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Emerging Superconducting Technology, A Key Technology for the 21st Century
-Meeting held to discuss trends in superconducting technology-

The International Superconductivity Technology Center(ISTEC) held its 3rd meeting to discuss trends in superconducting technology at the Toshi Center Hotel on Tuesday June 5. About 250 persons from government, companies, universities, institutes, and the press participated in the meeting. On the theme of "Emerging Superconducting Technology, A Key Technology for the 21st Century" eleven reports were presented and a heated question and answer session was followed.

Prof. Tanaka, the director of the Superconductivity Research Laboratory, gave a keynote speech titled "Toward Commercialization of Superconducting Technology." In his speech, he emphasized that it is very important to save the electricity of a server by using superconducting devices and to introduce superconducting electric power systems such as a superconducting cable in order to take measures against an increase in power consumption caused by rapid IT development.

In the material and process technology fields, the following achievements were reported.

(1) Jc of 100,000 A/cm^2 or more was obtained in Bi2223 single crystal, and a large size MgB_2 single crystal growth was successful.

(2) The trapped magnetic field reached 15T at 30K in the Y-based bulk prepared by the resin impregnation method.

(3) Jc of 100,000A/cm^2 and Ic of 50A were obtained with a 10m length next-generation coated conductor.

(4) Hundred junction multilayered structures with a dispersion of 6.6% were successfully prepared and a 190GHz comparator circuit and other devices were manufactured experimentally and demonstrated.

In the application field, latest developments were presented on the following topics:

(1) Using a bulk HTS the processing speed of a film magnetic separation purifier was improved and the purifier was made compact. It is expected to be applied to water purification.

(2) It is expected that use of an HTS in a magnetically levitated train will reduce the construction and operation costs and improve magnet reliability.

(3) High sensitivity and high selectivity of a reception front end for a portable telephone base station can be achieved by using a superconducting filter, which will enhance overall efficiency such as high speed, area expansion, and long-time use of a portable unit.

(4) Through development of the cost-reducing technology in the Superconducting Magnetic Energy Storage(SMES) system, a 15kWh-class system for system stabilization and a 500kWh-class system for load fluctuation compensation and frequency control can be manufactured with 28% and 16% of the conventional cost, respectively.

(5) In the superconducting magnetic bearing project for a fly-wheel energy storage, the loading capacity of a Y-based bulk for ϕ 180 mm (10 kWh) class bearing and an Sm-based bulk has been improved and development of the essential technology for reducing a rotation loss and the application technology has proved to be substantially successful.

Lastly, Professor Masada of the Tokyo Science University made a speech titled "Expectations for Application of Superconducting Technology to Industry," which can be summarized as follows. "The HTS essential technology development is on track toward its goal, with five national projects serving as the core of the superconducting technology development in our country. It is important to put a commercializable product on the market, from the small-scale trial production stage so that the superconducting technology will not miss the boat. The role played by demonstration for the commercialization is of particular importance."

(Yoshinobu Ueba, Director of Research and Planning Department of ISTEC)

(Prof. Tanaka, the director of ISTEC/SRL gave a keynote speech.)

Contents (Fall, 2001)

Survey Report on the Energy-saving Effect Produced by the Application of Superconductivity -Power demand forecast for information and communication equipment and the environmental and energy-saving effect of the application of superconductivity-

Under a commission from the New Energy and Industrial Technology Development Organization (NEDO), the International Superconductivity Technology Center(ISTEC) issued the “Survey Report on the Energy-saving Effect Produced by Applying Superconducting Technology” in March, 2001. This survey forecasts the power demand for information and communication equipment and systems which promise to develop dramatically and come into widespread use in the future. It has also clarified the environmental and energy-saving effects produced by the replacement of existing equipment into the devices using superconductors.

Firstly, the performance of the equipment, the number of units, the operation time, etc. for various types of information and communication equipment within the next five to ten years, have been analyzed in this report in detail, taking into consideration an exponential increase in traffic such as distribution of images and an advance in a conventional semiconductors technology. Next, the power demand of servers and necessary air-conditioning equipment has been forecast with the power consumption per server and the traffic being the parameters.

The power demand of the communication and information equipment and systems in the year 2000 was 41.8 billion kWh. According to a basic estimate, the power demand will be 86 billion kWh in 2005 and 326.8 billion kWh in 2010. These figures account for 4.3%, 8.9%, and 33.8%, respectively, of the total current power demand in our country. Future power demand is expected to be significantly high. Since these figures correspond to 1.2%, 2.6%, and 9.6%, respectively, in terms of carbon dioxide emissions, the environmental load cannot be overlooked.

On the other hand, application of the superconducting technology to servers, mainframe computers, routers and filters for communication base stations will provide substantial energy savings. It is expected that approximately 28% and 35% of the energy can be saved in 2005 and in 2010, respectively, and the environmental load also can be reduced.

Among these superconducting products, filters for communication have already been put to practical use. Subsequently, AD converters, routers, and servers also will be commercially available. There are problems to be solved concerning the development such as an improvement in integrity, an interface with semiconductors and optical devices, and its mounting technique. In spite of these problems, a superconducting device characterized by an ultra high speed and an ultra low power consumption is expected to be a promising device which can overcome speed and power consumption barriers with which silicon semiconductors will be confronted sooner or later.

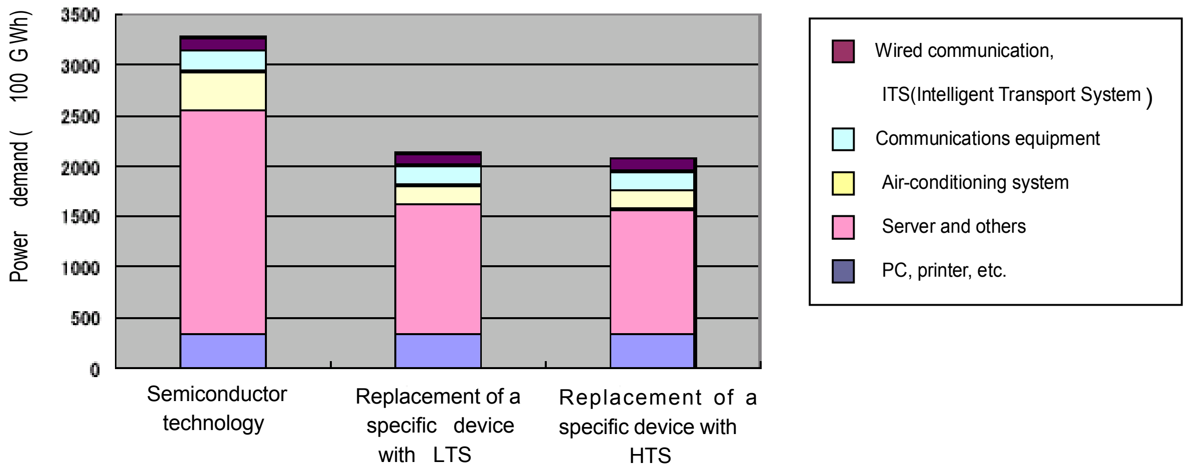
Japan is aiming to realize the world’s top-level ultra-high speed network as its IT policy. Japan is making a plan to enable 30million households to be accessible to a high speed Internet and 10million households to be accessible to the ultra high speed Internet at any time. Everybody admits that a vigorous demand for power underlies the recent energy crisis in California. There is a good prospect that the superconductivity application technology will be developed in the near future. Its speedy development has been proposed so that a possible power crisis triggered by this accelerated computerization can be avoided.

In the 21st century, the superconducting technology has become more and more important as a key technology which can contribute to energy saving and environmental protection, while improving the life of the people in our country and maintaining economic and industrial development.

(You can download the summary of the report written in Japanese from http://www.istec.or.jp/)

(Yoshinobu Ueba, Director of Research and Planning Department of ISTEC)

Power demand forecast for information and communication equipment in 2010 and the energy-saving effect of the application of superconductivity
(LTS: Low-temperature superconductor, HTS: High-temperature superconductor)



ISTEC General Board of Directors Meets

The International Superconductivity Technology Center (ISTEC, President: Hiroshi Araki) held the General Board of Directors in the 28th and the Board of Councilors in the 18th at the Keidanren Kaikan on June 14, 2001. Reports on current undertakings, the settlement of accounts (expenditures in FY 2000: approximately 4.5 billion yen), implementation of subsidiary undertakings in fiscal year 2000, appointment of officers and councilors and other matters were presented. After consultation, these items were unanimously approved. Since Managing Director Shigeru Kikuta had resigned, Yoshinori Tatsuta was elected as his successor, holding concurrently the posts of General Manager and Managing Director.

