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What's New in the World of Superconductivity (March & April, 2008)

Power

Zenergy Power plc (March 26, 2008)

Zenergy Power plc has received a commercial contract to perform a technology employment study of its patented HTS fault current limiter (FCL) for Consolidated Edison, Inc. ("Con Edison", USA). The study will form the basis for a technical analysis on whether Zenergy's FCL would be capable of protecting New York City from the damaging effects of power surges if it were to be installed in Con Edison's power grid. Con Edison will also use the study to evaluate the role that such FCLs might play in the creation of "Secure Super Grids" in the USA. The technical analysis will be completed as part of project Hydra, a US $39-million-dollar program sponsored by the U.S. Department of Homeland Security to develop stable power grids. In addition, Zenergy has been notified that it is currently the sole supplier of standalone HTS FCL technologies for project Hydra. Kevin Kolevar, Director of the Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy, commented. "The Department of Energy believes HTS technology is vitally important to the modernization of the nation's power grid. We are pleased to see the Secure Super Grid project in New York City building on the platform DOE helped to create over the past 20 years in partnership with U.S. industry. The Secure Super Grid project is the next logical step for short-length HTS applications as the Department continues to improve wire performance and materials challenges required for longer length projects and higher voltages. Together, these activities will help propel HTS technology toward commercialization."
Source:
"Commercial Contract for Department of Homeland Security Project"
Zenergy Power plc press release (March 26, 2008)
http://www.zenergypower.com/images/press_releases/2008-03-26-hydra.pdf

Zenergy Power plc (March 31, 2008)

Zenergy Power plc has reported their preliminary company results for the year ending December 31, 2007. The company's highlights include the first-ever commercial sale of an industrial-scale HTS induction heater, to be delivered in 2008; the establishment of a 5-year exclusive agreement with Converteam SAS to exploit commercial opportunities in global renewable energy generations markets; the start of a project with E.ON AG to develop and install the world's first HTS hydro-generator in a commercial hydro-dam; the establishment of a 5-year agreement with ThyssenKrupp GmbH to develop second-generation HTS wires; a US $500,000 grant from the California Energy Commission to develop, test, and install a medium-voltage fault current limiter (FCL); a US $11 million grant from the U.S. Department of Energy to develop, test, and install a high-voltage FCL; the successful completion of the construction and testing of Zenergy's proprietary medium-voltage FCL; the successful production of 10-meter lengths of second-generation HTS wire using a proprietary "all-chemical" deposition, low-cost, mass

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production technique; and the raising of £16 million through two institutional placings. Michael Fitzgerald, Chairman of Zenergy, stated, “It is with great pleasure that I report on the Group‘s first full year since its admission to trading in August 2006. Across all of our business divisions we accelerated towards our goal of commercializing the incredible electrical properties of our core HTS technology. The many years of investment, development and industry relationship building that pre-date our listing are fast reaching fruition through a growing number of highly progressive and demanding commercial arrangements, which themselves are fostering further opportunities for the Group.”
Source:
“Preliminary Results”
Zenergy Power plc press release (March 31, 2008)
http://www.zenergypower.com/images/press_releases/2008-03-31-preliminary-results.pdf

American Superconductor Corporation (April 2, 2008)
American Superconductor Corporation (AMSC) has received an order for wind turbine electrical systems and core electrical components valued at more than U.S. $18 million from Sinovel Wind Corporation Limited (Beijing, China). AMSC will deliver the products to Sinovel over the next 15 months. Upon delivery, the systems will be deployed in the 3-MW wind turbines that are being developed under a contract with AMSC Windtec, a wholly owned subsidiary of AMSC. Sinovel is presently manufacturing and deploying a 1.5-MW wind turbine that also utilizes core electrical components produced by AMSC, and they plan to develop a 5-MW model in the near future.

