

November, 2013

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Superconductivity Web21

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What's New in the World of Superconductivity (October, 2013)

초전도 뉴스 -세계의 동향-

超导新闻 -世界的动向-

chāo dǎo xīnwén - shìjiè de dòngxiàng-

Yutaka Yamada, Principal Research Fellow
Superconductivity Research Laboratory, ISTEK



★News sources and related areas in this issue

▶Wire 선 재료 線材料 [xiàn cáiliào]



[SuperPower Provides Wire for Superconducting Fault Current Limiter in EU ECCOFLOW Project](#)

SuperPower Inc. (September 23, 2013)

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SuperPower Inc., a subsidiary of the Furukawa Electric Company of Japan, recently announced that SuperPower provided the second-generation high-temperature superconducting wire that was used in the European Union collaboration program, known as Project ECCOFLOW. The focus of the program was the development of a new superconducting fault current limiter (SFCL) device capable of strengthening and protecting the utility grid. The ECCOFLOW SFCL was built by a team of 15 European organizations, including 5 European utilities, and is presently being installed in the Endesa utility grid in Palma de Mallorca, Spain. As this region typically experiences frequent lightning storms in autumn, the installation is expected to allow a full demonstration of the SFCL's ability to protect the power grid against short circuits. SFCL's are expected to be used to enhance the short-circuit strength of power grids, a factor that is becoming more important with the increase in renewable decentralized electric power generation. Yusei Shirasaka, president of SuperPower, commented, "Wire requirements for the ECCOFLOW limiter were extremely challenging, as this is the first SFCL design to match a wide range of grid environments and functional demands in one device. SuperPower's unique SFCL wire that is specifically focused on the requirements for FCL functionality—a highly resistive substrate, flexibility in wire stabilization options, and very tight current uniformity—was meticulously tested and evaluated and found to be the only wire capable of meeting all of the device requirements." The ECCOFLOW SFCL was designed and built by Nexans and shipped for type testing in late 2012. Once installed, the SFCL will be operated for 6 months in the Endesa substation. Thereafter, the SFCL will be moved to the Východoslovenská Energetika network in Košice, Slovakia, for a further period of operation and testing.

Source: "SUPERPOWER WIRE POWERS EUROPEAN UNION ECCOFLOW SUPERCONDUCTING FAULT CURRENT LIMITER"

SuperPower Inc. press release (September 23, 2013)

URL:

<http://www.superpower-inc.com/content/superpower-wire-powers-european-union-eccoflow-superconducting-fault-current-limiter>

Contact: Traute F. Lehner, tlehner@superpower-inc.com

▶ **Power Application** 전력응용 电力应用 [diànlì yìngyòng]



AMSC Wins First D-VAR® STATCOM Project in South Africa

AMSC (September 10, 2013)

AMSC has announced that South Africa's largest high voltage construction company, Consolidated Power Projects (CONCO), has selected AMSC's D-VAR® STATCOM solution to connect South Africa's largest wind farm to the main electricity grid. South Africa has established strict grid codes that must be met for renewable power plants to connect to the electricity grid, and AMSC's D-VAR solution will provide complete VAR compensation and voltage control, enabling the wind farm to meet these stringent requirements while augmenting the wind farm's overall performance. Daniel P. McGahn, President and CEO of AMSC,

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commented, "The D-VAR system cost effectively provides the dynamic reactive VAR compensation that is essential to connect renewable power plants to the grid effectively, making it an ideal solution for the emerging South African renewables market. CONCO has built a reputation as Africa's leading developer of quality, turnkey high voltage solutions and we are looking forward to working with them and helping to deliver a clean energy to South Africa." In the past, AMSC has received orders for over 100 STATCOM power grid solutions worldwide, and its customers include more than 20 power grid operators worldwide.

Source: "AMSC Wins First D-VAR® STATCOM Project in South Africa"

AMSC press release (September 10, 2013)

URL: <http://ir.amsc.com/releasedetail.cfm?ReleaseID=789769>

Contact: Kerry Farrell, kerry.farrell@amsc.com

► Basics 기초 基础 [jīchǔ]



Topological Insulator and High Temperature

Superconductivity

Lawrence Berkeley National Laboratory (September 16, 2013) and Johannes Gutenberg University Mainz (September 25, 2012)

A new exotic type of material, known as a topological insulator, has recently begun to attract attention. Topological insulators are insulating within a bulk material, similar to a normal insulator, but exhibit conductivity on the surface of the material. When a topological insulator is interfaced with a superconductor, a particle known as a Majorana fermion emerges; this particle can be used to fabricate a quantum computer that operates much more quickly than any currently available computer. Consequently, the search for Majorana fermions based on a topological insulator-superconductor interface has very recently become an intense race.

Working at the Advanced Light Source (ALS), an international collaboration of researchers from Tsinghua University (China) and the U.S. Department of Energy's Lawrence Berkeley National Laboratory recently used beams of ultraviolet light to demonstrate high-temperature superconductivity in the surface of a topological insulator. Alexei Fedorov, a staff scientist at the ALS, reported, "We have shown that by interfacing a topological insulator, bismuth selenide, with a high temperature superconductor, BSCCO (bismuth strontium calcium copper oxide), it is possible to induce superconductivity in the topological surface state. This is the first reported demonstration of induced high temperature superconductivity in a topological surface state." The use of topological insulators is considered to be a promising approach to solving the problem of "decoherence", or the fragility of qubits. In a topological quantum computer, the qubits would be made from Majorana particles, which are immune to decoherence. Thus, the information that is processed and stored in these topological qubits would always be preserved. Fedorov added, "Our studies reveal a large superconducting pairing gap on the topological surface states of thin films of the bismuth selenide topological insulator when grown on BSCCO. This suggests that Majorana zero modes are likely to exist, bound to magnetic vortices in this material, but we will have to do other types of measurements to find it."

