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# Superconductivity Web21

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## SMES Project Won the 60th IEEJ Technical Development Award

The SMES project (Project Leader: Yoshinori Tatsuta) "Superconducting Magnetic Energy Storage System (hereinafter called "SMES") Technical Development (FY 1999 to 2003)" has received the 60th IEEJ Academic Promotion Award (IEEJ Technical Development Award) from the Institute of Electrical Engineers of Japan (IEEJ, Chairperson: Tadashi Fukao) at the ordinary general meeting of IEEJ held on May 21, 2004. The recipients are five people representing the project: Naoki Hirano (Chubu Electric Power Co., Inc.)*, Satoshi Hanai (Toshiba Corp.), Kan-ichi Terazono (Kyushu Electric Power Co., Inc.), Hiroyuki Ohsaki (The University of Tokyo) and Yoshinori Tatsuta (ISTEC).

The IEEJ Technical Development Award is one of the old-line IEEJ Academic Promotion Awards dating back to 1942 at IEEJ (examples of other awards are IEEJ Distinguished Paper Award and IEEJ Book of the Year Award). This time, this award was given to eight cases that contributed to the development and advancement of electrical science and technology. This award was given as the technical development results of the SMES project, which International Superconductivity Technology Center (ISTEC) has been entrusted from New Energy and Industrial Technology Development Organization (NEDO), contributed significantly to the development of electrical science and technology.


This SMES project has a target to the SMES for small-scale power system control for which there are market needs and its practical application is expected, and has developed a cost reducing technology focusing at superconducting coils. In particular, cost minimum design of superconductive metal coils, manufacturing of model coils considering the performance equivalent to actual equipment's and performance verification test were carried out on both the SMES for 100MW/15kWh system stabilization and the SMES for 100MW/500kWh load change/frequency adjustment. In the results, they succeeded in 5kA/s 4-pulse high-speed current passage test of the model coils for system stabilization, in 10,000-time repeated current passages of model coils for load change compensation unequaled anywhere in the world, and verified the compatibility between cost competitiveness and technical performance of SMES.

Photo: Recipients of the 60th IEEJ Academic Promotion Award (IEEJ Technical Development Award)
From the left, Messrs. Satoshi Hanai, Yoshinori Tatsuta, Naoki Hirano, Hiroyuki Ohsaki, Kan-ichi Terazono

These technical development results have already spread to the development of SMES for instantaneous voltage drop compensation* at private companies, and are developing to a

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technical development of superconducting power network control intending also the application of oxide superconductors which have hidden potential to achieve the further improvement in economical efficiency. These facts are expected to boost the early practical application of SMES as power equipment.

* Mr. Naoki Hirano received the distinguished presented paper award from Cryogenic Association of Japan on May 24, 2004 for his presented paper "Development of 5MVA-5MJ Instantaneous Voltage Drop Compensating SMES System" (2003 Autumn conference, 1B-p01).

(Yasuzo Tanaka, Editor)

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# SRL and Nagoya Institute of Technology Jointly Developed A Magneto-Optical Thin Film by LPE for Superconductor Evaluation

Morioka Laboratory for Applied Superconductivity Technology of Superconductivity Research Laboratory (SRL) and Nagoya Institute of Technology succeeded in growth of Bi-substituted iron garnet film $(Bi,Lu)_3(Ga,Fe)_5O_{12}$ that shows substantial Faraday effect in the optical region and good magnetic field sensitivity on a (100) oriented 1-inch diameter single-crystal substrate of $Gd_3Ga_5O_{12}$ (GGG) as the results of joint development for Year 2003. This film is “in-plane” magnetized film having a spatial resolution of about 1μm as magnetic flux density distribution.

The magneto-optical imaging method that enables the observation of flux density’s spatial distribution is playing important role in superconductor’s critical current density evaluation and weak coupling inspection. Generally used as a detection medium is the magnetized garnet film having in-plane magnetization direction and large Faraday rotation angle, however, it is getting unavailable recently on a global scale. SRL carried out this development as a part of the technological development of high-temperature superconducting wire evaluation promoted by a NEDO project “Research and Development on Basic Technologies for Superconductivity Applications” (started in Year 2003), and developed this magneto-optical thin film by Liquid Phase Epitaxy (LPE) method, jointly with Nagoya Institute of Technology.

At the beginning of the LPE growth, a $PbO-B_2O_3$ flux agent and garnet-component oxide are agitated at a temperature higher than the saturation temperature by 100°C or more and left at rest for the first step so that the garnet component will melt completely in platinum crucible. When growing a film, single-crystal substrate of GGG is soaked in melt with being kept in a horizontal position in a supercooled state in order to keep supersaturated condition, and rotated for epitaxial growth until a film of desired thickness is formed. To grow a high-quality film, melt composition and film growth conditions (temperature of melt, growth time, rotation speed, etc.) are important factors, and the $(Bi,Lu)_3(Ga,Fe)_5O_{12}$ film exhibits various characteristics depending on such conditions. To grow a film having in-plane axis of easy magnetization, the lattice constant difference between the $(Bi,Lu)_3(Ga,Fe)_5O_{12}$ film and GGG single -crystal substrate is an important variable. As the lattice constants of both film and substrate become smaller by cooling and the lattice constant difference also varies, the film preparation shall be conducted considering the temperature range to use. Figure shows the observation result of YBCO/IBAD wire’s magnetic flux density distribution at 40K by using the $(Bi,Lu)_3(Ga,Fe)_5O_{12}$ film developed for evaluating superconducting wires. It shows the picture of the flux getting branched and proceeding into with in step with the increase of magnetic field.

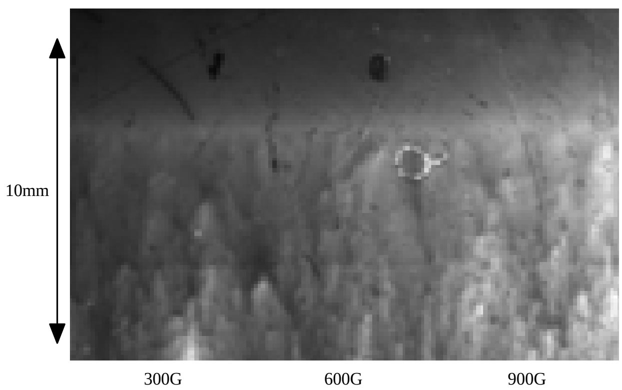


Fig.: Observation of YBCO/IBAD Wire’s Magnetic Flux Density Distribution at 40K by Magneto-Optical Imaging Method

The issue in the future is the development of a Bi-substituted iron garnet film that enables the flux observation with higher spatial resolution. Such magnetized garnet film is considered to contribute to the improvement of the wire characteristics by being utilized for clarifying superconducting wire's defects, grain boundary's flux pinning behaviors, etc.

(Editorial Staff/Morioka Laboratory for Applied Superconductivity Technology of Superconductivity Research Laboratory, SRL-ISTEC)

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# NEDO Determined to Commission FY 2004 project "Development of Superconducting Power Network Control Technology" to ISTEC and Other Two Institutions

New Energy and Industrial Technology Development Organization (NEDO) had accepted candidates for trustee of FY 2004 project "Development of Superconducting Power Network Control Technology" from the general public, and determined to commission the project to three institutions: International Superconductivity Technology Center (ISTEC, President: Hiroshi Araki), Chubu Electric Power Co., Inc. and Kyushu Electric Power Co., Inc. as of June 8, 2004 after a review by the review committee.

This project is a four-year program from FY 2004 to 2007, and the budget scale for the first FY 2004 is 684 million yen. The objectives of this project are the cost reduction of total SMES (Superconducting Magnetic Energy Storage) system aiming for practical application, and the development/verification of a network control system technology by actual system linkage test.

The following items are clarified specifically as contents of research and development. Among them, ISTEC examines these items concretely while recommissioning part of the research of applied technology standardization of SMES system to Central Research Institute of Electric Power Industry, as well as manages a committee of experts to promote the project consistently and efficiently, and ensures the mutual collaboration and total coordination among the institutions to carry out the research and development.

The objective for the last year of this project is to establish a 100MW-class (15kWh for system stabilization, 500kWh for load change compensation and frequency adjustment) power network control system technology using SMES.

(1) Development of SMES system
- Development of system configuration technology
  - Low-cost large-capacity power conversion system
  - SMES coil made of a high-magnetic-field oxide
  - Highly-reliable cryocooler
  - High-withstand-voltage conduction cooling current lead system
- System performance verification by actual system linkage operation test
- Development of system coordination technology

(2) Research of applied technology standardization of SMES system

(Editorial Staff)

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# Forum on Superconductivity Technology Trends 2004

ISTEC held a forum on superconductivity technology trends, entitled "Superconductivity Industry Entered the Dawn", on Thursday, May 20, 2004 at the Toshi Center Hotel, Tokyo. Some 240 people from Japanese government, business, and academic circles, mass media and public participated in the forum, where the results, challenging issues and trends in superconductivity technology development aiming at industrialization were presented and there were keen discussions.

Director Akira Kubota of the Research and Development Division at the Industrial Science and Technology Policy and Environment Bureau in the Ministry of Economy, Trade and Industry, and Director Masahiro Okuda of New Energy Technology Development Department in the New Energy and Industrial Technology Development Organization (NEDO) made congratulatory speeches at the opening of the forum. Their speeches focused on the expectations for the results of research and development which getting to bear fruit and expressed hopes for practical application as early as possible.

Director General Shoji Tanaka of SRL gave the keynote speech

Director General Shoji Tanaka of Superconductivity Research Laboratory (SRL) offered the perspective in his keynote speech titled "Rise of Superconductivity Industry" that the results of high-temperature superconductivity fundamental technology development for the past dozen years or so entered the harvest time recently. The applications to new areas "from quantum computer to nuclear fusion" came to visible, and the visions of the future for the years from 2010 to 2020 that he showed last year started to move.

Director Setsuko Tajima of the Division of Material Science and Physics of SRL reported that the development of high-temperature superconducting wires reached the stage where accumulated findings in basic research can be utilized to improve the characteristics by controlling the composition more precisely.

Senior Staff Masato Murakami of SRL introduced magnetic separation, magnetic levitation, magnet application as specific examples that have reached a practical application level for industry. These applications were based on the successful development of process technology that enabled dramatic improvement in trapped magnetic fields and the improvement in mechanical strength due to resin impregnation etc.

Hidemi Hayashi of Kyushu Electric Power Co., Inc. made a presentation entitled "Practical Application of Environment-Conscious Superconductivity Technology for a New Water-Treatment System" to introduce the design and trial manufacture of mobile magnetic separator using bulk superconductor, its purification characteristics and future issues, etc.

  

Deputy Director Naoki Koshizuka of the Morioka Laboratory for Applied Superconductivity Technology of SRL reported the technical perspective on superconducting bearing for 100kWh-class flywheel , factory test on 10kWh-class power storage system, success in the power storage by superconducting levitation using radial-type bearing, etc. as the results of technology development project of superconducting bearing for flywheel power storage.

Director Yuh Shiohara of the Division of Superconducting Tapes & Wires of SRL reported on the progress of increasing high critical current density, the progress of technology development for the long tape/wire manufacturing process, which are objectives of fundamental application project, and possible efforts for their practical applications in the future.

Ryosuke Hata of Sumitomo Electric Industries, Ltd. introduced a success story towards practical application of second-generation superconducting tape, on condition that high-temperature superconducting cables are a kind of OF cable and wires are part of the cable system.

Director Keiichi Tanabe of the Division of Electronic Devices of SRL reported the successes in realization of 40GHz operation of 4x4 switch, 16GHz operation of microprocessor, etc. due to the establishments of elemental technologies such as planarizing technology and automatic wiring tool during the low-temperature device development as the results of the low-power-consumption type superconducting network device development project, as well as the recent results with high-temperature devices, examples of applications, etc.

Kazunori Yamanaka of Fujitsu Laboratories introduced about the results of design and trial manufacture of superconductor filter for the receiver of mobile base transceiver station, trial-manufactured base transceiver station equipment using superconductor filter, etc.