(Mitsuhiro Anju, General Affairs Department, ISTEC)

ISTEC Extra General Board of Directors Meets

International Superconductivity Technology Center (ISTEC, President: Hiroshi Araki) held the Extra General Board of Directors in the 6th and the Extra Board of Councilors in the 3rd at Shiba Park Hotel on July 4, 2001. Consultations were held on the election of Directors and Councilors and the election of Senior Managing Directors and approved unanimously by the membership. Since Senior Managing Director Masaharu Higuchi had resigned, Shigeki Saito (Former Head of the Examination Procedures Department, Patent Office) was elected as his successor.

(Mitsuhiro Anju, General Affairs Department, ISTEC)

The Conclusion of International Workshops on Superconductivity

The International Workshop on Superconductivity, established in 1989 with the objectives of promoting research on superconductivity and encouraging international exchange programs through the reporting of the latest study results and discussion of specific issues on high-temperature superconductors, closed with the end of the 13th Workshop held in Hawaii in 2001.

The Workshop, which received financial help from the Japan Keirin Association from the beginning, was held every year for a period of twelve years. Since the Workshop in 1992, it was cosponsored every other year by ISTEC and Materials Research Society, MRS, of the USA. Each year, timely topics were chosen and efforts were made to create a relaxed atmosphere for researchers to be able to discuss the issues freely and deeply.

All thirteen workshops, including the 1st International Workshop on Superconductivity with the topic of “Critical Current Densities of High Temperature Superconductors”, which was held at Oiso, Kanagawa Prefecture in 1989, are summarized below. The number of participating countries was five to seventeen each year. The total number of participants reached 1,961 and the total number of theses presented totalled 1,100.

During these years, the mechanisms and basic character of high temperature superconductivity have become clear gradually, which contributed greatly to the technological development of thin film, wire and bulk material, and their manufacturing processes. The studies of high temperature superconductivity have greatly contributed to the construction of basic technologies to realize particularly, SFQ circuit, km class bismuth based silver-sheathed wire, 10-60 m class yttrium based wire, and the single domain bulk superconducting magnet of 100 mm diameter. The author believes that our Workshops have greatly contributed to the progress of the application fields which are steadily and broadly developing such as the AD converter, the superconducting transformer, the single crystal growth application, the power cable, the refrigerator cooling type superconducting magnet, the superconducting bearing for a flywheel, the magnetic separation water purifier and others.

Finally, I would like to take this opportunity to express my heartfelt appreciation to all the research participants and many people who worked on the organization, planning, and operation of the Workshops. A separate list details the thirteen International Workshops held in the past. If you need further detailed information or an “Extended Abstract,” please contact the Superconductivity Web 21 editor or International Superconductivity Technology Center (ISTEC).

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

(The 1st International Workshop on Superconductivity)

A List of the Thirteen Previous International Workshops on Superconductivity

The 13th Workshop

Date: June 24-27, 2001
Place: Honolulu, Hawaii, USA
Theme: “High Temperature Superconductors, Processing and Applications”
Chairperson of Program Committee: Yuh Shiohara, Superconductivity Research Laboratoty and Dr. Robert Hawsey, Oak Ridge National Laboratory
Participating countries: 6
Participants: 100
Papers presented: 82

The 12th Workshop

Date: June 19-22, 2000
Place:Matsue City, Shimane Prefecture
Theme: Structure and Property Relationship for Application of High-temperature Superconducting Materials
Chairperson of Program Committee: Dr. Naoki Koshizuka, Superconductivity Research Laboratory
Participating country: 7
Participants: 129
Papers presented: 87

The 11th Workshop

Date: June 27-30,1999
Place: Kauai Island, Hawaii, USA
Theme: High-temperature Supeconducting Materials and Devices for Electronics Applications.
Chairperson of Program Committee: Prof. Hisao Hayakawa, Nagoya University and Dr. J. Talvacchio, Northrop Grumman Company

Participating countries: 8
Participants: 114
Papers presented: 83

The 10th Workshop
Date: July 12-15, 1998
Place: Naha City, Okinawa Prefecture
Theme: Materials and Technology Issues for High Temperature Superconducting(HTS) Wires and Bulk Applications
Chairperson of Program Committee: Dr. Kohji Kishio, The University of Tokyo
Participating countries: 17
Participants: 141
Papers presented: 95

The 9th Workshop
Date: June 15-18, 1997
Place: Hawaii Island, Hawaii
Theme: Suitable Materials and Processing for High Temperature Superconductor Applications: Towards the Next Decade
Chairperson of Program Committee: Dr. Koji Kajimura, Electrotechnical Lab. and Prof. Eric E. Hellstrom, University of Wisconsin
Participating countries: 14
Participants: 150
Papers presented: 126

The 8th Workshop
Date: June 24-27, 1996
Place: Hachimantai, Iwate Prefecture
Theme: High Temperature Superconducting Electronics: Fundamentals and Applications
Chairperson of Program Committee: Prof. Yoichi Okabe, The University of Tokyo
Participating countries: 10
Participants: 154
Papers presented: 70

The 7th Workshop
Date: June 18-21, 1995
Place: Maui Island, Hawaii
Theme: Controlled Processing of High Temperature Superconductors: Fundamentals and Applications
Chairperson of Program Committee: Prof. Koichi Kitazawa, The University of Tokyo and Dr. Kenneth C. Goretta, ANL
Participating countries: 15
Participants: 181
Papers presented: 158

The 6th Workshop
Date: June 6-9, 1994
Place: Kyoto City
Theme: Critical Currents of High Temperature Superconductors and Related Topics
Chairperson of Program Committee: Prof. Teruo Matsushita, Kyushu Institute of Technology
Participating countries: 17
Participants: 181
Papers presented: 90

The 5th Workshop
Date: June 28-July 1, 1993
Place: Hakodate City, Hokkaido
Theme: Characterization of High Temperature Superconductors: Structures and Properties of Surfaces and Interfaces
Chairperson of Program Committee: Prof. Atsushi Koma, The University of Tokyo
Participating countries: 13
Participants: 134
Papers presented: 73

The 4th Workshop
Date: June 23-26, 1992
Place: Honolulu, Hawaii
Theme: Controlled Growth of Single-and-Poly-Crystals of High Temperature Superconductors
Chairperson of Program Committee: Prof. Tomoji Kawai, Osaka University and Dr. Elton N. Kaufmann, ANL
Participating countries: 15
Participants: 179
Papers presented: 130

The 3rd Workshop
Date: May 13-15, 1991
Place: Kumamoto City
Theme: New Superconductors and Synthesis
Chairperson of Program Committee: Prof. Shin-ichi Uchida, The University of Tokyo
Participating countries: 7
Participants: 143
Papers presented: 35

The 2nd Workshop
Date: May 28-30, 1990
Place: Kagoshima City
Theme: New Processing of High Temperature Superconducting Films
Chairperson of Program Committee: Prof. Yoshichika Bando, Kyoto University
Participating countries: 6
Participants: 185
Papers presented: 36

The 1st Workshop
Date: February 1-3, 1989
Place: Oiso, Kanagawa Prefecture
Theme: Critical Current Densities of High Temperature Superconductors
Chairperson of Program Committee: Dr. Koji Kajimura, Electrotechnical Laboratory, AIST
Participating countries: 5
Participants: 170
Papers presented: 35
(The titles are those at the time the Workshops were held.)
(Akihiko Tsutai, Director of the International Affairs Department, ISTEC)

ISTEC was entrusted with the "high-function superconducting material technology research and development" project by NEDO.

New Energy and Industrial Technology Development Organization (NEDO) invited public participation for "high-function superconducting material technology research and development." International Superconductivity Technology Center (ISTEC) was entrusted with the project.

The high-function superconducting material technology research and development aims to enhance the function of bismuth-based (Bi) high-temperature superconducting wire so that a high-temperature superconducting magnet can be widely applied to industrial equipment.

The content of this development project is as shown below.