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The bismuth selenide/BSCCO topological thin film heterostructure that was used in the study was made at Tsinghua University using molecular beam epitaxy. Xi Chen explained, "By controlling the growth kinetics carefully using molecular beam epitaxy, we managed to grow a topological insulator film with controlled thickness on a freshly cleaved BSCCO surface. This provided a cleaner and better-controlled interface, and also opened up opportunities for surface sensitive measurements." The material was then brought to the ALS to study the electronic states on its surface using a technique known as angle-resolved photoemission spectroscopy (ARPES). The group's work has been reported in *Nature Physics*.

In another collaboration between the Mac Planck Institute for Chemical Physics of Solids and the Johannes Gutenberg University Mainz in Germany, another group has recently predicted that the oxide compound BaBiO₃ may act as both a topological insulator and a superconductor. BaBiO₃ has long been known as a high-temperature superconductor with a critical temperature of nearly 30 K and p-type doping. Now, however, BaBiO₃ with n-type doping has been found to act as a topological insulator. Thus, a simple device with a p-n junction and gating or electrolyte gating might be capable of producing Majorana fermions for quantum computation in a manner that does not require a complex interface between two materials. The collaboration is now attempting to synthesize n-type doped BaBiO₃. The group's work was published in the September 22 issue of *Nature Physics*.

Source 1: "On the road to fault-tolerant quantum computing"

Lawrence Berkeley National Laboratory press release (September 16, 2013)

URL: <http://newscenter.lbl.gov/feature-stories/2013/09/16/fault-tolerant-quantum-computing/>

Contact: Lynn Yarris lcyarris@lbl.gov

Source 2: "New multifunctional topological insulator material with combined superconductivity"

Johannes Gutenberg University Mainz press release (September 25, 2012)

URL: http://www.uni-mainz.de/presse/16706_ENG_HTML.php

Contact: Professor Dr. Claudia Felser susanne.zuecker@cpfs.mpg.de

► Management and Finance 경영정보 经营信息[jīngyíng xīnxī]

US Legislation for Helium Supply Continuation of the BLM Supply is Essential While Facing Ongoing Global Helium Shortage

Air Products (October 3, 2013)

Air Products has applauded the successful passing of vital U.S. legislation required for the continuation of the critical helium supply from the U.S. Bureau of Land Management (BLM)'s Federal Helium Reserve, which currently provides 30% of the world's helium supply. The legislation will enable a potentially unprecedented supply crisis to be averted. Nevertheless, despite these actions, the helium shortage will persist. Walter Nelson, director of Helium Sourcing at Air Products, explained, "There will be no increase in the amount of helium molecules being produced by the BLM as a result of this legislation. The legislation maintains the status quo in terms of helium availability. However, we are just pleased that the legislation's passing prevented a difficult supply situation from getting any worse." The continued supply will also provide a "bridge" until new helium projects become operational, such as Air Product's new, jointly owned liquid

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helium production plant near Big Piney, Wyoming, which is scheduled to become operational in late 2013. The Big Piney facility will process natural gas from the Riley Ridge Field, one of the largest helium-rich natural gas fields in the United States. While the helium reserves in the Riley Ridge fields are believed to be capable of supporting production for decades, Air Products is also seeking ways to further improve the reliability of its future helium supply by looking for other helium source opportunities. Air Products is also encouraging all users of helium to look for ways to conserve or recycle helium and is working with several customers to accomplish this goal.

Source: "Air Products Applauds Approval of Helium Legislation"

Air Products press release (October 3, 2013)

URL:

<http://www.airproducts.com/company/news-center/2013/10/1003-air-products-applauds-approval-of-helium-legislation.aspx>

Contact: Art George, georgeaf@airproducts.com

The logo for IOPscience, featuring the letters "IOP" in red and "science" in blue.

Roadmap of Superconductivity and the Environment

Institute of Physics (September 15, 2013)

A topical review entitled, "Superconductivity and the environment: a Roadmap" has been published in the Institute of Physics (IOP) Publishing's journal *Superconductor Science and Technology*. The review explains how superconducting technologies can be used to address issues such as water purification, earthquake monitoring, and the reduction of greenhouse gases. Other applications mentioned in the review include the use of superconducting quantum interference devices (SQUIDs) to detect and recover unexploded weapons, otherwise known as unexploded ordnances (UXOs), safely. Thousands of UXOs continue to be discovered each year in Europe, especially in areas that were heavily bombed during the Second World War. Another section of the report explains how a global network of SQUIDS could aid in the detection of solar bursts, which can disrupt communication systems. A similar network could help to detect the specific magnetic signature of earthquakes before they occur.

The report also mentions the deployment of magnetically levitating (Maglev) trains in Germany, China, Japan, and Brazil. These countries are now attempting to develop high-temperature superconducting Maglev trains that use liquid nitrogen instead of liquid helium to cool the tracks, thereby simplifying the cooling process, reducing operational costs, and offering more stable levitation and lighter carriages to be used.

The report also discusses the use of high-temperature superconducting technologies to store power from wind and solar plants and the use of superconducting cables to distribute electricity with no resistance across large distances.

For more information about the environmental applications of superconductivity, including high-end computing and motors for ship propulsion, the paper can be downloaded from <http://iopscience.org/0953-2048/26/11/113001/article>.

Source: "Superconductivity to meet humanity's greatest challenges" Institute of Physics press release

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URL: <http://iopscience.iop.org/0953-2048/26/11/113001/article>

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