Managing Director Yoshinori Tatsuta of ISTEC reported on the design and manufacture of model coils and the establishment of SMES coil technology that provides compatibility between economical efficiency and performance through various kinds of tests as the results of NEDO SMES project, the possibility of further cost reduction by using a high-temperature superconducting SMES, and on future issues.

Shigeo Nagaya of Chubu Electric Power Co., Inc. reported on the SMES system at the stage of practical application by introducing about the design, manufacture, installation and verification result of a SMES system for instantaneous voltage drop compensation.

As a wrap-up speech, Professor Osami Tsukamoto at Yokohama National University made a keynote speech entitled “Applications of superconductivity technology to Industrial Electric Machinery and Apparatus”, and introduced the application to ships that requires low-speed large-torque, space saving and high efficiency as the prospective superconducting motor markets in transportation sector, the introduction of superconducting DC cable to data centers that allows expectations for merits of large reductions in transmission loss and space occupancy in the telecommunications sector, and the roadmap regarding wire development and its applicable sectors.

Additionally, Ex-Professor Hisao Hayakawa at Nagoya University made a keynote speech on recent development of superconducting digital equipments, and expressed his conviction that the advantages of superconducting digital technology are abilities to enable high-speed operation and low power consumption at a level that any of the conventional technologies such as CMOS could not realized, and its application field will extend to A/D converters by SFQ, switches for high-end router, and further to high-end computers.

The R&D of Fundamental Superconducting Application Technologies project has entered the time to harvest the results and the hope for early practical applications is growing. This forum made the participants realize the significance and importance of the ongoing integrated research and development projects among academic, business, and governmental circles.

Lecture scene

(Masaharu Saeki, Director, Research & Planning Department, ISTEC)

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# What's New in the World of Superconductivity (August)

## Power

### Intermagnetics General Corporation (August 4, 2004)

SuperPower, Inc. announced that it has obtained a world-record performance of 70 amperes using a highly uniform, 100-m length of second-generation (2G) HTS wire. This record surpasses SuperPower's previous world record of 6,000 amp-meters announced last March. The achievement of 100-m lengths of 2G wire is of particular importance, since this is the minimum length required for the fabrication of commercial devices. Predicted Glenn H. Epstein, chairman and chief executive officer of Intermagnetics (SuperPower's parent company), "We expect to achieve a milestone of 100 amperes, 100 meters before the end of 2004 and thus be commercially viable in 2005 and in full-scale production by 2006. Annual production capacity in 2006 is planned to be about 1,000,000 meters, which can easily be scaled up or down to meet market requirements…"

SuperPower also announced the first shipment of 2G HTS wire to Sumitomo Electric Industries for use in the Albany HTS cable project. The shipment consisted of more than 60 meters of wire that will be used to construct a one-meter test cable, in advance of the 30-meter cable section that will be installed in 2006. The AC loss of the 4-mm wide wire that was shipped was 20 times lower than previously demonstrated, a feature of great importance for minimizing the associated cryogenic refrigeration requirements. In total, SuperPower expects to supply a total of 8,000 meters of 2G wire to the Albany cable project by the fall of 2005.

Thirdly, SuperPower, in cooperation with X-Ray Optical Systems, Inc. and using funding from the New York State Energy Research and Development Authority (NYSERDA), has received a prestigious R&D 100 Award for the development of a quality control system. The system consists of a tabletop X-ray diffraction system for measuring the uniformity of both the buffer and superconducting layers of 2G wire. Pellegrino commented, "This invention will enhance SuperPower's ability to provide a high-quality, high-performance end product, which is absolutely critical to establishing our commercial viability."

Also reported at the 2004 Department of Energy Peer Review, SuperPower has provided four electrical coils, containing about 25 m of 2G HTS wire, to Rockwell Automation Power Systems. These coils were used in a small demonstration HTS generator, thought to be the world's first demonstration of 2G wire in a rotating machine. Rockwell Automation reported that the test generator had been operated at 1800 rpm and 1.2 horsepower.

Source:
"Intermagnetics' Superpower Subsidiary Achieves New World-Record Performance in Second-Generation HTS Wire"
Intermagnetics General Corporation press release (August 4, 2004)
http://ir.thomsonfn.com/InvestorRelations/PubNewsStory.aspx?partner=10215&storyId=118611

### American Superconductor Corporation (August 5, 2004)

American Superconductor Corporation announced the successful operation and testing of an advanced prototype SuperVAR synchronous condenser in a First Energy power transmission grid in Mansfield, Ohio. The SuperVAR condenser generated 8 mega-VAR of reactive power on a continuous basis, improving on an earlier model that was installed in a Tennessee Valley Authority (TVA) grid in

  

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January 2004. The advanced prototype reflects an improvement in the condenser's rotor design to increase the robustness of the machine and further reduce manufacturing costs. The prototype was operated at 1,800 rpm and13.8 kilovolts under no-load and load conditions. At present, the prototype is being shipped to Tennessee for installation in a TVA power grid.
Source:
"American Superconductor's SuperVAR™ Synchronous Condenser Successfully Generates Reactive Power on Ohio Transmission Grid"
American Superconductor Corporation press release (August 5, 2004)
http://www.amsuper.com/newsEvents/news.html

**American Superconductor Corporation (August 5, 2004)**

American Superconductor Corporation reported their financial results for the first quarter of fiscal 2005, ending June 30, 2004. Net revenues increased 63% to a record US $12.7 million, compared to net revenues of $7.8 million for the same quarter in the previous fiscal year. The net loss for the quarter was $4.9 million, compared with $8.4 million for the same period in the previous fiscal year. The company received $12.1 million in new orders and contracts during the first quarter; their order and contract backlog as of June 30, 2004, was $64.2 million, of which $42 million is expected to be recognized as revenue in fiscal 2005.
Source:
"American Superconductor Reports Fiscal 2005 First Quarter Results"
American Superconductor Corporation press release (August 5, 2004)
http://www.amsuper.com/newsEvents/news.html

**Intermagnetics General Corporation (August 30, 2004)**

SuperPower, Inc. and other dignitaries have announced the completion of successful proof-of-concept tests in the matrix fault current limiter (MFCL) development program. The devices being developed will eventually be used to protect utility transmission grids from power surges. SuperPower is leading the development project, in partnership with Nexans SuperConductors, GmbH. The project is sponsored by the Superconductivity Partnerships with Industry (SPI) program, under which the US Department of Energy will contribute half of the project's projected US $12.2 million development cost. The Electric power Research Institute (EPRI) has also committed $600,000 to the project. The proof-of concept tests complete the first major milestone of the development program and will provide the basis for a scale-up in design to transmission level operating voltages. Philip J. Pellegrino, president of SuperPower (a subsidiary of Intermagnetics General Corporation), elaborated, "The tests also showed that the MFCL provides significant current limiting (as much as 50% limitation) within about 50 milliseconds, which is the time at which conventional circuit breakers start to open to isolate a short circuit. This feature could obviate the need to upgrade multiple circuit breakers in transmission substations because, without the addition of an MFCL, their interrupting capability would eventually be exceeded. Depending upon the number of breaker replacements, or in a worse case, the necessity to build a new substation, the avoided cost could be many millions of dollars." The next prototype, which will be capable of withstanding transmission level voltage requirements, is scheduled for completion in late 2005.
Source:
"Intermagnetics' SuperPower Subsidiary Reports Successful Testing Of Prototype Superconducting 'power valve' Device"
Intermagnetics General Corporation press release (August 30, 2004)
http://ir.thomsonfn.com/InvestorRelations/PubNewsStory.aspx?partner=10215&storyId=119594

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## Medical

**CardioMag Imaging™ (August 9, 2004)**

CardioMag Imaging™ (CMI) announced that is has received comprehensive approvals and international quality certificates, such as CE certification, for the distribution of its magnetocardiograph (MCG) medical diagnostic systems in Europe, Canada, and elsewhere. These certificates ensure customer quality assurance, supporting the US Food and Drug Administration's recent approval of CMI's MCG systems for sale to the cardiology diagnostic market in the USA. CMI's MCG systems are expected to be of interest to hospitals, diagnostic imaging centers, and research institutions, enabling the rapid, accurate, and noninvasive diagnosis of a variety of cardiac conditions, particularly coronary artery disease. Several institutions are already using MCG to monitor cardiac events and to detect the sources of arrhythmias, and units installed in Germany, Italy, and China, as well as in the USA, are being used for groundbreaking research in the field of cardiology.

Source:
"CardioMag's Heart-Health Scanner Receives International Marketing and Product Quality Certification"
CardioMag Imaging™ press release (August 9, 2004)
http://www.cardiomag.com/about/news/CE_Press_Release_8-9-04.pdf

## Material

**Superconductive Components, Inc. (August 18, 2004)**

Superconductive Components, Inc. (SCCI) has reported their financial results for the second quarter ending June 30, 2004. Total revenues increased by 5.3% to US $661,162, compared to $627,765 for the same period in the previous fiscal year. The growth in revenue was mainly due to an increase in product shipments. Contract research revenue also increased by 6.5%, compared to the same period in the previous fiscal year, mainly due to a Phase II Department of Energy grant for the development of a manufacturing method for producing continuous reacted lengths of HTS wire. Dan Rooney, Chairman, President and Chief Executive Officer of SCCI, commented, "Market conditions began to gradually improve during the second quarter. Total revenues increased 29.7% on a sequential quarter basis and were also above the same period last year. Solid contributions to the second quarter revenues were realized from focused marketing initiatives. We are working diligently to improve our margins and also achieve sustained revenue growth, despite mixed signals from the economy at the end of the second quarter."

Source:
"Superconductive Components, Inc. Reports Second Quarter Results"
Superconductive Components, Inc. press release (August 18, 2004)
http://www.targetmaterials.com/ne/earnings/scci24.htm

## Communication

**Superconductor Technologies Inc. (August 5, 2004)**

Superconductor Technologies Inc. (STI) reported their financial results for the second quarter,

ending July 3, 2004. Net commercial product revenues amounted to US $4.6 million, compared to $8.9 million for the same quarter in the previous fiscal year. Government and other contract revenue amounted to $1.8 million, compared to $2.3 million for the same period in the previous fiscal year. Net loss for the quarter was $8.9 million, including restructuring charges of $2.5 million, compared to $3.1 million of the same period in the previous fiscal year. M. Peter Thomas, president and chief executive officer of STI, commented, “In the second quarter, we improved STI's financial flexibility by taking measures to lower our breakeven point, and by successfully concluding a public offering of common stock. Our cost reduction efforts will save STI about $1.7 million per quarter beginning in the third quarter, relative to our expenditure rate in the first quarter. Our public offering raised net proceeds of $16.8 million for the company.'' As of July 3, 2004, STI had a commercial product backlog of $1.8 million. The company expects third quarter total revenues to increase to $7.0 to $8.0 million, with a greater contribution from commercial revenues to the overall mix than what was realized in the second quarter.
Source:
“Superconductor Technologies Announces Second Quarter 2004 Results”
Superconductor Technologies Inc. press release (August 5, 2004)
http://ir.thomsonfn.com/InvestorRelations/PubNewsStory.aspx?partner=5951&storyId=118731

**Superconductor Technologies Inc. (August 19, 2004)**

Superconductor Technologies, Inc. (STI) has been named to the Deloitte & Touche’s prestigious Los Angeles Technology Fast 50 program for the third consecutive year. The Technology Fast 50 program ranks the fastest growing technology companies in the Los Angeles area. The rankings are based on the average percentage of growth in fiscal year revenue over a five-year period. Commented M. Peter Thomas, president and chief executive officer of STI, ''We are honored and very proud to achieve this prestigious milestone for the third year in a row. Despite a sluggish start in the first half of 2004, we now are cautiously optimistic about the future. Our customers have reported improving results and are showing signs of rebounding. As they enter into an upgrade cycle to expand coverage and capacity and introduce next-generation data networks, we look forward to helping them in these endeavors.''
Source:
“Superconductor Technologies Inc. Again Named One of LA's Fastest Growing Tech Companies in Deloitte & Touche 'Technology Fast 50' Program”
Superconductor Technologies Inc. press release (August 19, 2004)
http://ir.thomsonfn.com/InvestorRelations/PubNewsStory.aspx?partner=5951&storyId=119282

## Basic

**University of Illinois at Urbana-Champaign (July 30, 2004)**

Scientists at the University of Illinois at Urbana-Champaign have identified a large particle-hole asymmetry in the density of excitation states in HTS tunnel junctions embedded in a single crystal heterostructure. Since current theories predict that superconductors possess particle-hole symmetry, these results are unusual and, as yet, unexplained. Professor James Eckstien, leader of the research group, explained, ''Below the superconducting transition, the tunneling conductance showed a large unexpected asymmetrical feature near zero bias. This is evidence that crystals of high-temperature (cuprate) superconductors, atomically truncated with a titanate layer, have intrinsically broken particle-hole symmetry.'' The spectra exhibited the expected superconducting gap at a negative bias, corresponding to the tunneling of electrons from states with a particle-like character, but exhibited a step-like increase at a positive bias, corresponding to the tunneling of electrons into states with a hole-like character. Thus, the symmetry between particle-like and hole-like excitations was broken at this interface in the superconducting state.

