology (March 29, 2011)

Researchers at the Massachusetts Institute of Technology have synthesized, for the first time, a crystal that they believe may represent a two-dimensional quantum spin liquid: in other words, a solid

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material whose atomic spins continue to move even at the temperature of absolute zero. The crystal, known as herbertsmithite, belongs to a family of crystals known as Zn-paratacamites. While herbertsmithite is an insulator, not a superconductor, quantum spin liquid theory predicts that doping the crystal could transform it into a superconductor. Although the crystal does exist in nature, its forms are too impure to allow physical characterization. The MIT researchers were able to synthesize a crystal weighing about one-third of a gram. Using this crystal, the researchers plan to perform more tests to determine whether it actually is a quantum spin liquid. The identification of a quantum spin liquid and the production of large single crystals of such a material could help physicists to better understand the mechanisms of high-temperature superconductors. The synthesis of the material was described in the March 3 edition of *Physical Review B*.
Source:
“A new spin on superconductivity?”
Massachusetts Institute of Technology press release (March 29, 2011)
http://web.mit.edu/newsoffice/2011/quantum-spin-liquid-0329.html

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