-To develop a manufacturing technology for a long bismuth-based silver-sheathed wire with a higher function by decreasing the proportion of silver contained in the sheathed wire and reinforcing the wire

-To develop a manufacturing technology for a deformed (racetrack type) coil and magnet which can find more extensive application in the industry and development of power supply and cooling system technology which accompanies the coil and magnet manufacturing technology

-To study the magnet specifications which can realize energy saving when applied to industry such as application to a high magnetic field

-To study future trends in the development technology of various types of high-temperature superconducting wire and to carry out a comprehensive survey of the applicability to various industrial magnets and the economic effects

This project is scheduled for two years from fiscal 2001 and is a part of the present NEDO "R&D of Fundamental Technologies for Superconductivity Applications" project (Fiscal 1998 to fiscal 2002. Project leader: Shoji Tanaka, Director General, Superconductivity Research Laboratory). The budget for this project in fiscal 2001 is approximately 500 million yen.

(Mitsuhiro Anju, General Affairs Department, ISTEC)

Achievement of a manufacturing speed 20 times as high as the conventional manufacturing speed for yttrium-based oxides superconducting wire

Fujikura Ltd., Chubu Electric Power Co., Inc., the International Superconductivity Technology Center(ISTEC), and the Superconductivity Research Laboratory announced on May 15 that they succeeded in developing a technology to manufacture the yttrium-based oxide superconducting tape at a speed of 1 m/h, which is 20 times higher than the conventional speed.

These companies and institutions manufactured a 10-meter-long wire using this technology to demonstrate a critical current density of 400 thousand Amps per square centimeter and a critical current of 50 A at the temperature of liquid nitrogen. Manufacturing of the yttrium-based oxide superconducting tape can be roughly divided into two processes: a crystal-orientation process for the buffer layer composing a film substrate and a process to deposite a Y-123 oxide superconducting film on the layer.

The manufacturing speed of a tape wire depended on the speed of the former process to manufacture a crystal textured substrate. Although the critical current density per square centi-meter of a short-length wire was as high as 1million Amps, the tape rod manufacturing speed was as low as about 5 cm/h. There was a fear that the tape wire could not be put to practical use.

The manufacturing technology of this crystal textured substrate is based on the Ion Beam Assisted Deposition (IBAD) process developed by Fujikura Ltd. ten years ago. The following three new techniques have been applied to the IBAD process.

(1) Making the IBAD equipment larger

(2) Making the ion beam source rectangular

(3) Applying a new orientation buffer layer material called a pylochlore type oxide $Zr_2Gd_2O_7$

The orientation buffer layer manufacturing speed was increased to 1 m/h, which was 20 times higher than the conventional speed. This was a dramatic improvement. This rate is equivalent to the manufacturing speed of a Y-123 oxide superconducting thin film produced by eximer laser used in the post-process.

The current manufacturing technology was demonstrated with a 10-meter-long tape wire. Since it is easy to manufacture 50- or 100-meter-long wire, the success in developing this technology means that long, high-performance tape wire can be obtained on an industrial scale in the near future. In other words, application of yttrium-based oxide superconducting wire rods to power cables, various types of magnets with a high magnetic field, and other devices made great strides forward.

(Yasuzo Tanaka, Editor)

Application of a high-temperature superconductor to a NMR magnet

Since the detection sensitivity and the resolution improve with relation to the first order or higher against the magnetic field when the NMR steady magnetic field is made larger, efforts have been made to enhance the magnetic field of the NMR.

Improvement of the detection sensitivity enables us to shorten the measuring (diagnosing) time or measure the amount of trace sample. In addition, if the resolution is enhanced, a giant molecule sample of which the relaxation time is short and the spectral line is wide can be subject to analysis. At present, the development targets of 1GHz (23.5 T: ν (MHz) = 42.577B (T), where Proton resonance frequency: ν , Magnetic field: B) to 1.05GHz (24.7T) and 10 T have been set for an NMR unit and an MRI unit, respectively.

At the forefront of the development of 20T or more, application of a high-temperature oxide superconductor excellent in critical current characteristics in a high magnetic field as an insert coil has been studied. In order to simplify the operation of the magnet in a 0.2T unit of the MRI equipment, an attempt (connected to power supply at any time) to replace a water-cooling normal conducting coil with a refrigerator cooling Bi-based oxide superconducting coil is another trend.

A business paper reported on June 14 (and a general newspaper reported on June 15) that a group of Material Engineering Laboratory in the National Institute for Materials Science and Kobe Steel Ltd. developed a 21.6T superconducting magnet for 920MHz NMR equipment. A combination of a Nb-Ti alloy superconducting wire and a Ti-added Nb_3Sn compound superconducting wire for a high magnetic field was applied to this magnet. The magnet were cooled down to 1.6K. The newspapers mentioned that the magnet has such a high stability that it attenuates only by 0.3% or less in 100years in permanent current mode. In other words, the attenuation falls within 3Hz/hr (An attenuation of 10Hz/hr or less is required for measurement of a high resolution NMR unit).

According to Dr. Hitoshi Wada, the leader of Tsukuba Magnet Laboratory of the National Institute for Materials Science, the group is planning to achieve 950MHz (22.3T) through the development of metal-based wire technology and to develop an internal (built-in) coil made of high-temperature oxide superconducting wire in order to attain a stable, high magnetic field exceeding 1GHz (23.5T). This is a good example where needs (analysis of the post-genome protein structure and function) back up the development (wire and magnet). In addition, the results will be fed back to high magnetic field facilities to be supplied for research on properties.

(Masaji Yoshida, International Affairs Department of ISTEC)

Demand for 1 GHz NMR

A high-resolution NMR spectrometer is necessary to determine the structure of protein, elucidate the mechanism of manifestation of a disease, and clarify the workings of life. In this research field, a 1 GHz class NMR is in demand. In particular, a 1 GHz NMR will exhibit its performance in research on protein which is hardly crystallized where the X-ray crystal structure analysis technique cannot be used.

As described in an article in this issue, Japan leads the world in the magnet technology based on the superconductor technology. Japan is expected to take the lead in developing the 1 GHz NMR on the strength of a combination of probe technology and console technology. At present, the research on analysis of the structure of post-genome protein is being vigorously promoted, with as many commercially available 800 MHz NMR units of the highest performance as possible. A manufacturer has already received an order for 900 MHz (21.1 T) NMR units and each research center is looking forward to the delivery of these units.

According to Dr. Hideaki Maeda, Senior Technical Scientist at the Genomic Science Center of RIKEN Yokohama Institute, and a professor of the Graduate School of Yokohama City University, there is a project afoot to strategically construct a library on the structure of an enormous number of protein molecules exceeding 100,000 types, through international cooperation.

This project will accelerate development of new medicines. In order to realize this project, it is desirable to install as many GHz-class NMR units as possible unless there is a problem of installation space.

(Masaji Yoshida, International Affairs Department of ISTEC)

Recent development of YBCO wire by the TFA-MOD process in SRL

The TFA-MOD process has come into the limelight as a low-cost YBCO wire process attainable highly reproducible high Jc. Keen competition between Japan and the United States is continuing to spur the development of this process. We have developed a new purification technique for solution precursor solvent-into-gel (SIG process) and demonstrated a large-area YBCO thin film growth.

A high Jc characteristic exceeding 7.5 MA/cm^2 on a $LaA10_3$ substrate with a 2 inch diameter has been obtained and 2.5 MA/cm^2 (77K, self-field) has been obtained on the IBAD substrate which was developed by Fujikura Ltd.

Recently, Jc of 1.3 MA/cm^2 (77K, self-field) at a film thickness of 230 nm concerning a thin film grown by dip coat on a 10-cm-long IBAD substrate has also been obtained.

We hope that YBCO wire production in a practical scale will be developed through extensive cooperation with related companies.

(Izumi Hirabayashi, Director, Division V, SRL/ISTEC)

SRL succeeded in growing Bi-2223 single crystals

Lee et al. at Division II of SRL succeeded in growing $Bi_2Sr_2Ca_2Cu_3O_{10+x}$ (Bi-2223) single crystals by using KCl as a flux.

Bi-2223 is a practically useful material with the superconducting transition temperature above 100 K. However, it is difficult to synthesize even polycrystalline single-phase samples. One of the reasons for this difficulty is that a solid-state reaction process, in which Bi-2212 transforms into Bi-2223 phase, is very slow and cannot be completed within a conventional process time. Almost single-phase samples can be synthesised by a partial substitution of Bi by Pb in order to facilitate the Bi-2223 phase formation, or by slightly deviating the composition ratio of a starting material from 2:2:2:3.