The China Wind Power Report 2007 (published jointly by the Global Wind Energy Council, Greenpeace and the Chinese Renewable Energy Industry Association) predicts that China could lead the world in wind energy development and play a large role in combating climate change. The report projects that China's installed wind power capacity (currently more than 6 GW, 3.4 GW of which was installed in 2007) will grow to 10 GW by 2010 and could exceed 120 GW by 2020.
Source:
“AMSC Receives $18 Million Order from Sinovel Wind for 3 MW Wind Turbine Core Electrical Components”
American Superconductor Corporation press release (April 2, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1124799&highlight

Bruker Corporation (April 2, 2008)
The Advanced Supercon business unit of Bruker Corporation has signed a formal cooperation agreement with the Leibniz Institute for Solid State and Materials Research (IFW Dresden, Germany) for the joint development of MgB_2 superconducting wire. The immediate goals of the agreement are 1) to increase the critical current of MgB_2 wire and 2) to become capable of manufacturing 1-km-long segments of MgB_2 wire. Future collaborations are expected to include large-scale MgB_2 wire production and agreements with magnet manufacturers to produce next-generation MRI magnets and high-energy physics and fusion research magnets. The present agreement calls for IFW Dresden to provide existing know-how and future R&D results related to MgB_2 powder and conductor materials and for Bruker to contribute its broad experience with and large-scale manufacturing capacity for all types of technical superconductors. Dr. Burkhard Prause, Managing Director of the Advanced Supercon business at Bruker,

commented, "... we have been collaborating with IFW Dresden for several years already. Our development results have reached the point where we decided to strengthen and expand our ongoing joint efforts to further develop MgB_2 wire towards higher performance specifications and towards scaled-up industrial production. We believe that in the future there could be a large potential market for MgB_2 wire in 'dry' MRI and energy research magnets operating without liquid helium at temperatures greater than 10 degrees Kelvin."
Source:
“Bruker's Advanced Supercon Business Signs Cooperation Agreement with IFW Dresden for Further Development of MgB_2 Superconducting Wire”
Bruker Corporation press release (April 2, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=121496&p=irol-newsArticle&ID=1124644&highlight

American Superconductor Corporation (April 9, 2008)

American Superconductor Corporation (AMSC) has licensed its proprietary Windtec WT1650 wind turbine design and manufacturing know-how exclusively to Ghodawat Industries Pvt. Ltd. (GIIPL; Maharashtra, India) for use in certain countries in the Middle East, Southern Asia and Africa. GIIPL has been manufacturing wind turbine towers since 2004 and also owns and operates wind farms across four states in India. The company plans to utilize AMSC's proprietary design, technology and core electrical components to begin manufacturing complete wind turbines for use in India and for export to countries in the Middle East, Southern Asia and Africa. GIIPL expects to being manufacturing 1.65-MW turbines in 2009. In addition to a multi-million dollar upfront license fee, AMSC will receive a royalty payment for the first 550 WT1650 wind turbines manufactured by GIIPL. AMSC also has a right-of-first-refusal to provide the full electrical systems and core electrical components for all of the wind turbines manufactured by GIIPL. Greg Yurek, AMSC founder and chief executive officer, commented, "This license agreement with GIIPL represents our entry point for the market in India, not only for the wind industry, but also for the power grid sector. GIIPL has the experience and knowledge base to rapidly expand its business in the fast growing Indian wind market. And as this penetration begins, we also expect to generate traction in India's power grid market, which will be going through a major expansion over the next two decades.”

According to a recent report by the Global Wind Energy Council, India now ranks fourth in the world in terms of total wind power capacity. Capacity in the country grew by 28 % in 2007 to 8 GW. According to India's Ministry of New and Renewable Energy, the country has 60 GW of wind power potential.
Source:
“AMSC Enters Market in India with First Wind Turbine License to Ghodawat Industries (India) Pvt. Ltd.”
American Superconductor Corporation press release (April 9, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1127487&highlight

European High Temperature Superconductors (April 15, 2008)

European High Temperature Superconductors (EHTS) has achieved a 90 % yield for the processing of biaxially textured yttria-stabilized zirconia (YSZ) buffered tapes with a total length of 2000 meters. The tapes were produced using alternating beam-assisted deposition (ABAD), which is a proprietary technology belonging to EHTS. ABAD can be used to create YBCO coated

conductors on stainless steel substrate tapes in a cost-effective manner. Dr. Alexander Usoskin, head of the coated conductor R&D department at EHTS, commented, “This substantial increase of processing yield of substrate buffering will result in both higher reproducibility and improved production capacity for coated conductors; previously, this technological step represented a bottleneck in the entire coated conductor production.” The new level of quality enabled by the ABAD technique, combined with the use of a high-rate pulsed laser process to deposit the YBCO layer, has resulted in a significant improvement in the critical current, with a maximum value of 306 A/cm-width in a 40-m coated conductor tape (at 77 K and in a self-field). This achievement greatly surpasses the previous record of 253 A/cm-width. EHTS now plans to scale up their production performance to enable the consistent production of coated conductors with high critical currents in lengths of 1 km or longer.

