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Joint Communiqué

International Superconductivity Industry Summit
ISIS -17
"Expansion of Superconductor Applications"

Tsukuba, Japan
October 30-31, 2008

ISIS-17 AND FUTURE ISIS MEETINGS

The 17th International Superconductivity Industry Summit (ISIS-17) was held at the Tsukuba International Congress Center, Japan, on October 30--31, 2008. More than 30 delegates from the Consortium of European Companies Determined to Use Superconductivity (CONECTUS, EU), the Coalition for Commercial Application of Superconductors (CCAS, USA), the NZ High Temperature Superconductor Industry Association (NZHTSIA, New Zealand) and the International Superconductivity Technology Center (ISTEC, Japan) attended the summit. At this summit, NZHTSIA (New Zealand) was approved as a new ISIS member. In addition to the ISIS member organizations, observers from Korea and China were invited to the summit. The theme of this year's summit was "**Expansion of Superconductor Applications**."

ISIS is an international forum that allows delegates to meet under one roof to discuss their common goals of promoting and providing leadership for the industrialization and commercialization of superconductor technology. The ISIS mission is to promote international cooperation and information exchange between industry, government and academic institutions worldwide to stimulate scientific programs in superconductivity and the rapid development and commercial acceptance of superconductor-based products. The annual summits have helped to deepen the general understanding of the benefits of commercial superconductor applications and to accelerate their earliest market adoption.

The delegates discussed many aspects regarding the facilitation of superconductor technology commercialization. Recognizing that the superconductor technology is one of the most supporting technologies for sustainable future growth, the delegates agreed that they should continue and strengthen their investments and efforts toward the commercialization of the superconductor technologies. Their discussions at ISIS included reports on the progress being made in numerous superconductor applications, such as HTS wires, power cables, transformers, fault current limiters, SMES, generators, motors and ship propulsion systems, MRI and NMR systems, induction heater systems, filters and network devices.

Since its inception, the ISIS has been managed by CONECTUS, CCAS and ISTEC. At present, however, superconductor-related activities, including research, development and commercialization, are being carried out globally and people from all over the world are expected to enjoy the benefits of these activities. In this context, the original ISIS members have expanded membership opportunities to include organizations who share the ISIS vision: that superconductivity and its related technologies are critical to sustaining the continued technological advancement of our modern society and the industrialization of the developing world. At ISIS-17, New Zealand was approved as a new official member of ISIS by a unanimous vote of ISIS member organizations.

It was also agreed that the next summit, ISIS-18, would be held in 2009 in Wellington, New Zealand.

SALIENT POINTS OF DISCUSSION AT ISIS-17

Delegates reviewed significant advances in several areas of technology. The discussions highlighted the challenges for technological development and commercialization in several major segments of the superconductor technology.

(1) Technologies for Electric Power Applications

Energy is one of the most important elements for sustainable development in our society. The global demand for energy is continuously increasing. Recently, it has been recognized that we are too dependent on imported petroleum, particularly, from politically unstable regions. Simultaneously, the consumption volume of coal has increased. The price of energy continues to rise, with various social and economic problems emerging as a result. In particular, the price of crude oil increased to more than $140 per barrel at its peak, severely impacting the global economy. In addition, severely deteriorating effects of carbon emissions on our environment and the resulting drastic climate changes leading to natural disasters including drought, flood and large scale hurricanes are receiving worldwide attention. Our present consumption rate of fossil fuel-based energy resources cannot be continued. The global warming effect caused by carbon emissions is one of the most important political issues in the world. Energy problems are also closely related to the national security of our respective countries.

A very large portion of our present energy consumption is in the form of electricity. We have an important obligation to use electric energy much more efficiently than ever before. Under these circumstances, more effective generation, transmission, and utilization of electricity is urgently required. Electrical outages cause large economic losses and sometimes endanger human lives. We cannot stress enough the importance of a reliable electricity supply. Superconductor technology is one of the most important and promising new technologies available with the potential to meet these pressing economic and societal needs.