In the present process, oxide precursor powder reacts in the KCl melt and phase formation is completed in a short time (about 15 hours). In addition, since precursor powder with the 2223 nominal composition is almost 100% converted into a target Bi-2223 phase, impurity phases are hardly detected when KCl flux is rinsed out later.

Although the Pb-doped Bi-2223 phase can be grown by the same method as well, addition of Pb is not a necessary condition for phase formation in this process. Single crystals with a size of 0.5 mm can be obtained by making reaction time slightly longer. Various physical properties that have not been determined so far are now under investigation by using these single crystals.

(Setsuko Tajima, Director, Div.II, SRL/ISTEC)

Building of the NMR facilities of RIKEN Yokohama Institute (Half term of the project has been completed.) These buildings were constructed in the Yokohama Science Frontier (provisional name) Zone in Tsurumi Ward, Yokohama City. The outer walls of the huge glittering hat-shaped buildings are made of aluminum and their inner walls and framework are made of wood. The number of NMR units of 800 MHz or more to be installed in each buildings is limited to one because the magnetic field must be factored in.

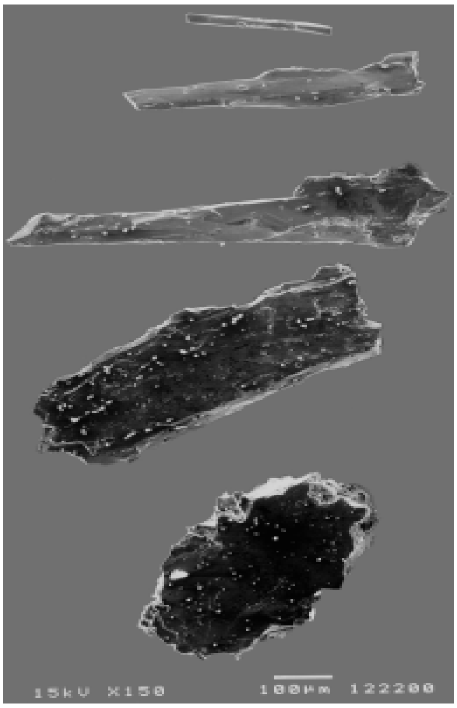
SRL grew MgB_2 single crystals and evaluated their physical properties

A great number of papers on a new superconductor, MgB_2 (T_c=39 K), which was discovered at the beginning of this year, were published in a short time. Overheat of the research on this compound is a current topic in the field of superconductivity research. From the layered crystal, it is expected that many physical parameters including superconductivity parameters show an anisotropy (two-dimensionality). In order to determine the anisotropy ratio, measurements of physical properties using single crystal samples are necessary. After keen international competition, three domestic and foreign groups, including SRL, have succeeded in growing MgB_2 single crystals around the same time.

These groups adopted different synthetic techniques. Lee et al. at Div.II of SRL successfully grew the MgB_2 single crystals with a size of 0.6 mm in Mg-B-N system under a high temperature and a high pressure.

A precise X-ray diffraction analysis showed that the obtained crystals proved to be highly pure and crystalline. A sharp superconducting transition as narrow as 0.3 K was observed by electric resistivity and magnetization measurements, which guaranteed the crystalline uniformity. Anisotropy of the second (upper) critical field was estimated at about 2.7 by measuring the electric resistance under a magnetic field. In addition, the irreversibility field, when a magnetic field is applied in parallel with the boron planes, proved to be almost equal to the second (upper) critical field. This indicates that it is necessary to align the crystal axes of MgB_2, like high-temperature superconductors, when it is utilized for practical applications.

(Setsuko Tajima, Director, Div.II, SRL/ISTEC)



Single crystals of MgB_2

Topics of the 13th International Workshop on Superconductivity

Japanese companies lead the world in the buffer layer substrate technology for next-generation wire

In June, 2001, Fujikura Ltd., Chubu Electric Power Co., Inc., and Superconductivity Research Laboratory announced at the 13th International Workshop on Superconductivity held in Hawaii co-sponsored by ISTEC and MRS that they had successfully fabricated the buffer layer film with a 60-m-long tape for yttrium oxide superconducting tapes.

Yttrium oxide superconductors have been excellent in high magnetic field characteristics of critical current density at a liquid nitrogen temperature of 77 K. Its development has been desired as a next-generation wire, following the bismuth oxide wires. The basic film formation technology concerning the buffer layer substrate of an yttrium oxide superconducting wire was developed as Ion Beam Assisted Deposition (the IBAD method) by Fujikura Ltd. in 1991. This technology is well known throughout the world. An important technological challenge in this technology is how to improve the manufacturing speed of the in-plane aligned buffer layer substrate in a preliminary stage where an oxide superconductor film is grown.

The following two technologies were used to improve the buffer layer manufacturing speed to about 20 times as fast as the conventional speed and to demonstrate this technology by continuously manufacturing a 60-meter-long buffer layer tape.

To be more specific, the following two improvements have been made.

i) The manufacturing speed has been increased sixfold to tenfold by improving the ion source to form a film of an in-plane aligned mosaic buffer layer and by developing a multiple reel-to-reel continuous thin film deposition system.

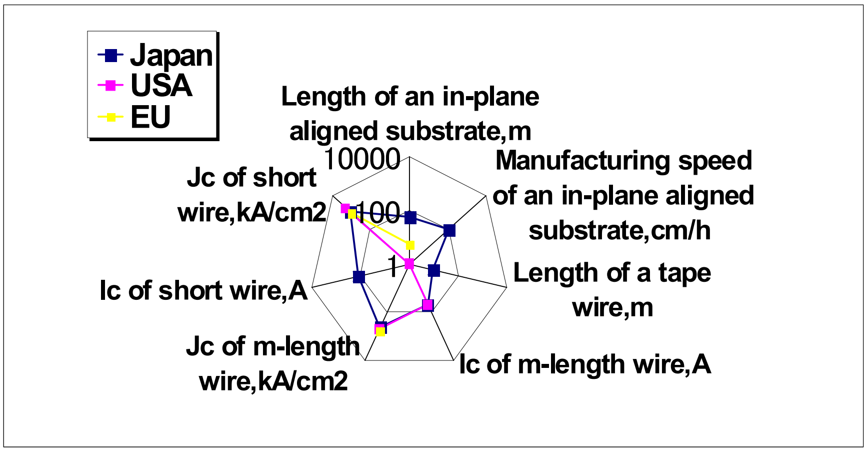
ii) The manufacturing speed has been doubled by changing the buffer layer film material from a conventional material of yttrium stabilized zirconia YSZ to a new material of $Zr_2Gd_2O_7$ having a pyrochlore crystal structure. For the details of the buffer layer having a pyrochlore crystal structure, refer to Program and Extended Abstracts of the 13th International Workshop on Superconductivity shown below.

Y. Iijima et al.: Program and Extended Abstracts of 2001 International Workshop on Superconductivity, June 24-27, 2001, Honolulu, Hawaii, U.S.A., S2-3

The comparison of the fundamental technology development related to the next-generation wire including this buffer layer substrate technology, clarified at the 13th International Workshop on Superconductivity, between Japan, the United States and European countries revealed that, at present, Japan leads in the fundamental technology development of the next-generation wire. As shown in the figure, Japan leads in the short wire characteristics as well as in the industrial fundamental technology such as the length of an in-plane aligned buffer layer substrate tape, the manufacturing speed of a buffer layer substrate, the length of a coated superconductor and the critical current capacity of a superconducting tape. These research and development results suggest that there is a good prospect of achieving the goals of the “R&D of Fundamental Technologies for Superconductivity Application” a project

commissioned by New Energy and Industrial Technology Development Organization (NEDO). It is expected that these results will give a fresh driving force to development and application of technologies which are now underway such as a power transmission cable, a superconducting magnetic energy storage system, and a device using a superconducting magnet.
(Yasuzo Tanaka in Editor)

A 60-m-long buffer layer substrate by courtesy of Fujikura Ltd.



Comparison of fundamental technology of next-generation wire in Summer, 2001

Hopes run high that superconductors will be applied to electric power

Rump session concerning a high-temperature superconducting application was held on the evening of June 26 (Tuesday) and a total of seven cases were reported. The following is a summary of some of the reports presented.