Source:

“EHTS achieved a 90 % yield for biaxial buffering that allows critical currents of more than 300A/cm-width in coated conductors”

European High Temperature Superconductors press release (April 15, 2008)

http://www.bruker-ehts.com/fileadmin/Press_Release/2008/Pressemitteilung_EHTS_HTS_YBCO_HMI_2008.pdf

Zenergy Power plc (April 21, 2008)

Zenergy Power plc, together with its collaborative manufacturer Bültmann GmbH, has received the Hermes Award for its groundbreaking HTS industrial heater – the first industrial application of superconductor technology to a widely used industrial process. The Hermes Award, a prestigious annual technology prize, was presented to Zenergy at the opening of the 2008 Hannover Fair. Zenergy Power is only the fifth company to receive the Hermes Award, which is presented for exceptional new technical products that demonstrate substantial commercial benefits and have either undergone rigorous industrial trials or reached the industrial application stage; accompanying the award is a prize of €100,000. Dr. Annette Schavan, German Federal Minister for Education and Research and the presenter of the Hermes Award, commented, “Zenergy‘s HTS induction heater is contributing towards the fight against climate change and helping to safeguard the environment. It clearly demonstrates that the classical engineering and electrotechnical industries are proving to be successful partners in our attempts at climate control.”

Source:

“Zenergy‘s High Temperature Superconductor (`HTS‘) Induction Heater Wins Prestigious Hermes Award”

Zenergy Power plc press release (April 21, 2008)

http://www.zenergypower.com/images/press_releases/2008-04-21-hermes-award-win.pdf

American Superconductor Corporation (April 22, 2008)

American Superconductor Corporation (AMSC) has received orders for its D-VAR grid interconnection solution from two more wind farms in the U.S. and Canada. Together, these two wind farms will provide more than 200-MW of power for the North American market. The D-VAR systems will be delivered by the end of 2008. These orders bring the total number of wind farms utilizing AMSC’s D-VAR solution to 20 in North America and 35 worldwide.

According to a recent report by the Global Wind Energy Council, wind power capacity grew

27 % worldwide in 2007 to more than 94 GW. Wind power capacity in the United States and Canada grew by 45 % and 26 %, respectively, in 2007.
Source:
"AMSC Receives Orders for Grid Interconnection of North American Wind Farms"
American Superconductor Corporation press release (April 22, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1133104&highlight

Zenergy Power plc (April 29, 2008)

Zenergy Power plc announced that options for 6,873 new ordinary shares of £0.01 each have been exercised. An application has been made for the new Ordinary Shares to be admitted to trading on AIM on or around May 6, 2008. The new Ordinary Shares will rank *pari passu* with the existing ordinary shares and have been allotted and issued credited as fully paid. Upon admission, the total issues share capital with voting rights in Zenergy Power plc will be 44,027,804 Ordinary Shares.
Source:
"Issue of equity and total voting rights"
Zenergy Power plc press release (April 29, 2008)
http://www.zenergypower.com/images/press_releases/2008-04-29-issue-of-equity-and-tvr.pd

American Superconductor Corporation and Nexans (April 30, 2008)