The heterostructures in which the experiments were performed were grown by oxide molecular beam epitaxy and optimized using in situ monitoring techniques, resulting in the unprecedented crystalline perfection at the superconductor/insulator interface that led to the present results. "The presence of this well-defined interface obviously perturbs the superconductivity," Eckstein said. "So these results can provide a new test for theories of high-temperature superconductivity." The research will be published in an upcoming issue of Physical Review Letters.

Source:
"Asymmetric feature shows puzzling face for superconductivity"
University of Illinois at Urbana-Champaign press release (July 30, 2004)
http://www.news.uiuc.edu/news/04/0730eckstein.html

**University of California, Berkeley (August 16, 2004)**

Researchers at the University of California, Berkeley, and the Lawrence Berkeley National Laboratory, in collaboration with The University of Tokyo, have demonstrated that crystal lattice vibrations play a significant, but unconventional, role in superconductivity. Conventional high-temperature superconductor theory generally ignores these lattice vibrations, known as phonons, centering instead around the idea that superconductivity arises from the movement of "holes", left by the depletion of electrons, over a background of magnetic moments. However, the possible role of phonons in high-temperature superconductivity has not been completely discarded and continues to be a topic of debate. To shed light on this issue, the researchers substituted heavier oxygen-18 for oxygen-16 in a Bi-2212 superconductor, believing that the heavier and stiffer lattice would affect the electron cloud in the superconductor. Using angle-resolved photoemission spectroscopy (APRES), which measures the velocity of the electrons in a material, information was obtained that unambiguously shows the direct influence of the lattice on the single electron dynamics in the cuprate material. The results showed that the action of phonons can no longer be excluded from working theories describing high-temperature superconductivity and may help to identify new, as yet undiscovered, classes of superconductors. The research was published in the July 8 issue of Nature.

Source:
"Vibrations in crystal lattice play big role in high-temperature superconductors"
University of California, Berkeley press release (August 16, 2004)
http://www.berkeley.edu/news/media/releases/2004/08/16_Lanzara.shtml

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

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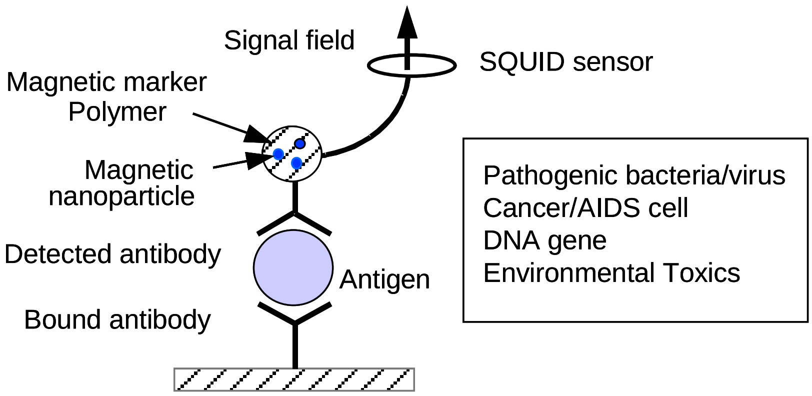
# Feature Articles: Superconducting Electronics- Extending SQUID* Application - Immunoassay Method Using SQUID -

Keiji Enpuku, Professor
Research Institute of Superconductor Science and Systems
Kyushu University

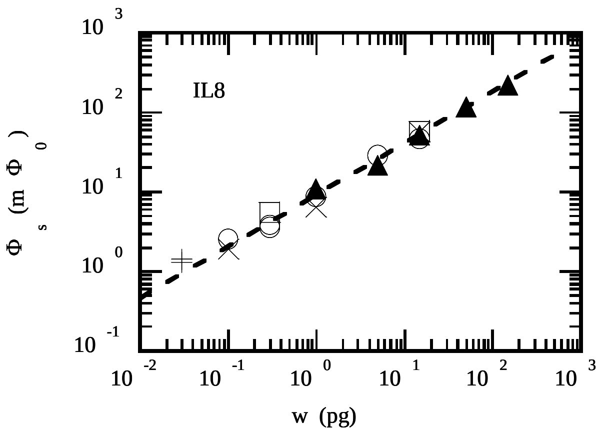
In medical diagnosis, a biological immunoassay as shown in Fig. 1 (a) is used for detecting pathogenic bacteria, cancer cell, etc. The substances to detect are named generically as antigen, and a test reagent (antibody) that combines selectively with antigen is used for its detection. In this case, the antibody is labeled with something called marker, and the antigen-antibody binding reaction can be detected by measuring the signal from the marker.

The popular markers currently used are optical markers such as fluorescent enzyme. As another new immunoassay, magnetic immunoassays to use magnetic marker and SQUID sensor are attracting attention recently. As weak magnetic signals from markers can be measured by using SQUID, SQUID is expected to enable very high-sensitive immunoassays. To improve the sensitivity of this magnetic immunoassay; (1) magnetic marker to generate a large magnetic signal (2) SQUID system of which the distance from a sample at room-temperature is adjacent to the extent of approx. 1 mm, (3) optimization of magnetic field detection method (magnetic susceptibility, magnetic relaxation, magnetic remanence), etc. are required.

Fig. 1 (b) shows the results of immunoassay using magnetic remanence. As antigen, the protein used for diagnoses of cancer etc. called "Interleukin 8 (IL8)" was used. The horizontal axis in the figure shows the weight of IL8 (=w(pg)), and the vertical axis shows the flux signal detected by SQUID (=$\Phi_s$). There was a good correlation between the two. In this experiment, the IL8 up to 0.03 pg could be




(a)




(b)

Fig.1 (a) Magnetic immunoassay using magnetic marker and SQUID
(b) Relationship between weight of antigen (IL 8) obtained by immunoassay (=*w*) and signal flux (=$\Phi_s$).

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detected. This results shows that this system is 30 times or more sensitive than the conventional optical method. In addition, this system will be able to detect IL8 of 0.01 pg or smaller when a proper improvement is done. Once this improvement is realized, the system becomes 100 times or more sensitive than the conventional one, and turns to an innovative system in immunoassay field.

References
1) K. Enpuku, D. Kuroda, A. Ohba, T. Q. Yang, K. Yoshinaga, T. Nakahara, H. Kuma and N. Hamasaki, Jpn. J. Appl. Phys. Vol. 42, No. 12A, p. L1436 (2003)

*SQUID stands for Superconducting QUantum Interference Device.

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# Feature Articles: Superconducting Electronics- Extending SQUID Application - Mobile Whole-head SQUID Magnetoencephalograph (MEG) in a High-Temperature Superconducting Magnetic Shield -

Hiroshi Ohta
Millimeter-Wave Devices Group, Wireless Communications Dept.
National Institute of Information and Communications Technology

National Institute of Information and Communications Technology (NICT) made the MEG (Fig. 1) of SQUID of SNS (Superconductor/Normal Metal/Superconductor) mesoscopic junction and superconducting magnetic shield, and demonstrated that it is more than100 times more sensitive than a SQUID system in a standard magnetically shielded room of Permalloy below 1 Hz. We have successfully conducted demonstration experiments twice; during "Nano Tech 2003" held from February 26 to 28, 2003 at Nippon Convention Center "Makuhari Messe"; and during "Nano Tech 2004" held from March 17 to 19, 2004, at Tokyo International Exhibition Center "Tokyo Big Sight", and succeeded in observing brain magnetic fields in the large crowds both times. At the demonstration experiment at

Fig. 1 Developed MEG

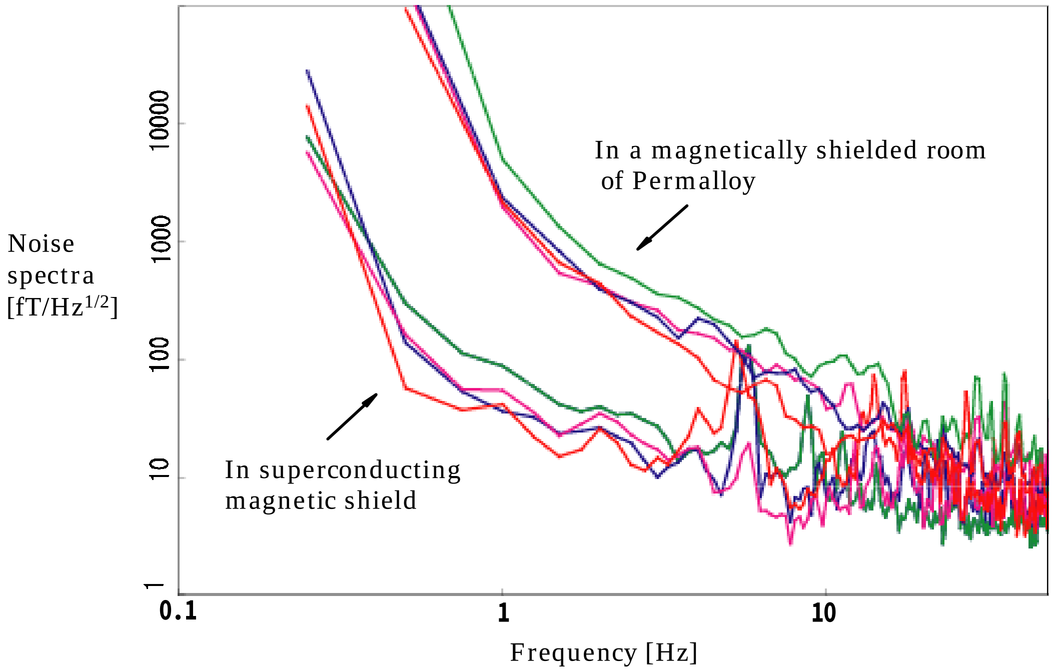


Fig. 2 Comparison of noise spectra of a same SQUID both measured in a magnetically shielded room of Permalloy and in the superconducting magnetic shield.
(The same color corresponds to the same SQUID in the different magnetic shields.)

Tokyo Big Sight in March 2004, the signal-to-noise ratio (S/N ratio) was much better than that in the last demonstration experiment at Makuhari Messe. This time, both of the site-schedule and the time-schedule forced us to start operation of the SQUID system by using a 20kVA generator and a coolant chiller, mounted on a 10-ton truck with air suspension. As a result, we have learnt a lot about what are required to make a mobile SQUID. The success in this experiment could be a step toward a mobile clinic for mental care.

Magnetic fields generated by nerve currents in brains are much weaker than the earth magnetic field, and magnetically shielded rooms of Permalloy have been used conventionally. However, environmental magnetic noises by traffic of cars and trains(movement of steel blocks) within several kilometers in radius have the maximum peak around 0.1Hz. The superconducting magnetic shield of high-temperature phase of BSCCO is perfectly diamagnetic and its shielding factor does not degrade even at lower frequencies than 1Hz . Figure 2 shows comparison of the noise spectra measured in the magnetically shielded room of Permalloy and in the superconducting shield by using the same SQUID sensors. The SQUID sensors in the superconducting magnetic shield are more than 100 times more sensitive than those in a magnetically shielded room of Permalloy below 1 Hz. Up to the present, more than 200 subjects were measured using this SQUID system.