Prof.Funaki et al. of the Kyushu University reported on the results of the field test of a high-temperature superconducting transformer made of Bi2223 wires. This is a 22 kV/6.9 kV single-phase device. Compared with a conventional transformer, its efficiency increased to 99.4% and its weight was almost halved. The field test in a system of the Kyushu Electric Power Co., Inc. revealed that the superconducting transformer worked well for 144 hours without a supply of liquid nitrogen during the test. I received the impression that we have moved a step closer to future commercialization.

Dr.Mehtara et al. of Waukesha Electric Systems introduced a conceptual design of a high-temperature superconducting transformer. They say that there are now 18,866 superannuated transformers in the United States and they will need to be replaced within the next ten years. This situation is called the Time Window. If HiTc is put to practical use in time, these transformers can be replaced during this period. If this opportunity is missed, there would not be another chance for replacement for several decades, or until the transformers again came to the end of their useful life.

I recognized the importance of timing in the development of facilities related to electric power.

Dr.Okada et al. of Hitachi Ltd. announced that they had developed the ROSAT Wire using a Bi2212 wire. The development of the world's longest wire of 3.5 km means that the ROSAT wire has been completely commercialized. The eyes of the world will be gradually focus on the problem of cost. They also introduced how a high magnetic field exceeding 20 T, which can be created only by this wire, is being used to develop a 1 GHz NMR in cooperation with the National Institute for Material Science and Material Engineering Laboratory.

Dr.Nassi et al. of Pirelli introduced five cable projects in Europe and the United States using ASC Corp's Bi2223 wire. A report on preparations for a test conducted by connecting the Bi2223 wire to a live network, which is underway in theFrisbie Substation in Detroit, was impressive. They were enthusiastically advertising the strong points of the cable, emphasizing that cabling can be performed safely and without deterioration of the cable even in adverse underground cabling environments full of muddy water when replacement of a conventional superannuated copper cable is required.

In addition, Dr. Grant of EPRI was humorously introduced the way he was helping the cabling work, using an OHP. Dr. Nassi commented that the rigid and flexible cable is designed to allow laymen to perform the cabling with ease. He gave the audience the impression that the cable presents no problem in practical use. A continuity test will be carried out in the latter half of this fiscal year and an electric current will be passed through a 400-foot-long cable at 24 kV and 100 MW if everything goes well.

Dr.Kubota et al. of Toshiba Corp. introduced a fault current limiter using a YBCO film. They proposed a structure in which the YBCO film and a metal film on the substrate were electrically connected in parallel. Toshiba's researchers claimed that this structure can reduce the length required for a fault current limiter to 1/10. It is anticipated that fault current limiter will be made larger in the future.
(Yutaka Yamada, Division V, SRL/ISTEC)

Business opportunities
Commercialization of a high-temperature superconductor magnetic separation system for water cleaning

The International Superconductivity Technology Center (ISTEC) and Hitachi, Ltd. have been carrying out development of a water cleaning system using an impregnated type high-temperature superconducting bulk body for a project entrusted to them by the New Energy and Industrial Technology Development Organization (NEDO). Recently, Hitachi announced the development results of a trial model having a throughput of 100 t/day in a superconducting technology trend report meeting held on June 5 at the Toshi Center Hotel, sponsored by ISTEC.

Many systems of this type, including coagulating sedimentation, have been developed. These systems, however, have some drawbacks. For example, a large-scale unit is required. The operation is performed by a batch system. A large amount of sludge will be discharged because the concentration of sludge discharged after the water cleaning is low, and it takes several hours to clean water. Therefore, the overall treatment capacity is low.

A newly developed magnetic separation water cleaning system consists of two drums: a magnetic separation drum equipped with eleven 33 mm square, high-temperature superconducting bulks cooled down to 40 to 50K by the conductive cryocooler and a rotating filter drum. This system is characterized by the fact that both objectives, continuous cleaning operations and high-speed rotating separation, have been achieved at the same time.

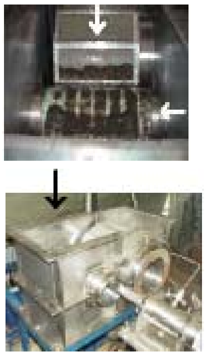
The cleaning principle is summarized below. The bottom of these two drums is brought into contact with a floc mixture obtained by adding magnetic powder and inorganic coagulant to untreated waste water in advance. Cleaned water is removed by a rotating filter, and at the same time flocs stuck to the surface of the filter are scraped off by the rotating opposite magnetic separation drum.

This system is so compact that its volume is only 1 m^3 and has a throughput of 100 t/day. It can clean water at a suspended solid (SS) removal rate of 90% or more for untreated waste water of which the SS concentration is 20 mg/l to 90 mg/l and at a high recovered sludge water content of 96% or less.

Although this system has the same SS removal rate as conventional facilities for coagulating sedimentation, the facilities of this system are compact, continuous cleaning operations are possible, and the treatment capacity is about 20 times as large as a conventional system, which is a remarkable improvement.

In addition to pollutants such as water bloom, this system can be applied to phosphorus in untreated waste water. Phosphorus can be effectively removed as iron phosphate. In terms of cleaning and treatment capacity, this is the only system of its kind in the world. Mr. Norihide Saho, Senior Researcher of the Mechanical Engineering Research Laboratory of Hitachi, Ltd. emphasized the application of this system to clarification facilities of domestic waste water, industrial effluent, waste water from facilities such as hospitals, and polluted lakes and ponds will be accelerated. According to Mr. Saho, this system will be put to practical use by fiscal 2004 at the latest on the condition that the following problems can be solved: a further improvement on the high-temperature superconducting bulk characteristics is made to reduce the operation cost of magnetic powder and others, a high-availability compact system having a throughput of 400 t/day is developed, a long-time operation test is conducted, and close coordination with the installation site is secured.
(Yasuzo Tanaka, in Editor)

Rotating film



Sludge

Film magnetic separation tank
(Throughput: 100 m^3/day)
By courtesy of Hitachi, Ltd.

To be established market for cryocooler type superconducting magnets

According to the report “Recent Market Trends in the Cryogenic Industry” presented in 1999 by Mr. Akio Sato, of the National Institute for Material Science (Formerly the National Research Institute for Metals of the Science and Technology Agency), an independent administrative institute as of fiscal 1999, a total of 136 cryocooler type superconducting magnets have been shipped since they appeared on the market on a commercial basis in 1993. Since then, annual total shipments have been maintained at a level of about 40 units per year. The size of the market is estimated at approximately 1 billion yen.

Superconducting magnets before 1993 were operated by the pool cooling system using expensive liquid helium. Their applications were limited to specific research laboratories. A high-level of expertise is required to handle liquid helium and operate a superconducting magnet in a sound manner.

On the other hand, the cryocooler type superconducting magnet, which has become popular since 1993, is manufactured by using a cryocooler to cool down a superconducting coil by means of conduction. Because no expertise in handling liquid helium or superconductivity is required, anybody can operate a cryocooler type superconducting magnet at the flick of a switch. This convenience is one of the major factors in the widespread use and the rapid establishment of this magnet in the market.

This cryocooler type superconducting magnet consists of a superconducting coil, a high-temperature superconducting current lead, a refrigerator having a Watt-class cooling capacity (normal G-M refrigerator), a cryostat and a power circuit.

All superconductive materials applied to the superconducting coil are low-temperature superconductors such as Nb-Ti alloy and Nb_3Sn compound.
Subsequently, Electric Power and Industrial System Research and Development Center of Toshiba Corp. announced Toshiba has recently succeeded development of equipment using silver sheathed Bi-2223 wire in a joint effort with Sumitomo Electric Industries, Ltd. and Shin-Etsu Handotai Co., Ltd. High-temperature superconductors such as Bi-2223 and Y-123 are also applied to a current

lead. According to this Center, because the high-temperature superconductors greatly contributed to a decrease in power input into the refrigerator, heat leak through the current lead was reduced to 0.8 W or less when an operation current of 100 A is passed.
Development of applications for the cryocooler type superconducting magnet is an important challenge for the future. (the Nuclear Power Development Sales Department of Power System Company of Toshiba Corp.)
At present, the world record in the maximum magnetic field being merchandized is 15 T (4.2 K), while 5 T and 10 T types are popular and are used for scientific and chemical research. A large-clear-bore 5 T type is mainly used for research on polymers and organic substances. (the Nuclear Power Development Sales Department of Power System Company of Toshiba Corp.)
In the future, it is expected that large-clear-bore systems which operate at around 20 K, typified by an already developed silicon single crystal growth equipment, will find widespread use. In particular, the high-temperature operation of high-temperature superconducting materials and their operating characteristics in changing magnetic fields will lead dominant technologies. The coexistence of various cryocooler type superconducting magnets on the market is gradually being clarified.
(Yasuzo Tanaka in Editor)

High-temperature superconducting magnet for silicon single crystal growth equipment.
By courtesy of Toshiba Corp.