The Long Island Power Authority (LIPA), together with American Superconductor Corporation (AMSC) and Nexans, has announced the operation of the world's first HTS power transmission cable system in a commercial power grid. The 600-meter, 138-kV, 574 MVA system was energized on April 22, 2008, and has been successfully operating in LIPA's Holbrook transmission right-of-way. AMSC provided the HTS wire used to construct the cable and acted as the prime contractor for the project. The cable system and its six outdoor terminations for connection to the LIPA grid were designed, manufactured and installed by Nexans. The HTS cable is cryogenically cooled using a liquid nitrogen refrigeration system from Air Liquide. In addition to these companies, the U.S. Department of Energy provided U.S. $27.5 million in funding to help cover the costs of the $58.5-million-dollar project. When operated at full capacity, the new HTS cable system is capable of transmitting up to 574 MW of electricity, or enough to power 300,000 homes. While LIPA is the third electric utility in the U.S. to deploy an HTS cable system in its power grid, the LIPA HTS cable is the longest and it is also the first to operate at transmission voltages. LIPA expects to retain the new superconductor cable as a permanent part of its grid once performance and economic reviews of the cable system have been completed.
Source:
"World's First Transmission Voltage Superconductor Cable Energized in LIPA's Power Grid"
American Superconductor Corporation press release (April 30, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1137104&highlight
"World's first transmission voltage superconductor cable energized successfully in LIPA's power grid"
Nexans press release (April 30, 2008)
http://www.nexans.com/eservice/Corporate-en/navigatepub_142482_-16156/World_s_first_transmission_voltage_superconductor_.html

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Bruker Corporation (April 30, 2008)

Bruker Corporation has established a new subsidiary, Advanced Supercon, Inc. (ASCI), in Billerica, Massachusetts (USA). Advanced Supercond will provide business development and customer support operations for Bruker's products in the United States. The manufacturing and research operations of the Advanced Supercon business will continue to be performed in Europe, although select superconducting device-related R&D projects may be performed at the U.S. facilities in the future. Tom Rosa, former Vice President and Chief Financial Officer of American Superconductor Corporation, has been hired as the company's Chief Financial Officer and Senior Vice President. Mr. Rosa commented, "I am very pleased to join the Advanced Supercon business and look forward to playing an important role not only in finance, but also in promoting global awareness of ASCI as a high-quality provider of LTS and HTS wire products and devices. We expect to make additional hires in the U.S. in the near future as our business expands in North America as well as in the Asia-Pacific region. We're excited to be getting the word out about the broad range of superconductor products we offer or are developing here in the Advanced Supercon business, including first-generation (BSCCO) and second-generation (YBCO) HTS wire and medium temperature superconductor (MTS) magnesium diboride (MgB_2) wire. The Advanced Supercon business already manufactures and sells tens of thousands of kilometers of high-performance LTS wire annually worldwide, primarily for MRI, NMR, physics research and experimental fusion magnets."

Source: "Bruker's New Advanced Supercon, Inc. (ASCI) Subsidiary Starts U.S. Operations and Hires Tom Rosa as CFO and Senior VP"

Bruker Corporation press release (April 30, 2008)

http://phx.corporate-ir.net/phoenix.zhtml?c=121496&p=irol-newsArticle&ID=1137653&highlight

Electronics

Institute of Physics (March 28, 2008)

The Institute of Physics held a conference on Condensed Matter and Materials Physics at the Royal Holloway College of the University of London at which the future of computing was examined. At the conference, two talks focused on the ability of superconductors "to harness the power of quantum physics" to boost computing power. The two talks were given by Hans Mooij of the Delft University of Technology (the Netherlands) and Raymond Simmons of the National Institute of Standards and Technology (USA). Mooij described the progress that he and others have made in making practical quantum devices and in using them to explore fundamental aspects of quantum mechanics. Meanwhile, Simmons described the first demonstration of information being transmitted between two superconducting qubits, confirming that such a device can be used as a quantum-computing memory and a "bus" for qubits to communicate with each other.

Source:

"The future of computing – carbon nanotubes and superconductors to replace the silicon chip"

Institute of Physics press release (March 28, 2008)

http://www.iop.org/Media/Press%20Releases/press_29029.html

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Sensor

National Institute of Standards and Technology (April 15, 2008)

Researchers at the National Institute of Standards and Technology (NIST), in collaboration with researchers at the University of Massachusetts, have demonstrated a highly sensitive, high-resolution imaging system that can detect naturally occurring terahertz radiation. The device, known as a hot electron bolometer imager, promises to become a new tool for chemical and biochemical analyses ranging from early tumor detection to the rapid and precise identification of chemical hazards. The NIST prototype uses a superconducting detector combined with microelectronics and optics technologies that allow it to operate in the terahertz range. Incoming terahertz radiation is mixed with a stable internal terahertz signal in a thin-film superconductor, which changes temperature upon the arrival of even minute amounts of radiation energy. The slight frequency difference between the two original terahertz signals in turn produces a more easily detected microwave frequency signal. Because the passively emitted signals are very weak, the present system takes about 20 minutes to create a single 40 x 40 pixel image. Researchers are now working on an improved and faster version that should also be able to achieve a better spatial resolution.