Figure 3 shows data of 64 channels together using the common time axis. In longer latencies than 250ms, theta rhythms of 6Hz are observed. In particular, nodes of the theta rhythm oscillations in long latencies are very narrow just inducating that the low-frequency noise of this SQUID system is very small. Responses in brains evoked by sensory stimulations such as median nerve stimulation generally phase out by around 250ms. The signals in longer latencies than 250ms appear in the second somatosensory area etc., and are related with higher functions of the brains. These rhythmic after-discharges observed in long latencies could be caused by afterdepolarization or afterhyperpolarization. The thalamo-cortical network will be understood better by investigating brain function in long latencies.

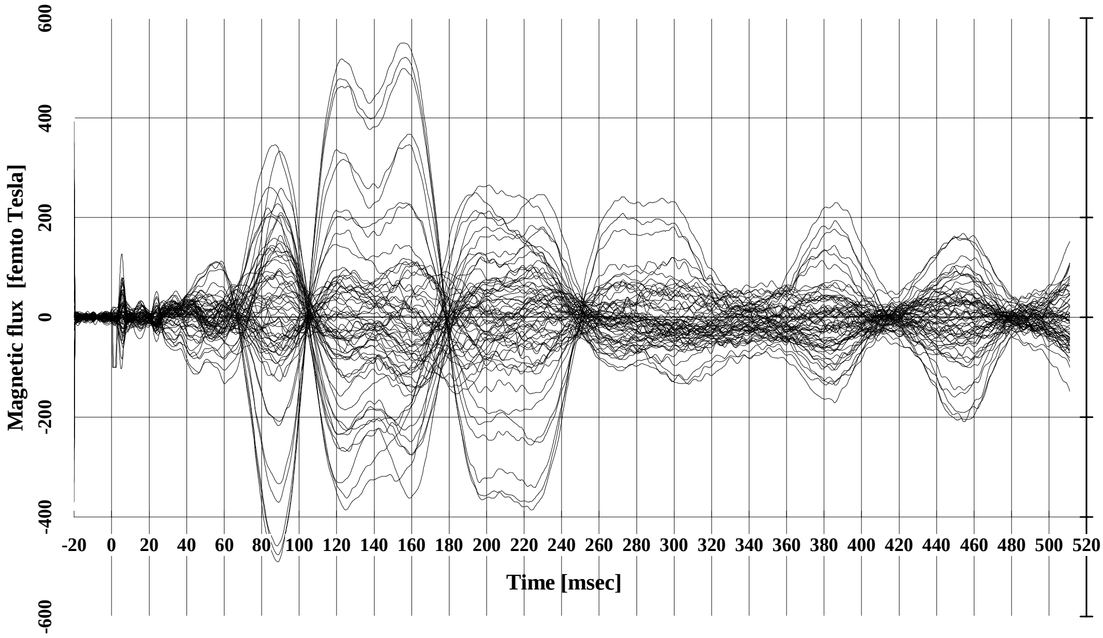


Fig. 3 Data of 64 channel SQUID in the superconducting magnetic shield vs. the common time axis.

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The time constant of hyperpolarization-activated cation current $I_h$ is about 1 sec, and the current controls not only thalamus and hippocampus, but also heartbeat. In addition, time constants of calcium ion channels involved with memory and learning are much longer than 1 sec requiring good magnetic shield at low frequencies.

It is expected that the SQUID system will be used for the experimental confirmation of neural network models that manifest our understanding of human brain.

This new MEG using the high-temperature superconducting magnetic shield, which has been experimentally proved to have technological advantages, could be used more popularly both in neuroscience researches and clinical researches in the near future. The organizer of Biomag2004 expressed a strong interest in this equipment made by years of continuous efforts by many researchers. Details of this research are published in Proceeding of the 14th International Conference on Biomagnetism (Biomag2004) held in Boston from August 8 to 12, 2004.

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# Feature Articles: Superconducting Electronics- Extending SQUID Application - Semiconductor Inspection by HTS Laser SQUID Microscope -

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SQUID (Superconducting Quantum Interference Device) is the most sensitive magnetic sensor in the solid devices, however, it will face a big problem when, for example, trying to measure the magnetic field distribution of a semiconductor. The problem is the inability to measure with spatially detailed distribution. The main cause is the distance to the observation object arising from the fact that the object is at room temperature whereas SQUID shall be kept at low temperature by vacuum insulation. In addition, if reduce the size of SQUID, its good sensitivity as a feature will be sacrificed. To solve this problem, we are developing a laser SQUID microscope applying the principle that the object is irradiated with a focused laser beam and the induced change in magnetic field will be measured by using SQUID. The observable objects are limited to those which will bring changes in magnetic field by laser beam, however, as the laser can be focused to the extent of wavelength in principle, the spatial resolution will be improved to the extent of the total of focusing area and the blur of magnetic signal source.

Fig. 1 shows the block diagram of laser SQUID microscope. HTS-SQUID magnetometer is used in the magnetic shield. As a lock-in detection is executed in synchronization with laser beam amplitude modulation, the magnetic shield is not required to be strict one such as for biomagnetism measurement. Various wavelengths from ultraviolet to near-infrared are selectable for the laser according to the bandgap of target semiconductor. To minimize the magnetic noise, the servocontrol by piezoactuator is executed to a location accuracy of 0.3 µm by using a ceramics sample stage.

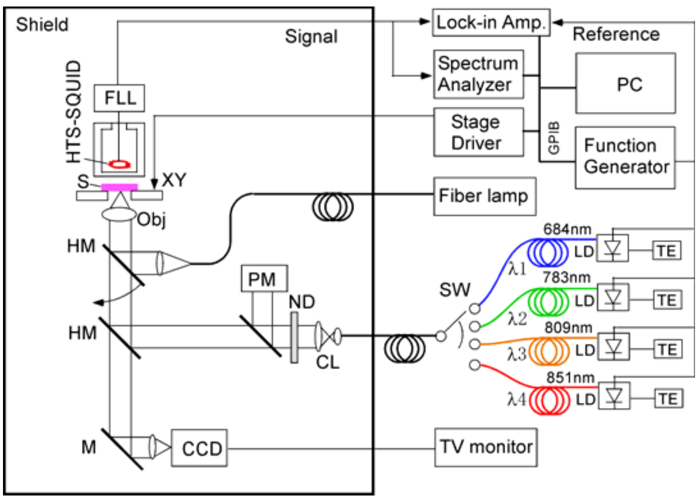


Fig. 1 Block diagram of laser SQUID microscope

Fig. 2 shows a measurement example of a power diode formed in silicon wafer by thermal diffusion. This sample in manufacturing process has the structure that p-n junctions are arranged concentrically, and the corresponding magnetic field distribution was obtained. In this figure, it can be confirmed that the minimum diffusion layer line width of this sample 20µm was identified sufficiently. In addition, we are developing a method to measure the diffusion length of minority carrier from the wavelength dependence of photocurrent (magnetic field) by using 4 different laser wavelengths.

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In the next place, regarding the multi-crystalline silicon substrate to be used for solar battery etc., the evaluation of crystal grain boundary becomes important as it may cause an effect lowering. As the magnetic field changes rapidly in the crystal grain boundary, the magnetic field distribution was second-order-differentiated spatially (Fig. 3). The laser SQUID method does not remove the current to outside, so all the photo-generated carriers recombined. The merit of application to solar battery is the ability to measure the magnetic field distribution when the internal recombination current is maximum.

**Summary**

The combination of laser and SQUID is effective for improving the spatial resolution of SQUID. In addition, with this semiconductor measurement by using laser SQUID microscope, the information about electric structure is obtainable without contact, measurement is available even when insulative surface oxide film or nitride film is existing, there is no concern about metal pollution due to a probe contact, thus, this measurement method is useful for evaluation in process of manufacturing or rapid feedback.

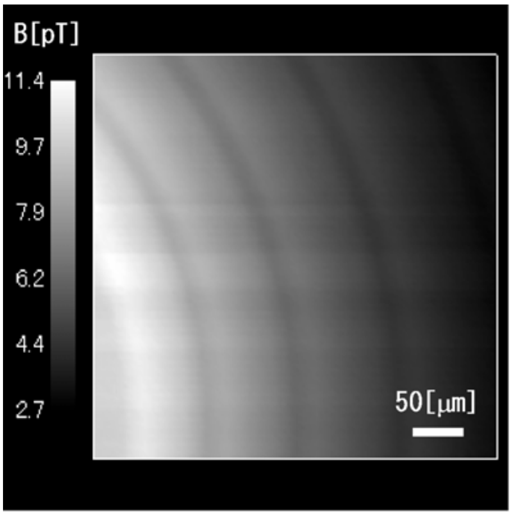


Fig.2 p-n junction of diode inside silicon wafer

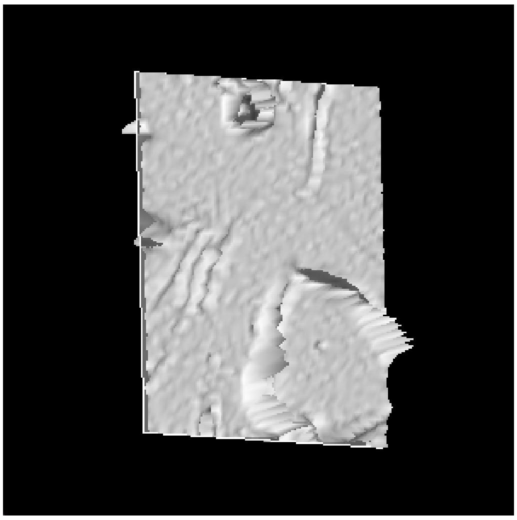

Fig.3 Crystal grain boundary of polycrystalline silicon wafer (second-order-differential image of magnetic field distribution)

**References**

1) M. Daibo et al., Physica C, Vol.357-360, pp.1483-1487, 2001.
2) M. Daibo et al., Physica C, Vol.372-376, pp.263-266, 2002.
3) M. Daibo et al., IEEE Trans. Appl. Supercon., Vol.13, No.2, pp.223-226, 2003.
4) M. Daibo et al., The 64th semiannual meeting of JSAP (the Japan Society of Applied Physics), 2a-X-4, pp. 222, 2003.
5) M. Daibo et al., SICE (the Society of Instrument and Control Engineers) Trans. on Industrial Application, Vol.2, No.3, pp.19-26, 2003.

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## Feature Articles: Superconducting Electronics- Extending SQUID Application - Application of Scanning SQUID Microscope to Digital Device Process -

The scanning SQUID microscope unit is the equipment that enables the observation of a local flux condition by making SQUID scan the sample surface. This equipment is known for being used in the research of the superconducting energy gap symmetry, etc. in the early 1990's. Currently, this equipment is already commercialized by SII NanoTechnology Inc. etc. here in Japan as well. The scanning SQUID microscope unit displays its greatest force especially in the superconducting device field. The superconducting SFQ (Single Flux Quantum) circuit is very susceptible to magnetic field. Given this factor, it is very important to design a magnetic-field-resistant and much more reliable circuit by observing flux condition with the use of a scanning SQUID microscope and feeding back the results to the circuit design. Introduced here is the flux image observation results of the SFQ sampler circuit[1] that has the moat array[2] for flux trapping being designed by such process. Fig.1 shows the flux density image observed by using the Nb-dc-SQUID-equipped scanning SQUID microscope system after cooling the $YBa_2Cu_3O_y$ (YBCO) SFQ sampler circuit with superconducting ground-plane designed and manufactured in Superconductivity Research Laboratory, to 10K or lower in the magnetic field of about 1μT. The peak structure is the flux quantum $\Phi_0$(=$2.07\times10^{-15}$Wb) trapped in the circuit when cooling. In contrast, you can see that the flux was trapped in the 5μm-width narrow moat structures formed into ground-plane for flux trapping, and no flux was trapped in the main part of the circuit, which includes Josephson junctions etc. as being surrounded by moats. Moreover, the required magnetic shield level can be found out by investigating the threshold of magnetic field from which a flux enters into the area surrounded by moats. Described here is just an example. The scanning SQUID microscopic observation is an avenue of research that provides important guidelines on circuit design for the development of superconducting devices. With the practical application of superconducting device circuit approaching, such observation is considered to be getting more important in the future.