More than 9,100 NMR spectrometers in operation

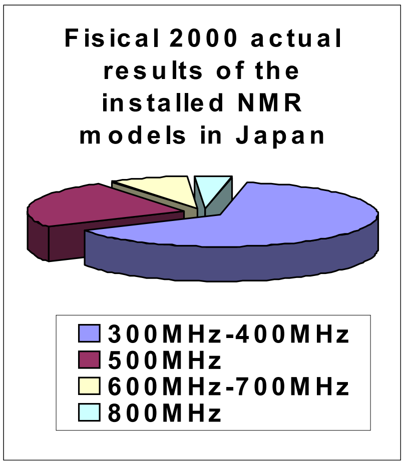
More than 9,100 NMR spectrometers have already been installed all over the world. They are used as an indispensable device to analyze the structure of an organic compound, a biopolymer, DNA, and protein and to do research on the stereostructure. The size of the world's NMR spectrometer market is estimated to be at least 680 million dollars/year (57 billion yen/year). The fiscal 2000 actual result in Japan's market is estimated at about 12.5 billion yen.

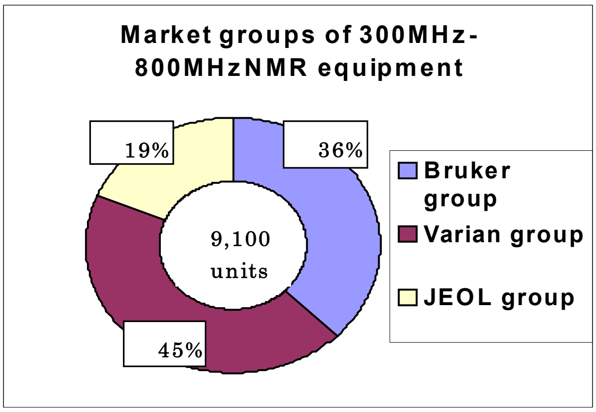
The expanding NMR market seems to be set against the background of the decoding of human genomes, bioscience immediately to be develop and its accompanying pharmaceutical business strategy. An X-ray analyzer typified by Spring-8, large-scale photon factory in RIKEN Harima Institute has been exclusively used for structural analysis of DNA and research on the stereostructure of protein. However, as the research proceeds, if the amount of test specimens is small like DNA, the crystallization requires a long time, or the crystallization itself is difficult. Analysis with an X-ray analyzer is remarkably limited because protein has a large amount of molecule. In other words, since an NMR spectrometer is applicable to a liquid specimen as well as to a solid crystal specimen, it is essential as a supplementary and efficient means of analysis of the stereostructure.

The biggest feature of the NMR spectrometer market is its strong grouping. The market of the existing NMR spectrometer from 300 MHz to 800 MHz is divided into three groups in the world: the Bruker group, Varian group, and JEOL Ltd. (JEOL) group which command a 36%, 45%, and 19% share of the market, respectively. The Varian group assumes a predominant position.

On the other hand, the Bruker, Varian, and JEOL Ltd. (JEOL) series account for 20%, 25%, and 55% of Japan's market share, respectively. The JEOL series has the edge over the other two series in Japan. Originally, Oxford, JEOL, and Bruker moved into the NMR spectrometer market in this order. Recently, the Bruker brand, a latecomer to this market, has taken a big leap ahead. The Bruker series is highly valued by users because it is well controlled in each commercialization stage of technological development, procurement of superconducting wire, manufacturing of coils, systematization, and maintenance, and it also meets the user's requests as much as possible. The Varian series aims to develop the market by respecting the affiliated manufacturers' individuality and understanding the regional characteristics of an installation location.

On the other hand, according to the distribution of 9,100 NMR installed spectrometers, 1,600 units, 5,400 units, and 2,100 units are now in operation in Europe, the United States, and Japan, respectively. The distribution shows that the U.S. possesses more than half of the units. A domestic NMR spectrometer-related company, conducted a survey of 125 units actually introduced into Japan in fiscal 2000. It revealed 80 units of 300 MHz – 400 MHz, 30 units with an output of 500 MHz, 10 units with an output of 600 MHz – 700 MHz, and 5 units with an output of 800 MHz. The majority of the units are models of 500 MHz or less. In other words, the number of introduced units of 600 MHz or more in Japan is relatively small.
(Yasuzo Tanaka in Editor)





Competition in developing 800 MHz to 1 GHz NMR equipment

Sales and development competition is heating up in the high-resolution NMR market of 800 MHz or more.

According to a report on worldwide installation, there were a hundred 800 MHz NMR units and eight 900 MHz-class units while there was no 1 GHz-class unit at the beginning of 2001. The recent “Superconductor Week, May 28, 2001” reported that Bruker received an order for eight 900 MHz NMR units and Varian would complete several units soon.

The main users of these units are RIKEN Yokohama Institute, NMR Research Center of University of Wisconsin in the United States and Max-Planck Institut in Germany. It was reported that the manufacturing capacity of both manufacturers is 6 units/year and 4 units/year. The technological challenges in developing 800 MHz and 900 MHz-class NMR units are as follows:

(1) Improvement of characteristics of Nb_3Sn wire in a high magnetic field
(2) Enhancement of the strength of wire and coil
(3) Low-temperature operation technique at 1.8 K or less, and
(4) Reduction of leakage magnetic flux

At present, much progress is being made in challenges from (1) to (3) above.

On the other hand, development of a 1 GHz NMR is now underway at four groups: the National Institute for Material Science/Kobe Steel Ltd., NHMFL in the U.S., Bruker/FZK in Germany, and Oxford/Varian. These groups are pursuing their own development projects with a view to making improvements over Nb_3Sn wire. They are also aiming for application of oxide superconducting wires. These groups are postponing a decision on whether Nb_3Sn is suitable or not for a 1 GHz NMR. Conversely, it can be said that development of an oxide superconducting coil which can meet the requirements of a magnetic field stability of 3 Hz/hr is an important technological challenge for the future.
(Yasuzo Tanaka in Editor)

1 GHz NMR unit currently developed by a group of NIMS and Kobe Steel Ltd. The development of this unit, which can achieve up to 920 MHz (21.6 T), is being speeded up so that it can be installed at NIMS located in the Tsukuba Sakura Technopark by the end of this fiscal year.

How to Develop Superconducting Equipment

1. Superconductivity vs. Energy Conservation

In this issue, the application of superconductivity to MRI diagnostic equipment and other equipment has already been introduced. Superconductivity also has been used for silicon single crystal pulling equipment to exercise its great power. These facts, however, have been noticed by only a very limited number of people. This is because, except for MRI medical use, superconductivity has been used only for industry, research and development. It has not been applied to general uses, not to mention electric household appliances.

That reminds me of the severe criticism expressed by Ms. Mieko Kenjo (a journalist and professor of Aomori University) after my lecture at a symposium on superconductivity last year. She said that little information on superconductivity has been provided pen to the general public and not much thought has been given to letting it reach ordinary life. In order to make clear that superconductivity can improve the efficiency of electric energy and also for the public to understand the relation between superconductivity and energy conservation in daily life, it is important to be given more information about superconductivity. It is the responsibility of those who are concerned to raise public recognition of the connection to superconductivity.

An investigation on “Energy Conservation with Superconductivity” which our Center had been carrying out was concluded recently. An article based on the results of this investigation appeared in the Japanese monthly magazine “Bungei Shunju in August 2001”. The article appeared in the form of an interview with Prof. Tanaka, director (SRL/ISTEC). The contents of the article suggested that the more IT technology such as Internet progressed, the more enormous the consumption of electric power would become. To reduce energy consumption, there is no other way than energy conservation. For this purpose, he said that superconductivity would be one of the most effective means. I think that the article was very timely, and should meet Prof. Kenjo’s expectations.