Wire manufacturing is an indispensable and basic technology for power or large-scale applications. Superconductor power devices including power cables, transformers, SMES systems and fault current limiters offer various benefits in distributing and transmitting electricity, especially in urban areas. These power devices can carry much larger amounts of electricity and contribute to more robust power networks. HTS wire can operate at higher temperature than low-temperature superconducting wire or at the temperature of liquid nitrogen; therefore, it is more suitable for power transmission and distribution applications. LTS wire is presently used in magnets for NMR and MRI as well as in High Energy Physics and Fusion applications. Regarding HTS, first-generation BSCCO wire is available in commercial quantities and YBCO coated conductors are also entering into the commercial stage. In Japan, a five-year national project for YBCO coated conductors was successfully completed, meeting project goals, in March, 2008. In the United States and Europe, YBCO wire is now commercially available. High current capacity stranded conductors are successfully developed in a co-operation between New Zealand and Europe. Research and development of a new superconductor, MgB_2, is also steadily progressing, including its magnet applications. MgB_2 wires and tapes are already commercially available in Europe.

In the USA, three cable demonstration projects using BSCCO wires are under way: (1) a 13.2-kV, 200-m, 3-kA triaxial distribution cable project in Columbus, Ohio, (2) a 34.5-kV, 350-m, 800-A “3-in-One” cable project in Albany, NY, and (3) a 138-kV, 600-m, 2.4-kA transmission cable project in Long Island, New York. In the Albany project, a part of the BSSCO cable system was replaced by a 30-m YBCO cable. All these international projects are strongly supported by partnering European and Japanese manufacturers. In Japan, a 66-kV, 200-300-meter, 3-kA 3-in-One BSCCO cable project is presently under way; the HTS cable will be connected to a commercial grid in Yokohama in 2010. Cable demonstration programs are also planned or under way in Europe, Korea and China.

Recently several new projects have been initiated to facilitate the further expansion of superconductor applications, including BSCCO and YBCO applications. In the United States,

the Department of Homeland Security initiated a YBCO cable project, known as “HYDRA”, in 2007. The US Department of Energy also launched new HTS cable and fault current limiter (FCL) demonstration projects in 2007, some of which comprise YBCO cable and YBCO FCL demonstrations. In Japan, a new 5-year YBCO power application technology development project was initiated in FY2008. Application technologies for the future commercialization of power cables, SMES systems and transformers using YBCO, including other REBCO, will be developed in parallel with efforts to improve the performance of the YBCO wires.

Superconductor power devices are energy-efficient, compact and lightweight, and are expected to play important roles in various aspects of the future power industry. The technical research and development of power applications is under way around the world. Attention has been focused on power cables, motors, synchronous condensers, power generators, wind power turbines, fault current limiters, magnets for magnetic separation, transformers and SMES systems. The U.S. is now pursuing the development and demonstration of HTS motors and generators for ship propulsion systems. Europe, Korea and Japan are also successfully and continuously developing such motors and generators for electric ship propulsion systems. In Europe, an HTS induction heater system using BSCCO wire has been commercialized for billet extrusion. In New Zealand the effort has been on the manufacture of a Roebel cable made from YBCO wire for AC and high current power systems equipment applications. Work has commenced on a demonstration transformer using this cable.

MRI and NMR magnets using LTS wires have been successfully commercialized for many years. Recently, HTS magnets have also become commercially available. In Japan, 3-T compact MRI magnet system development using BSCCO wire is now launched. New Zealand is participating in this new HTS application market with commercial sales of scientific and industrial HTS magnets. The superconducting magnets are an indispensable element of MRI and NMR systems, the benefit and value of which have already been fully acknowledged in the marketplace. Large-scale superconducting magnet systems also form the core components of fusion reactors and particle colliders. The Large Hadron Collider at CERN is now in its commissioning stage, and the ITER project has already been initiated. New Zealand is also exploring the use of HTS magnets in NMR and synchrotrons.

(2) Technologies for Electronic Applications

During the past decade, the quantity of information being transmitted has increased tremendously with the advancement of IT technologies. The volume of information being exchanged is huge, and information traffic continues to increase at a very rapid rate. In the future, computer and communication network systems will need to process and exchange even larger amounts of information, requiring devices with greater energy efficiency that process information at much higher speeds. Superconducting electronics devices can operate at more than 100 GHz without any heat-related problems. Superconductor technology is one of the most promising solutions for coping with the envisioned flood of information through communication networks and information-processing machines in the future.