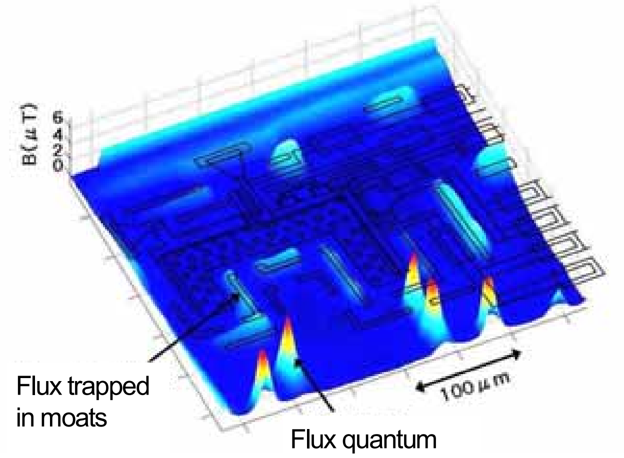


Fig.1 Flux density image of the YBCO SFQ sampler circuit having the superconducting ground-plane with moats, observed by using the scanning SQUID microscope system (made by SII NanoTechnology Inc.)

**References**

1) M. Hidaka, M. Maruyama, T. Satoh: IEICE (the Institute of Electronics, Information and Communication Engineers) Trans., Nov. 2003, 1128-1135.
2) K. Suzuki, H. Suzuki, S. Adachi, T. Utagawa, U. Kawabe, K. Tanabe: Physica C, vol.378-381 (2002) 1301-1305.

(Koji Suzuki, Division of Electronic Devices, SRL/ISTEC)

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# Feature Articles: Superconducting Electronics- Extending SQUID Application - Development of Geological Survey Technology Using Superconducting SQUID -

Tatsuoki Nagaishi, Senior Engineer
Hajime Ohta
Development Group, System & Electronic Equipment Division
Sumitomo Electric Hightechs Co., Ltd.

Eiichi Arai, Deputy Director
Exploration Technical Development Team
Metal Exploration Group
Japan Oil, Gas and Metals National Corporation

In the recent exploration of metallic ore deposits, the case of hidden head of ore deposit is getting more probable, and the location is moving farther inland. These facts are raising the hopes for the geophysical exploration, a remote sensing method. Commonly used is the method using induction coil, but the exploration technology using high-sensitive SQUID as sensor is expected to improve the exploration accuracy. In addition, while the induction coil measures the time change of magnetic field, SQUID measures the magnetic field displacement itself, thus SQUID is considered to have an advantage in the measurement of induction current that attenuates rapidly in the ground.

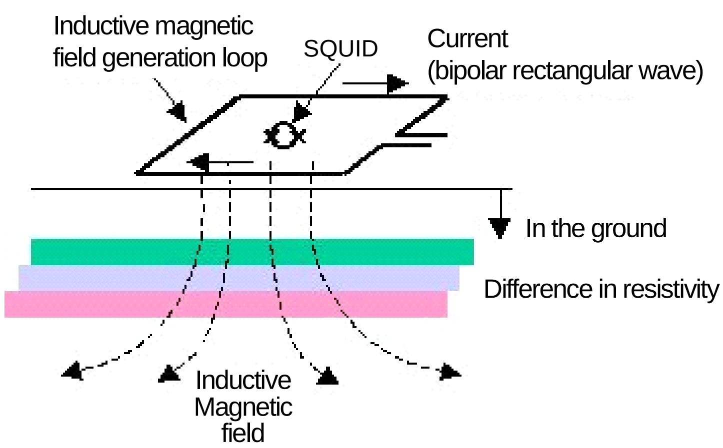


Fig.1 Geological survey technology using superconducting SQUID

The application of high-temperature superconducting SQUID to the geological survey technology has been studied energetically in Australia and Germany. [1), 2)] In Japan, Japan Oil, Gas and Metals National Corporation (former Metal Mining Agency of Japan) has been playing a central role in the development since 1998.

Fig. 2 Developed SQUID system
(Left: Sensor portion, Right: Measuring portion)

As shown in Fig. 1, in the geological survey using SQUID, the rectangular wave current is applied to the magnetic field sending loop set up on the ground surface, and the inductive magnetic field made by induction current induced underground after turning off the current is measured by using the SQUID installed on the ground surface. As the diffusion depth at time t of electromagnetic field that diffuses in depth direction is proportional to the square root of t, the time dependency of magnetic field strength after turning off the current is equal to the profile of underground resistivity in depth direction.

For the SQUID to be applied to geological survey, unique performances are required. For example, ①Cooling and magnetic-shieldless operation under earth's magnetic field, ②operational stability in several-handred-nT-order rectangular magnetic field, ③from the aspect of practical use, adjustment of SQUID, display of measurement data and integrating data, and data storage functions using personal computer, ④battery-operated, etc.

The system having been developed pursuing these performances has achieved the performances exceeding those of conventional equipment. Fig.2 shows the system of triaxial-3ch (1ch x 2 is also acceptable), consists of the probe integrated with drive circuit, liquid nitrogen dewar, controller, A/D converter, personal computer, and battery. The achieved noise is 100fT/$\sqrt{\text{Hz}}$ or less under the earth's magnetic field, and the achieved through rate is 7.3mT/sec. For details of performance etc., refer to References3) -7).

To confirm the effectiveness of SQUID system, we

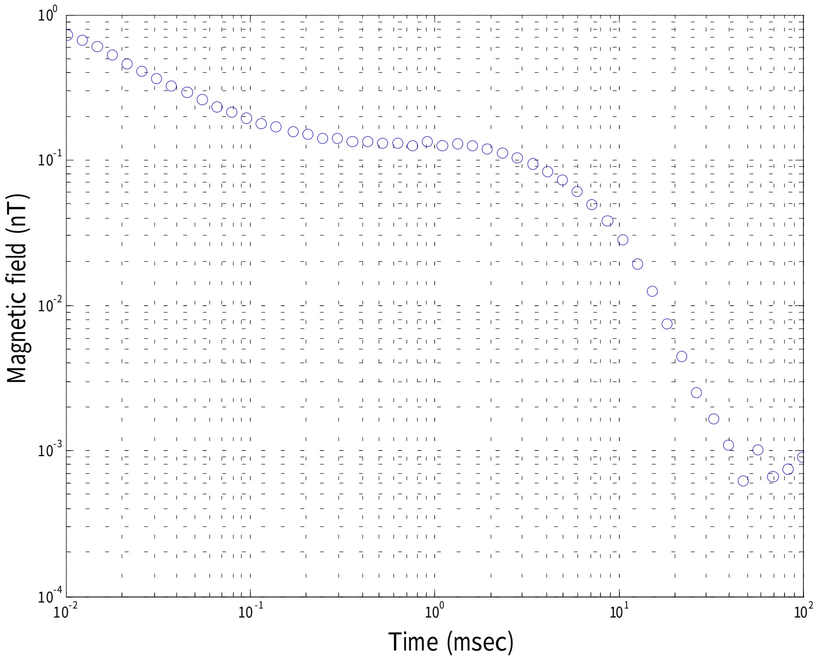


Fig. 3 A case of measurement by SQUID

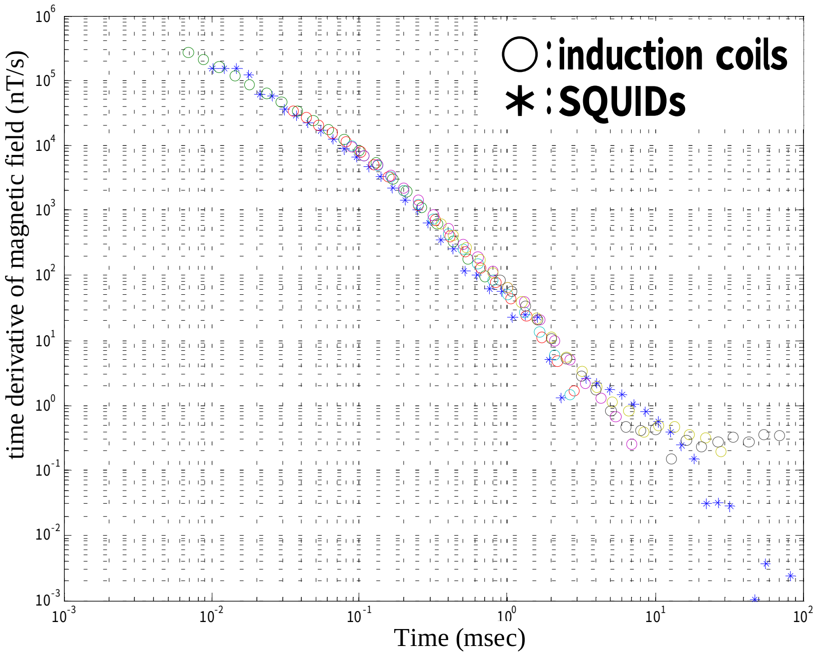


Fig. 4 Data comparison between induction coil and SQUID

performed field tests at several sites in Japan. Shown here is the test result at the vacant lot of Kosaka Mine in Akita prefecture. In Fig. 3, the slope changes with time as sharp-gentle-sharp. This indicates that the layers of high-low-high resistivities exist in this order from the ground surface. There was a problem that the information about the underlying low-resistive layer was hard to obtain with induction coil. With this SQUID, however such information was observed clearly. Fig. 4 shows the result after plotting the differentiated SQUID-measured data on the same graph for comparison with conventional system. While the values measured by induction-coil type were saturated at 10msec, SQUID succeeded in measuring on and after 30msec. This means a deeper exploration depth is available with SQUID.

As described above, the originally expected effectiveness of SQUID was confirmed. In the future, we are planning to carry out the development toward the practical application by improving the system stability, portability, etc. and increase the completeness of this system.

This research and development was carried out as part of the project "Research of Mineral Resources Exploration Technology Development etc./ The Development of High Precision Geophysical Exploration System" commissioned by Ministry of Economy, Trade and Industry.

**References**

1) C. P. Foley, K. E. Leslie, R. Binks, C. Lewis, W. Murray, G. J. Sloggett, S. Lam, B. Sankrithyan, N. Savvides, A. Katzaros, K. -H. Muller, E. E. Mitchell, J. Pollock, J. Lee, D. L. Dart, R. R. Barrow, M. Asten, A. Maddever, G. Panjkovic, Mark Downey, C. Hoffman and R. Turner, "Field Trials using HTS SQUID Magnetometers for Ground-based and Airborne Geophysical Applications", IEEE Trans. Appl. Superconductivity, vol.9, no.2, pp.3786-3792, June 1999.
2) M. Bick, G. Panaitov, N. Wolters, Y. Zhang, H. Bousack, A. I. Braginski, U. Kalberkamp, H. Burkhardt, U. Matzander, "A HTS rf SQUID Vector Magnetometer for Geophysical Exploration", IEEE Trans. Appl. Superconductivity, vol.9, no.2, pp.3780-3785, June 1999.
3) New Energy and Industrial Technology Development Organization: Report on the development Item "Development of Disaster Prediction Technology" (2000)
4) Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry: Report on Research of Exploration Technical Development in 2002/ Development of High-Accuracy Geophysical Exploration Technology (2002)
5) Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry: Report on Research of Exploration Technical Development in 2003/ Development of High-Accuracy Geophysical Exploration Technology (2003)
6) Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry: Report on Research of Exploration Technical Development in 2004/ Development of High-Accuracy Geophysical Exploration Technology (2004)
7) Eiichi Arai, "Development of the Data Acquisition System for Time-Domain Electromagnetic Method Using SQUID Magnetometer for Mineral Exploration", Cryogenic Engineering, Vol.38, No.9 (2003)

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# Superconductivity Related Product Guide
# - Superconducting Quantum Interference Device (SQUID) Related Products -

**(Company names in Japanese syllabary order)**

**-- SII NanoTechnology Inc.**
Nb low-temperature scanning type SQUID microscope and other scientific equipments
Tel: +81-43-211-1338 Fax: +81-43-211-8067 e-mail: yukiya.watanabe@sii.co.jp
Contact: Mr. Yukiya Watanabe, 1st Sales Sec., 1st Sales Dept.