Source:
“Prototype terahertz imager promises biochem advances”
National Institute of Standards and Technology press release (April 15, 2008)
http://www.nist.gov/public_affairs/techbeat/tb2008_0415.htm#terahertz

National Institute of Standards and Technology (April 15, 2008)

Researchers at the National Institute of Standards and Technology (NIST) have successfully combined a cryogenic sensor and a microrefrigerator on a single microchip, possibly enabling applications like cheaper, simpler, and faster precision analyses of materials like semiconductors and stardust. The cryogenic sensor is a transition-edge sensor (TES) that is made from a superconducting thin film; the sensor can identify X-ray signatures with much greater precision than other available devices. This sensor was combined with a solid-state refrigerator composed of a sandwich of a normal metal, an insulator, and a superconductor. This combination represents the first successful application of a microrefrigerator for the cooling of a fully functional detector. TES sensors usually require bulky complex refrigerators to reach their ultralow operating temperature. Using the NIST chip, which provides the second stage of cooling (from 300 mK to about 100 mK), a much simpler refrigerator can be utilized for the primary cooling (to cool the chip from room temperature to 300 mK). The microchip will be described in *Applied Physics Letters*.

Source:
“NIST micro sensor and micro fridge make cool pair”
National Institute of Standards and Technology press release (April 15, 2008)
http://www.nist.gov/public_affairs/techbeat/tb2008_0415.htm#microfridge

Basic

Princeton University and the National Science Foundation (April 10, 2008)

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Researchers at Princeton University, in collaboration with the University of Illinois-Urbana/Champaign, Brookhaven National Laboratory, Osaka University (Japan) and the Central Research Institute of Electric Power Research (Japan), have reported that superconductivity may not rely on a “glue” that binds electrons together – as many have imagined – but on the ability of electrons to take advantage of their natural repulsion in a complex situation. The team observed an unexpected connection between the behavior of electrons when they pair up during superconductivity and when they repel each other at temperatures far above the critical temperature required for superconductivity. Ali Yazdani, a professor of physics at Princeton, explained, "It appears that the electrons with the strongest repulsion in one situation are the most adept at superconductivity in another."

The Princeton group utilized a specialized scanning tunneling microscope with tracking capabilities that allowed them to focus on the same atom as the electrons moving in the sample went from repelling each other at high temperatures to pairing with each other at low temperatures. After searching for experimental signatures that might hint at the mechanism of pairing, they found that the atomic locations of the sample at which the electrons exhibited the strongest repulsion for each other (at very high temperatures) formed the strongest bonded pairs of electrons at low temperatures, contrary to the behavior of electrons in low-temperature superconducting materials. When the samples were then heated to very high temperatures at which the electrons no longer paired, the electrons that had been superconducting at colder temperatures exhibited unique quantum properties, indicating that they possessed extremely strong repulsive forces. Thus, unlike in low-temperature superconducting materials, the electrons in high-temperature superconductors that are most likely to pair are the ones that repel each other the strongest when the environment is not conducive to superconductivity.

The group’s research was reported in the April 11 issue of *Science*. This research was supported by the U.S. Department of Energy’s Office of Basic Energy Sciences and by the National Science Foundation (NSF). Charles Bouldin, NSF Program Manager, commented, “By showing that a fundamentally different electron pairing mechanism exists in high-temperature superconductors, this work will move the field in new directions, and will help find new materials to investigate.”

Source:
“Where’s the glue?’
Princeton University press release (April 10, 2008)
http://www.princeton.edu/main/news/archive/S20/77/71A47/index.xml?section=newsreleases
“Attraction at the atomic level”
National Science Foundation press release (April 10, 2008)
http://www.nsf.gov/news/news_summ.jsp?cntn_id=111397&org=NSF&from=news

(Akihiko Tsutai, Director, International Affairs Department, ISTEC)

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