Quantitative discussions of energy saving have already taken place. It was roughly estimated how much oil would be saved and how much emission of CO_2 could be reduced if superconductivity was used for electric, industrial, and electronic equipment, respectively. From the estimation, it is assumed that the effects of superconductivity would be great. It will be really useful for realization of the Kyoto Protocol.

If the superconductivity is so useful, you might ask why not use it right away. Unfortunately, as mentioned above, it has been used only for limited equipment at present.

2. How superconductivity has been used and spread?

Why is it used only for very limited equipment?

Low temperature superconductivity technology has a long, 90-year history and the technology is almost perfect, but it is not so widely used. One of the reasons is the handicap that it must be used at an extremely low temperature region (4.2K) like liquid helium.

On the other hand, material technology of the high temperature superconductor discovered fourteen years ago is too immature to make equipment and requires a little more time. It is expected that if materials of the next generation such as the Y system and others available at the temperature (77K)of liquid nitrogen are developed,

superconducting equipment will spread in various industries rapidly. For several years now, manufacturing technologies of bulk, wire and electronic devices using high temperature superconductivity technology have made a big progress respectively. In five or ten years, it is considered that various equipment will be realized with superconductive materials of the next generation.

In parallel with the development of materials, the advancement of equipment has to be put forward also.

All the countries of Europe, the USA, and Japan are wrestling with the development of materials as well as equipment.

As for the advancement of equipment, all the countries, including Japan, are active particularly in the development of equipment applied with electric power.

Since electric power is the infrastructure of society, it may be a matter of course to encourage its development as a nation, but there are very difficult technological problems. One of the causes of the difficulties is the use of alternating current. Another reason is that superconducting equipment is rarely used alone but it is often connected with electric systems. If any accidents should happen when the superconducting equipment is connected to systems, its impact would be disastrous; therefore, to introduce superconductivity to actual systems, its reliability must be thoroughly acceptable. Unless the technology of superconductivity has become completely mature, it cannot be put to practical use.

As for the first issue of alternating current, the fact that superconductivity's electric resistance is "zero" can be applied to use with direct current (DC) only; therefore, with the alternating current (AC), there will be loss. Consequently, materials that have less AC loss have to be developed. In the development of equipment also, compositions having less AC loss must be considered.

As for the second issue of connected use of superconducting equipment with other equipment, a possible approach to consider is that efforts should be made to study about the fields where superconducting equipment can be used alone, and that then only after the technology for superconductivity alone has well matured, it could be applied to the electric power field.

As for the fields in which superconducting equipment has been used (or is to be used), please refer to the picture on page 3 of Superconductivity Web21, August issue, Japanese edition. You will see that superconductivity is going to be used in quite a number of fields.

3. Methodology for development of superconducting equipment

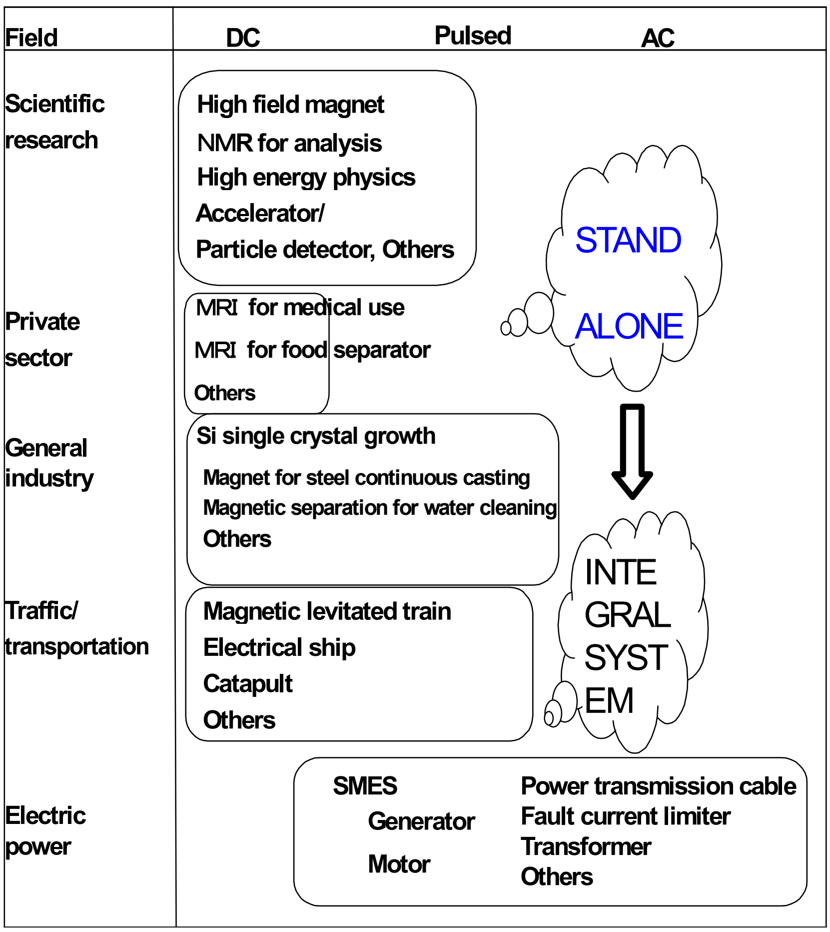
Now, I would like to introduce my ideas on the order in which this equipment should be developed. Looking at the operation forms of equipment in which superconductivity is going to be used, they can be classified into the fields of direct current, pulse, and alternating current. As for the uses, there are two ways: one is that superconductivity is used for one piece of equipment alone. For example, MRI for medical use in hospitals. The other way is to use superconductivity with other equipment in connected units. The former can be called stand-alone use and the latter integrated system use.

Technological development becomes more difficult in order of the direct current - pulse - alternating current. The influence of reliability given to users seems to become greater in the order of the scientific technological field - industry in general - social infrastructure such as electric power and transportation. These are classified and arranged in the figure below.

It is my view that the development should be started from the items listed in the upper left corner and moved on to those in the lower right corner. Technological development of the products listed in the lower right corner is more difficult than those in the upper left corner, and the impact on society from defective products in the latter fields will be much greater. It is, therefore, a matter of course to say that the national government should assist encourage proper development. At the same time, I think it is absolutely necessary to make efforts to develop stand-alone equipment with direct current, and the accumulated technologies there should be utilized for the next step to advance the technology steadily, and should be matured through use at real sites. From both the financial and technological points of view, it is too risky for each enterprise to develop superconducting equipment by itself for industrial applications such as steel and semiconductors. Therefore, national government support, not only for social infrastructure but also for these fields, will be helpful and will eventually be a short cut to establishing the superconductive technologies as social infrastructure including electric power and transportation. The above are my views, I would like to hear your opinions.

Because of space limitations, I am afraid that I have not expressed my ideas fully. I hope I will be able to exchange opinions with those who are interested in superconductivity in the "Readers' Column."

(Osamu Horigami, Special Researcher, SRL/ISTEC)



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

Power Applications

Superconductive Components, Inc. (August 8, 2001)

Superconductive Components, Inc., has announced the receipt of a US $ 300,000 Phase IIB Small Business Innovation Research (SBIR) grant from the National Science Foundation for the development of an advanced method of manufacturing long, continuous reacted lengths of BSCCO-2212 silver-alloy HTS wire. Upon completion of the project, the Bi-2212 conductor is expected to be cost competitive with Nb_3Sn wire and to exhibit superior performance in high magnetic fields. Superconductive Components will be working with Oxford Instruments, Superconducting Technology (OST), a division of Oxford Instruments, plc, to optimize the wire fabrication process.

News Source:
"Superconductive Components, Inc. Receives Grant to Develop Advanced Manufacturing Method for HTS Wires"
(Superconductive Components Press Release, August 8, 2001)
http://www.superconductivecomp.com

Materials

Superconductive Components, Inc. (August 13, 2001)

Due to higher product sales Superconductive Components Inc. (SCCI) reported that **r**evenues rose to $905,071 for second quarter 2001 from $703,369 last year. Contract research revenue benefited from $50,000 for a Phase I SBIR grant from the National Science Foundation awarded earlier this year. In addition gross margin improved to $333,168, or 36.8% of revenues, for second quarter 2001 compared with $155,862 or 22.2% of revenues for the same period last year. Increased utilization of production capacity contributed to the improved gross margin.
General and administrative expenses were $262,360, or 29.0% of revenues, for second quarter 2001 versus $113,316, or 16.1% of revenues, the prior year. This increase is principally due to professional staff additions during the past year.
Moreover, SCCI acquired $124,586 of machinery and equipment during second quarter 2001 compared with $22,114 the prior year to accommodate increased production needs.