**-- Sumitomo Electric Hightechs Co., Ltd.**
SQUID beginner's kit and SQUID experimental kit using high-temperature superconducting magnetic sensor, SEIQUID II, SQUID microscope, biomagnetometer, antigen-antibody reaction inspection equipment, detector for magnetic foreign objects mixed in food etc., semiconductor inspection equipment, geological survey equipment and other scientific equipments
Contact: Mr. Nagaishi, Mr. Ohta; Tel: +81-72-771-3022 Fax: +81-72-771-3023

**-- Medical Systems Sales & Marketing Div., Life Science Business Group, Hitachi High-Technologies Corp.**
MC-6400 Hitachi Magnetocardiograph system
Technical Contact: Mr. Shigeaki Naito (Hitachi High-Technologies Corp.)
Tel: +81-3-3504-5818 Fax: +81-3-3504-7756
e-mail: naito-shigeaki@nst.hitachi-hitec.com
Sales Contact: Mr. Hiroshi Hanaoka (Fukuda Denshi Co., Ltd.)
Tel: +81-3-5684-1233 Fax: +81-3-5684-1315
e-mail: hanaoka@fukuda.co.jp

**-- MEG Center, Aerospace Products Business Headquarters, Yokogawa Electric Corp.**
Magnetoencephalograph (MEG), small-size weak magnetic field measuring equipment
Tel: +81-422-52-5662 Fax: +81-422-52-5946 e-mail: meg@csv.yokogawa.co.jp
Contact: Mr. Hideaki Tomizawa

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# Feature Articles: Fusion Reactor and Superconductivity

## - Superconductive Materials to Be Used for Superconducting Coils in the International Thermonuclear Experimental Reactor (ITER) and Their Required Performance -

Kiyoshi Okuno, Head
Superconducting Magnet Laboratory
Department of Fusion Engineering Research
Japan Atomic Energy Research Institute

The International Thermonuclear Experimental Reactor (ITER) project started with its conceptual design activity as a quadripartite international cooperation among Japan, European Union (EU), Russia and USA in 1988, and through nine-year engineering design activity from 1992, completed with its final design report in 2001. At present, adding China and Korea, the construction site is under selection by six parties toward a completion of the construction in the mid-2010s.

As shown in Fig., there are three kinds of superconducting coils in ITER: toroidal field (TF) coils, a central solenoid (CS), and poloidal field (PF) coils. Used for these coils are forced-flow-cooling conductors made by bundling approx. 1000 superconducting wires having 0.8mm diameter and enclosed in a metal tube. For the TF coils and CS, $Nb_3Sn$ is used as superconducting material because they will be operated in a magnetic field of 12 to 13T, whereas NbTi is used for PF coils because it will be used in a magnetic field of 6T or less.

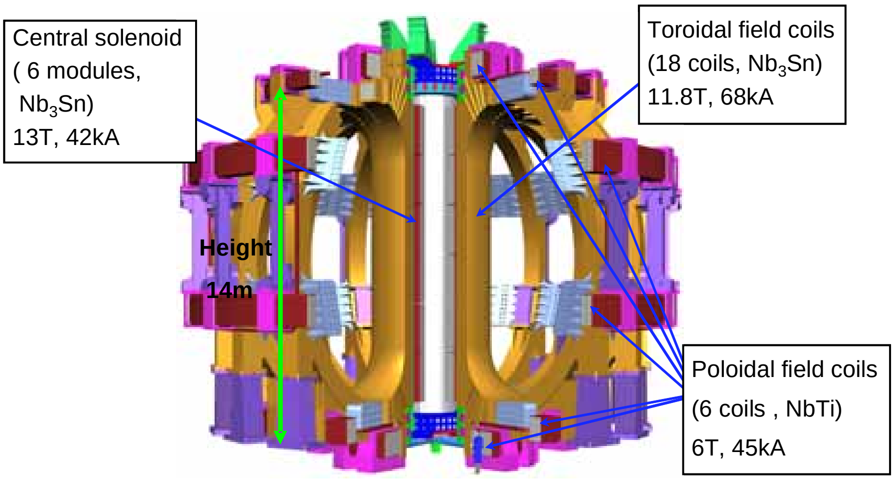


Fig. Superconducting coils in the International Thermonuclear Experimental Reactor (ITER)

In the engineering design activity of ITER, we have developed a CS model coil to be operated in the ITER-relevant conditions of high magnetic field (13T) and high current (46kA). One of the major issues in this development was to establish a technology for a high-performance $Nb_3Sn$ wire having high current density and low hysteresis loss. The typical manufacturing processes of $Nb_3Sn$ wires are the bronze process and the internal diffusion process. For the of bronze process, of which the hysteresis loss is originally low, increasing the tin concentration of bronze is necessary for improving the critical current density, and we developed a wire manufacturing technology available for such bronze which was harder due to higher tin content of 14%. Nowadays, 15% to 16% high-tin-concentration bronze was developed, and higher current

  

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density became possible. On the contrary, for the internal diffusion process of which increasing current density is relatively easy, reducing hysteresis loss had been an issue, and we established a method to reduce the loss by preventing the bridging between filaments. Herewith, we succeeded in the development of a high-performance $Nb_3Sn$ wire that actualizes high current density and low hysteresis loss at a time, and established the mass production technology.

Meanwhile, the design approach and design accuracy were improved by carrying out the tests and detailed evaluations of the CS model coil. In the result, the required performances shown for $Nb_3Sn$ wire in the ITER were the critical current density of 700 A/mm$^2$ or above (bronze process), 800A/mm$^2$ or above (internal diffusion process) at 12T and 4.2K, and 1000mJ/cm$^3$ (±3T) as the upper limit of hysteresis loss. These requirements are well achievable by extrapolation of the technologies developed with model coils. The total weight of $Nb_3Sn$ wires required for ITER is approx. 500 ton, and NbTi wires approx 250 ton.

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# Superconductivity Web21

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## Feature Articles: Fusion Reactor and Superconductivity
## - Superconductive Materials for Demonstration Power Reactor -

As is well known, the decision on the construction site for International Thermonuclear Experimental Reactor (ITER) has been much delayed. However, there is no doubt that ITER is the first step in developing a commercial fusion reactor. While the mission of ITER is "to demonstrate the fusion reaction and reactor engineering", that of "demonstration power reactor" is literally "to demonstrate the power generation". And then, the construction of "thermonuclear power plant" towards "commercial power generation" will follow.

For the development of fusion reactor also, like a development of other equipment, not only the demonstration of principle but also the market competitiveness of cost of energy (COE) is strongly called into question. It is said that the cost of superconductivity-related equipments will constitute one-third of the fusion reactor construction cost, and the magnetic field strength for plasma confinement is known to have a large impact on COE as shown Fig. 1.

As seen in Fig. 1, COE relates to the magnetic field strength and the β value of plasma. The generated magnetic field in ITER (the maximum magnetic field applied to the wires composing the magnet) is 13 Tesla (T), and this magnetic field strength is considered to be not competitive with the existing nuclear power generation in terms of COE. Regarding the superconducting magnet for "demonstration power reactor", two options are now under consideration. One option is the magnetic field of 16T that is regarded to allow the use of superconducting wires made of $Nb_3Al$. To be cost competitive with this magnetic field, the further advancement in plasma physics, that is to say β value enhancement*, is required. The other option is to generate a magnetic field around 20T for which high-temperature superconducting wires, especially Y

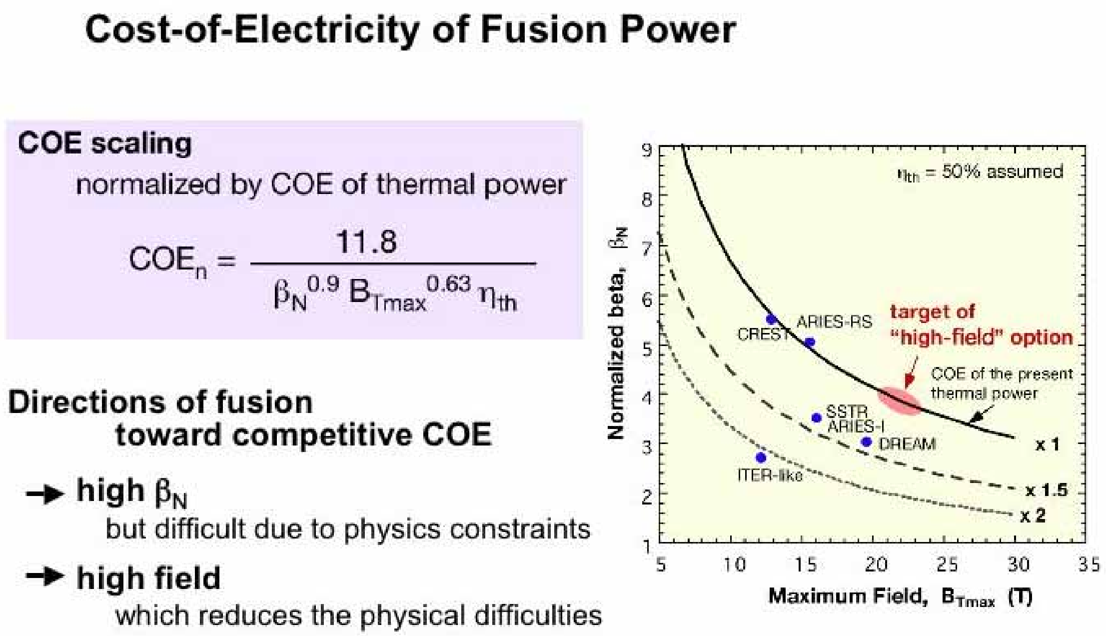


Fig. 1 Relation between magnetic field and β value for unit cost of energy by fusion reactor
(Source: Japan Atomic Energy Research Institute)

  

wires are front runners. The merit to use such wire is that the high fusion output is available with the current β value. Therefore, a choice of enhancing β value or making magnetic field strength to be around 20T is presented to realize a commercial reactor. Once a long high-temperature superconducting Y wire is developed, as shown in Fig. 2, the generation of magnetic field of 20T or more is possible in principle if selecting operating temperature properly. There is a potential as wire.

Regrettably, the maximum length of existing Y wires in the world is only approx. 100m, however, it is obvious from case of NbTi wire development (ratio of superconducting wire section to copper wire section is 1:1) for the magnet for magnetic levitation propulsion system, that huge projects such as the development of fusion reactor can play a leading role in the wire development. When generated magnetic field became higher, the electromagnetic force to be applied to the magnet also becomes larger, and the magnet manufacturing technology including the development of structural materials seems to be attended with particular difficulties. Despite such difficulties, the efforts to overcome them and lead the development to success are required. Regarding the "demonstration power reactor", its operation is considered to start around 2030. As the full-scale design is regarded to start after R&D for about 10 years from now, to advancing the R&D of Y wires and to find out the applicability to "demonstration power reactor" or "commercial power reactor" during this period are deemed necessary. In addition, as the wire manufacturing technologies to be developed in such process are applicable to superconducting equipments for general industries, the promotion of application/diffusion of superconducting equipments to general industries as well as the solution of energy problems are expected.