Superconducting filters were originally commercialized, especially, in the U.S. to enhance coverage area, increase capacity and improve communication quality. Recently, satellite and military applications have also been realized in the U.S., thanks to the smaller size and weight of HTS-based receiver front-ends with very high performances.

Rapid single flux quantum (RSFQ) devices exhibit an extremely fast switching speed and their energy consumption is extremely low, compared with existing silicon devices. These features of RSFQ devices offer great promise in coping with the foreseeable problems related to information flooding in communication networks and data-processing devices. In FY2006, Japan completed a four-year HTS development project for A/D converter and sampler technology, in which RSFQ switching technology for a high-speed router was successfully demonstrated. Consequently, a new 5-year project for next-generation efficient network devices was commenced in FY2007. This project includes the development of RSFQ circuit technology and system integration technology.

In parallel, quantum computing technology is advancing steadily. This technology offers

the opportunity to solve problems that are practically unsolvable by using conventional Neumann-type computers. Superconductor technology is expected to be one of the most promising technologies for realizing the practical quantum computers in the future.

Superconducting quantum interference devices (SQUIDs) are the most sensitive magnetic sensors available, capable of detecting extremely small magnetic signals. Magnetoencephalography (MEG) and magnetocardiography (MCG) utilize SQUID technology to provide non-invasive and effective methods for diagnosing diseases that cannot otherwise be identified using any other available method. The commercialization of these systems is progressing. Steady technological progress is also being observed in various fields of SQUID technologies, such as non-invasive testing, geophysical exploration and immunoassay analysis.

(3) Efforts Toward the Expansion of Superconductor Applications

Ninety-seven years have passed since superconductivity was first discovered in 1911. Twenty-two years have passed since Drs. J.G. Bednorz and K. A. Müller first reported the high temperature superconductor with Tc of about 30K. Now we have high temperature superconductors with much higher Tc, more than 100K. In the interim, various efforts for the technological development and commercialization of this technology have been vigorously and continuously pursued. Several products using superconductor technology have been commercialized, including NMR and MRI systems using superconductor magnets, and superconductor technology is regarded as indispensable for the realization of both high energy particle accelerators and nuclear fusion reactors. This technology is already responding to societal demands.

We are entering into an uncharted era where we are reaching the limits of fossil-based energy. At this critical point in time, the development stage of YBCO wire technology, which is expected to play a key role in the expansion of various HTS power technology applications, is being successfully completed. We have now added YBCO wire, a very promising key product, to our superconductor product line-up, although development efforts will need to continue so that YBCO technology may surpass conventional technologies on every front. Using this technology, we will be able to contribute to the solution of our present-day and future energy-related problems in much more sophisticated, environmentally significant ways. To realize the commercialization of superconductor technology on a much wider front, development efforts in various power application fields must be continued, strengthened and expanded. Convincing future customers of the economic viability and technological reliability of superconductor technology is critical for all power application development programs. Without customer confidence in this, and other new technologies, its commercialization will not occur.

Regarding electronics applications, we must be able to cope with the need to communicate and process large amounts of information. Failure to meet this need could lead to societal chaos. Thanks to their ultra high-speed and extremely low energy consumption, superconductor electronics technologies, including superconducting routers and superconducting computer servers, are expected to play very important roles in IT. For the expansion of superconducting electronics technology applications, various problems remain to be solved before full commercialization becomes feasible. Steady efforts to realize the commercialization of superconductor electronics technologies must continue.

It is incumbent upon the global superconductivity community to engage in a concerted effort to realize the full commercial utilization of these new technologies that will help ensure the sustainable future economic growth and prosperity of human-beings. The superconductor industry is typical of other technology-intensive, emerging industries in that it faces a lengthy period of high capital investment for development and testing. For the expansion and commercialization of superconductor technologies, sustained governmental commitment and support are vital and essential.

Good products eventually enter the mainstream marketplace when coupled with a concerted effort to showcase their benefits, reliability and ultimate cost-effectiveness. This is an unchangeable truth. ISIS-17 delegates are confident that superconductor technology will

flourish in the near future.