News Source:
"Superconductive Components Inc. Reports Second Quarter Results"
(Superconductive Components Inc. Press release; August 13, 2001)
http://www.superconductivecomp.com/

Medical Applications

4-D Neuroimaging (August 27, 2001)

4-D Neuroimaging announced that its advanced radial detection magnetoencephalography (MEG) system, the Magnes 3600, has been installed at the Veterans Administration Medical Center in Minneapolis, USA. The system will be used for research on brain function. Information from the MEG system will be combined with data from the advanced functional MRI laboratory at the University of Minnesota and applied to the study of mental illness as well as normal sensory, motor, and cognitive activities.

News Source:
"4-D Neuroimaging Announces Opening of Magnes 3600 Facility – Veterans Administration Medical Center in Minneapolis, MN Holds Inauguration of MEG Center"
(4-D Neuroimaging Press Release, August, 27, 2001)
Scott Buchanan (phone 1-858-453-6300)
http://www.4dneuroimaging.com

Telecommunications

ISCO International (August 9,2001)

ISCO International Inc. (ISCO) announced today that after a successful multi-site trial it has sold 12 Cryogenic Receiver Front-end (CRFE) Systems and four Adaptive Notch Filter (ANF?) Systems to Verizon Wireless. These interference-control systems serve 37 individual CDMA sectors in 12 cell-sites surrounding the O•fHare Airport in Chicago. This is one of the highest traffic regions in Verizon Wireless•f network. The results of the trial demonstrated that eliminating interference can recover 'lost' system traffic, allowing the systems in dense urban environments to carry much more traffic (as much as 25% to 35%) and this persuaded Verizon Wireless to purchase the systems.
This has significant implications for improving profitability of current 2G networks, as well as for future 2.5G and 3G networks

News Source:
"ISCO International Announces Deal With Verizon Wireless."
(ISCO International. Press Release; August 9, 2001)
http://www.iscointl.com/

ISCO International (August 14, 2001)

Dr. George Calhoun, ISCO's Chairman and Chief Executive Officer stated that in the second quarter, ISCO began to see the first concrete results of their strategic re-engagement with the marketplace. Dr. Calhoun added that in July ISCO, received what they consider the fundamental US patent for commercially viable CRFE(cryogenic front end) systems and have therefore initiated an action seeking to prohibit competitors from manufacturing, selling or marketing CRFE systems that so infringe on the patent

Financial details for ISCO International, Inc. (ISCO) were; consolidated net revenues of $1,374,000 for the quarter ending June 30, 2001, versus $15,000 during the same period of 2000. For the six-month period ending June 30, 2001, consolidated net revenues were $1,886,000, versus $187,000 during the first six months of 2000. The net loss from continuing operations was $5,529,000 and $10,276,000 for the three and six month periods ending June 30, 2001, respectively, versus $3,782,000 and $6,185,000 during the same periods in 2000. The increase in net loss was due primarily to increases in development costs associated with 3G prototype and development and field trials for 2G and 2.5G wireless systems in both Asia and North America, as well as other projects.

News Source:
ISCO International Reports Substantial Revenue Increase in Second Quarter 2001 Financial Results
(ISCO Press release; August 14, 2001)
http://www.iscointl.com/

Fullerene

Hong Kong University of Science and Technology (July 3, 2001)

Physicists at the Hong Kong University of Science and Technology (HKUST) have discovered that single-carbon nanotubes exhibit superconductivity at below 15 K. The group's findings have been published in Science (June 29, 2001) and were highlighted as one of the most important findings to be published in that issue. This is the first time that pure carbon has been shown to exhibit superconductivity. The single-walled carbon nanotubes (0.4 nm in diameter) form an almost ideal one-dimensional system and have enabled various theoretical calculations to be confirmed. Wires made from these nanotubes could enable nanocircuitries with low dissipation to be realized. The HKUST group was led by Prof. Ping Sheng, Head of the Physics Department and Director of HKUST's Institute of Nano Science and Technology.

News Source:
"HKUST Scientists Discover Superconductivity in World's Smallest Single-carbon Nanotubes"
(HKUST Press Release, July 3, 2001)
http://www.ust.hk

Lucent Technologies (August 30, 2001)

Scientists at Lucent Technologies' Bell Labs have demonstrated that soccer ball-shaped carbon molecules, known as "bucky balls" in recognition of American inventor R. Buckminister Fuller, can operate as superconductors at relatively warm temperatures (below 117 K). The bucky ball crystals contain molecules of chloroform and bromoform to "stretch" the bucky balls apart, thereby lowering their electronic and molecular attraction. Bucky ball superconductors are potentially less expensive than copper oxide superconductors, and their physics is better understood. The finding increases the chances of realizing inexpensive organic electronics that exhibit zero power loss and other practical applications, such as quantum computers.

News Source:
"Bell Labs scientists create record-breaking, high-temperature organic superconductor out of carbon bucky balls"
(Lucent Technologies Press Release, August 30, 2001)
http://www.bell-labs.com/news/2001/august/30/1.html

(Akihiko Tsutai,Director International Affairs Department, ISTEC)

Patent information

Published unexamined patents in the fourth quarter of fiscal 2000

We inform you of the following patents which were applied for by ISTEC and opened to public during the period from January to March 2001. For details, refer to the patent database of the Industrial Property Digital Library on the Japan Patent Office's homepage.
(1) Publication No.2001-80994 "Oxide superconducting laminated substrate and its manufacturing process"
(2) Publication No.2001-77667 "Decimation filter"
(3) Publication No.2001-73142 "Raw material for thin film of perovskite-type complex oxide and method for growing the oxide"
(4) Publication No.2001-64016 "Oxide superconductor excellent in cracking resistance and its production" (Patent No.3090658)
(5) Publication No.2001-64018 "Superconductive thin film of mercury base copper oxide and its production"
(6) Publication No.2001-53345 "Josephson junction"
(7) Publication No.2001-10879 "Oxide superconductor with excellent property-maintaining performance and its production"
(Patent No.3100375)

Introduction of recently obtained patents

(1) "Manufacturing method of Sm 123 crystal"
Patent number 1995-17790 (applied for in fiscal 1993): This is a patent related to the fablication of an Sm123 single crystal by the SRL-CP (Solvent Rich Liquid Crystal Pulling) process, the large-size single crystal fablication technology of an oxide superconductor developed by the Superconductivity Research Laboratory of ISTEC. The point of this invention is to fablicate a single crystal by a pulling process, gradually dissolving a solid-phase Sm211 in oxide solutions of Cu, Ba and BaCu. Component control of these solutions which is far more difficult than that of Y123 has been overcome.
(2) "Bi-Sr-Ca-Cu-O superconducting thin film and its production" Patent number 1993-294798 (applied for in fiscal 1992): This is a patent related to the fablication technology for a well aligned thin film of Bi2212 and Bi2223 on a MgO single crystal substrate and it will be use in fablicating of a superconducting electronic devices. The point of this invention is a two-step MOCVD technique by which an ultrathin film of Sr-Ca-Cu-O is introduced for the seed film and then a (110) faced thin film of Bi-Sr-Ca-Cu-O is selectively grown.

Published unexamined patents in the first quarter of fiscal 2001

We inform you of the patents which were applied for by ISTEC and opened to public during the period from April to June 2001. For details, refer to the patent database of the Industrial Property Digital Library on the Japan Patent Office's homepage.
(1) Publication No.2001-93728 "Method for magnetizing plural bulk superconducting magnets with different magnetic poles"

(2) Publication No.2001-101930 “Oxide superconducting laminated for substrate and manufacturing method therefor and manufacturing method for superconducting integrated circuit”
(3) Publication No.2001-110255 “High strength orientation multicrystal metal substrate and oxide superconductive wire material”
(4) Publication No.2001-114518 “Oxide superconductive material and its production”
(5) Publication No.2001-127351 “Superconductive circuit device and its manufacturing method”
(6) Publication No.2001-155566 “Joining method for superconductors and superconductive material for junction”
(Katsuo Nakazato, Director, Research and Development Promotion Division, SRL/ISTEC)

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