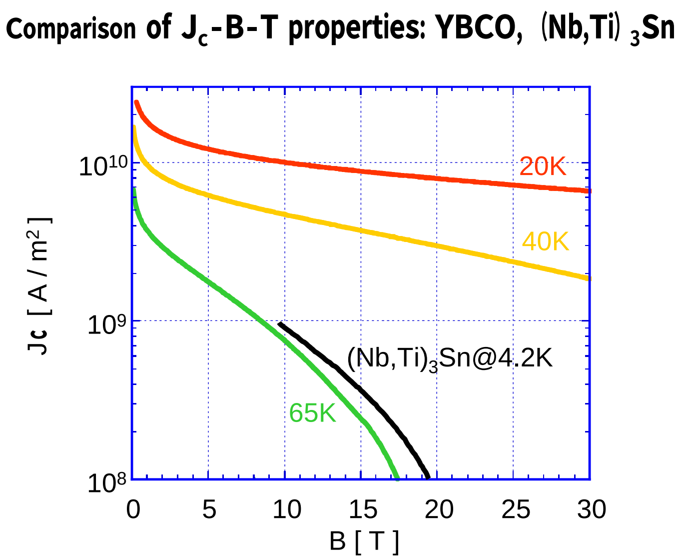


Fig. 2 Relation between magnetic field and critical current density of YBCO (comparison with $(NbTi)_3Sn$ wires)
(Source: Prof. Kiss at Kyushu University)

β value enhancement*

β value is the index of efficiency of fusion reactors such as Tokamak type to be used to confine magnetic field.

β value depends on the plasma particle density, plasma temperature and applied magnetic field. Therefore, a high β value operation in a strong magnetic field is important for higher efficiency of fusion reactor.

(Osamu Horigami, Director, SRL/ISTEC)

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# Feature Articles: Fusion Reactor and Superconductivity
## - Large Helical Device (LHD) and Superconducting Technology -

Toshiyuki Mito, Division Director / Professor
Fusion and Advanced Technology Systems Division
Department of Large Helical Device Project
National Institute for Fusion Science (NIFS)

The Large Helical Device (LHD) is the world's first helical type plasma experimental equipment that adopted superconducting coils to all coils for magnetic confinement, and capable of confining currentless steady-state plasma by heliotron-type magnetic configuration. The superconducting coil system, the feature of LHD, consists of two helical coils and three pairs of poloidal coils. This is the world's largest superconducting system with a plasma central magnetic field of 3T and magnetic stored energy of 0.9 GJ. National Institute for Fusion Science (NIFS) completed the eight-year LHD construction program from Year 1991 and started the plasma experiment from March 1998. Fig. 1 shows the layout inside the main experimental hall in LHD building. Centering around LHD cryostat, three kinds of plasma heating equipments (NBI, ECH, ICRF), valve boxes (Helical V. B., Poloidal V. B.) which control distribution of cryogen from the cryogenic system to each superconducting coil, etc. are installed.

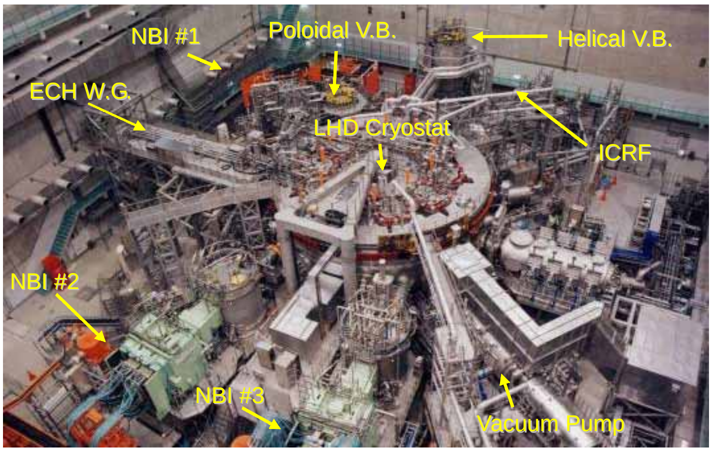


Fig. 1 Inside of the main experimental hall in LHD building

Fig. 2 shows the internal structure of cryostat. The helical coil has major radius of 3.9 m, minor radius of 0.975 m, and the coil does five laps in minor radius direction while doing one lap in major radius direction. The LHD consists of two helical coils (H1 and H2). To make a complex 3-D shape winding to a high position accuracy—within the tolerance of ±2 mm required by plasma experiment, we completed such helical coils by carrying out winding works around the clock for one and a half years from January 1995 to May 1996, by using a

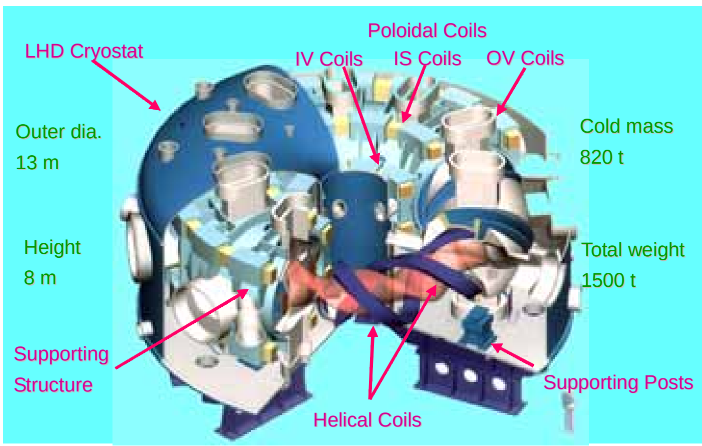


Fig. 2 Inside of LHD cryostat

  

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13-shaft-control special winding machine.

Three kinds of poloidal coils are called as, from the inside to the outside, Inner Vertical (IV) coil, Inner Shaping (IS) coil, and Outer Vertical (OV) coil, and each coil is used in vertical pairs. The largest OV coil has the center diameter of 11.1 m and this is the world's largest existing forced-cooling-type superconducting coil.

For LHD, we have developed and used a superconducting bus line as power line to supply current from the power supply to superconducting coils. Having the maximum rated current of 31.3kA and total extended length of 497m, this is a realization of the world's largest direct current superconducting power line.

Fig. 3 shows the operating history of LHD cryogenic system. For six years up to the spring of 2004, we carried

- Long-term continuous operations carried out: 7 times for 6 years from Feb. 1998.
- Steady operation in superconducting state: 21,887 hours
- Total operation of LHD cryogenic system: 31,963 hours
- Coil excitation: 804 times Plasma shot: 48,721 times

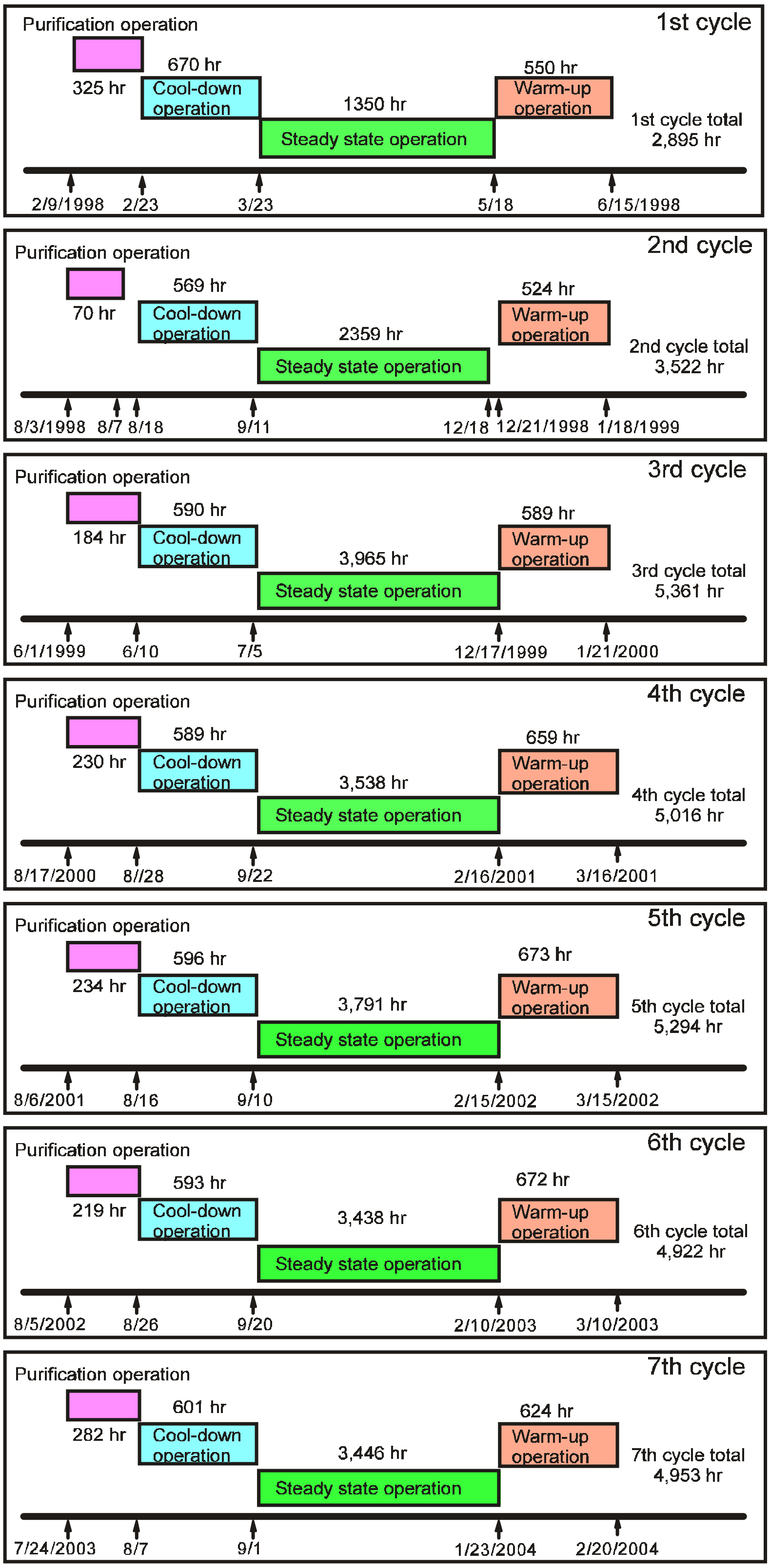


Fig. 3 Operation histories of LHD superconducting system

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out stable long-term continuous operations seven times and enabled a high-performance plasma experiment. One operation consists of cryogenic system's purification operation, cool-down operation for nearly one month, steady operation for about five months, warm-up operation for nearly one month, thus, around the clock continuous operations were carried out for more than two-thirds of a year. During this period, nothing to disrupt the stable continuous operation such as system failure and characteristic degradation of superconducting coils across the ages was observed, and the high reliability and stability of large superconducting system for fusion experiments has been demonstrated continuously.

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# Feature Articles: Fusion Reactor and Superconductivity
# - Prospects for Realization of Fusion Energy Utilization -

Satoshi Morozumi, Research Director
Energy Policy and Technology Research Division
Mitsubishi Research Institute, Inc.

As a global environment problem, it is considered to be almost certain that the global warming due to the green house effect by the carbon dioxide emissions resulting from fossil energy consumption is going on, and to reduce this carbon dioxide emissions is essential for global environment conservation. Accordingly, the focus of the current energy problems is to hold down the fossil energy consumption and shift over to energy sources that do not emit carbon dioxide. The nuclear fusion has been a focus of attention as an energy source that does not release carbon dioxide, in addition, its fuel sources--deuterium and lithium metal are contained nearly exhaustlessly in seawater without locating eccentrically in specific area. As this is also an advantage in problems over resources, the nuclear fusion has been a focus of attention as an ultimate energy source.

Human beings have already actualized a nuclear fusion on earth in form of hydrogen bomb. However, the time to undergo nuclear fusion is instantaneous, and to extract and utilize energy by this method is extremely difficult. For utilization of nuclear fusion energy, a steady heat extraction by undergoing, maintaining and controlling nuclear fusion reaction is necessary. Therefore, to confine these materials in plasma state and control the reaction will be an important technology for utilizing nuclear fusion as energy. To generate a strong magnetic field that confines plasma state, a powerful coil is required. There are several methods for nuclear fusion by magnetic field confinement such as Tokamak method or Helical method. To realize a power generation by nuclear fusion, the critical plasma condition, which depends on the product of plasma core temperature, plasma confinement density and confinement time (heat retention characteristic) shall be cleared as a first step, and then generating plasma and long-time confinement shall be achieved as a second step.

One of Tokamak method fusion experimental facilities is JT-60 installed at Naka Fusion Research Establishment of Japan Atomic Energy Research Institute in 1985. Right now, the critical plasma condition has been achieved at the world's big three Tokamak reactors including JT-60 in Japan. The project following JT-60 is International Thermonuclear Experimental Reactor (ITER). ITER is the equipment to achieve burning plasma in full scale and demonstrate a continuous energy generation of 500MW by nuclear fusion. This ITER is an international collaborative project being started as a new experimental reactor to achieve generating plasma and realize long-time confinement. After the success in ITER, the next step is considered to be a prototype reactor to demonstrate the power generation by nuclear fusion.

  

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## Objectives of experimental fusion reactor

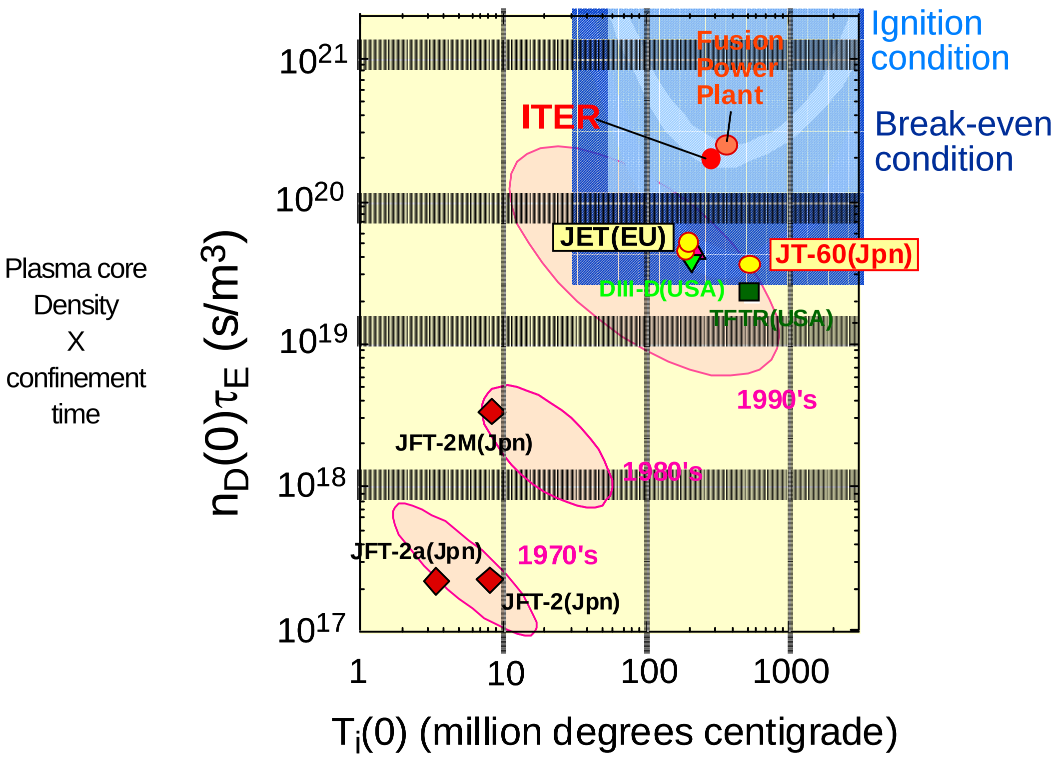


Fig. Position of ITER in development of commercial fusion reactor
Source: Naka Fusion Research Establishment of Japan Atomic Energy Research Institute/
Website of International Thermonuclear Experimental Reactor (ITER)

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# Patent Information

## Introduction of Published Unexamined Patents in the 1st Quarter of Fiscal 2004

The following are ISTEC's patents published from April through June in 2004. For more information, access the homepage of the Patent Office of Japan and visit the Industrial Property Digital Library (IPDL).

**1) Publication No. 2004-111203: "Manufacturing method of $MgB_2$ superconducting wires"**

This invention relates to $MgB_2$ superconducting wires with critical temperature of 39K. The method is to encapsulate the mixed powder prepared by adding appropriate amount of Ti powder to powdery Mg and B, in a metal tube such as copper tube, and after a wire drawing such as dice-work, heat it in the atmosphere of inert gas under high pressure. By repeating the wire drawing and heat treatment several times, the $MgB_2$ superconducting wires having the critical current density no less than $2x10^5/cm^2$ at the temperature of 4.2K can be obtained.

**2) Publication No. 2004-149378: "Method to form a thin film on a substrate via interlayer"**

This invention relates to the method to form superconducting thin film on a substrate via an interlayer and provides a method to select an interlayer material that enables the formation of a high-quality superconducting thin film (epitaxial thin film). This invention is characterized by the steps to calculate the interfacial energy(Ea) of interface A between the substrate and the interlayer, the interfacial energy(Eb) of interface B between the interlayer and the superconducting thin film, and the interfacial energy(Ec) of the substrate-superconducting thin film interface C when forming the superconducting thin film directly on the substrate, then select an interlayer material that meets both conditions $Ea<Ec$ and $Eb<Ec$.

**3) Publication No. 2004-149380: "Single crystal thin film"**

This invention provides a high-quality single crystal superconducting thin film on a substrate, having the same or better properties than single crystal bulk material. When forming superconducting thin film (Sm123 for example) on a substrate ($BaZrO_3$ substrate for example), this invention makes an atomic layer (BaO for example) in the interface between the substrate and the thin film so that it can be shared by both layers, because of existing of the atomic layer in the both layers. Furthermore, this invention is characterized by the epitaxial growth percentage of no less than 50% at a deviation angle within $\pm 2°$ for the thin film layer within the thickness of 100 unit cells from the interface.

**4) Publication No. 2004-161504: "RE-Ba-Cu-O superconductor precursor and RE-Ba-Cu-O superconductive material and method for manufacturing the same"**

This invention relates to a manufacturing method of a large-size bulk superconductor, and provides a simple and easy method to manufacture an Ag-added large-size superconductor by adopting a new precursor structure. The new precursor structure has a layer B stacked on a layer A, in which the layer A is comprised of the RE-Ba-Cu-O-system mixture containing a given amount of Ag or Ag-compound, and layer B comprised of the RE-Ba-Cu-O-system mixture containing reduced amount of Ag or Ag-compound. The manufacturing method is comprised of locating/burring a seed on/in the layer B, heating the precursor until partial melting condition, and cooling down it. By this method, it can be achieved to prevent the reduction of melting temperature of the seed crystal due to the reaction of the seed crystal with Ag, thus the manufacturing of large-size bulk containing large mount of Ag is facilitated.

  

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**5) Publication No. 2004-161505: "Constituents for oxide superconducting thick film and a thick film tape of oxide superconductor"**

This invention relates to new raw materials suitable for the precursor of Y-Ba-Cu-O-system superconducting film by metalorganic deposition method (MOD method), and provides a thick film tape of oxide superconductor formed uniformly at a high speed. The new precursor material is featured by containing a carboxylic copper salt of carbon number six or more, and adopting a mixture of such carboxylic copper salt with selected metallic salts from yttrium trifluoroacetate or yttrium carboxylate, and barium trifluoroacetate etc. to form a precursor film. As the result, the mount of fluorine in the precursor film is extremely reduced, the occurrence of crack is suppressed, and a high-speed film production is achieved.

(Katsuo Nakazato, Director, Research & Development Promotion Division, SRL/ISTEC)

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# Standardization Activities

## - ISTEC and IEEJ Agreed on Superconducting Transmission and Transformation Equipments Standardization Data Research -

International Superconductivity Technology Center (ISTEC) (President: Hiroshi Araki) and the Institute of Electrical Engineers of Japan (IEEJ) (President: Tadashi Fukao) agreed on the research project for standardization data related to superconducting power cables, superconducting current limiters, and superconducting transformers as of May 18, 2004. The implementation term of this project is seven months from May to December 2004.

This project relates to the project that IEEJ is entrusted as a part of "research on effect of introduction" of the national project "Research and Development Project of Key Technology for Alternative Current Superconducting Power Equipment" that Engineering Research Association for Superconductive Generation Equipment and Materials has been entrusted by New Energy and Industrial Technology Development Organization (NEDO) and carrying out as a five-year project from fiscal 2000 through fiscal 2004.

The contents of this project considered to be appropriate are; (1) first of all, extract the object items which conform to standardization from the scientific papers and technical information documents related to superconducting power cables, superconducting current limiters, and superconducting transformers as the results of said national project carried out by Engineering Research Association for Superconductive Generation Equipment and Materials; (2) a part of the extraction work of standardization conforming items has started and general test requirements of superconducting power cables, superconducting current limiters, and superconducting transformers are envisioned; (3) and then, as these requirements are based on the results of research and development projects in Japan, round up them in a form of Technical Specification (TS) considering their completeness and market suitability.

For carrying out this project, under technical assistances of said national project and IEEJ, a new system consists of superconductivity standardization committee, power cable working group, current limiter working group and transformer working group is scheduled to be organized inside ISTEC to accomplish the goal in a short period by mobilizing all available conventional engineers and superconductivity engineers involved in transmission and transformation equipments.

The results of this project are intended to be presented to Japanese domestic IEC/TC90 Superconductivity Committee, which is an international managing member of IEC/TC90 (Superconductivity), and submitted to IEC/TC90 as an international standard proposal through this committee aiming for their reflection on the international standard documents at the end.

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## - 2004 Steering Committee for IEC/TC90 Superconductivity was Held -

Japan national committee for the IEC/TC90 Superconductivity (Chairperson: Shigeki Saito, Senior Managing Director of ISTEC) held the 17th steering committee on June 7, 2004 at a conference room in Tokyo. Participants, from 12 institutions in Japan--eight industry groups and four research-related institutions involved in superconductivity, deliberated on the continuous operation of superconductivity standardization project and Japanese presence as a secretariat country of IEC/TC90.

At the beginning of this conference, drafts of the project report for fiscal 2003, the balance settlement for fiscal 2003, the project plan for fiscal 2004 and the balance budget for fiscal 2004 were passed unanimously. The characteristic projects for fiscal 2004 were an ongoing project commissioned by Ministry of Economy, Trade and Industry "Research and Study of Technical Base Standardization for Superconducting Power Equipments", projects from Japanese Standards Association "operations as secretariat country", "drafting of international response", "drafting of JIS", and a contracting project from the Institute of Electrical Engineers of Japan "Power Transmission and Transformation Equipment Standardization Project". These projects for fiscal 2004 included the dispatch of committee members, adjustment and preparation of deliberation items for the 9th IEC/TC90 international conference to be held for three days from September 1, 2004 at Argonne National Laboratory in U.S., and the proposal to invite 10th IEC/TC90 international conference to Japan.

Subsequently, the superconductivity standardization in Japan came up for discussion. Japan has executed "operations as secretariat country" as secretariat country of IEC/TC90 since 1990. The meanings of this "operations as secretariat country" are the international contribution through the superconductivity standardization as well as the presence of Japanese technological skills in superconductivity.


Supported by the superconductivity-related market grown to a scale around 400 billion yen, the objective of superconductivity standardization in "operations as secretariat country" is shifting from the conventional basic test method standard toward the product specification. However, considering the modest growth rate of superconductivity market itself, it was understood that the most part of the immediate standardization activity would be the integrated promotion with research and development projects.

Within this meaning, "Power Transmission and Transformation Equipment Standardization Project" to be implemented as a new contracting project for fiscal 2004 was understood as part of the integrated promotion activity with the national project "Research and Development Project of Key Technology for Alternative Current Superconducting Power Equipments" to be terminated within fiscal 2004. The goal of this project is preparing a draft proposal of Technical Specification (TS) of general test requirements (general rules) related to the superconducting transmission and transformation equipments which adopt high-temperature superconductors to be introduced in the market pretty soon.

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(Yasuzo Tanaka, Director, Standardization Department, ISTEC)

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