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Superconductivity Web21

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Superconductivity

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Superconductivity Fair "SUPERCONDUCTIVITY EXPO2007" First to be held in Japan

Levitation experiment using large bulk superconductor. President Araki of ISTEC is experiencing magnetic levitation

Amidst the recent mounting public interest in environmental problems, a superconductivity fair titled "SUPERCONDUCTIVITY EXPO2007" was held at the Big Sight Fair Ground in Daiba, Tokyo, December 13 to 15 in parallel with the Eco Products Fair sponsored by Nikkei Inc. About 600 participants attended the 9th Eco Products Fair in 2007, which is a highest number in comparison with the past records, and the fair secretariat announced that about 160,000 visitors visited the fair throughout the three days. (http://eco-pro.com/)

The staff of the Nikkei Inc. and Nikkei PR Advertising Co. floated the idea of organizing a superconductivity fair about three years ago. In the past three years, ISTEC discussed with Nikkei and related parties what form of the fair would be most effective. About three years ago, journalists had already sensed that high-temperature superconductivity would be introduced to the market sooner or later.

The concept for the superconductivity fair evolved on the following two conditions: (1) The fair would be held in Tokyo and (2) Many general visitors would visit. After discussions, it was decided to hold the "SUPERCONDUCTIVITY EXPO2007" in the form of a "fair within a fair" in conjunction with the Eco Products Fair sponsored by Nikkei as Nikkei would sponsor the two fairs concurrently and that this fair scheme would meet these conditions. The fair was supported by the Ministry of Economy, Trade and Industry, the New Energy and Industrial Technology Development Organization (NEDO), the Cryogenic Association of Japan and the International Superconductivity Technology Center (ISTEC).

Fourteen companies and organizations exhibited products and panels in the fair as follows. NEDO (9 booths), ISTEC/SRL (3), Sumitomo Electric Industries (2), Chubu Electric Power Co. (1, the following exhibitors opened one booth each), Kyushu Electric Power Co., Fuji Electric, Furukawa Electric, Fujikura, Showa Electric Wire & Cable, Japan Superconductor Technology (JASTEC), SuperPower (USA), Iwatani International, Japan Quantum Design and Toyo Corp. The principal exhibits by the exhibitors were as follows. NEDO made a strong effort by opening nine booths and displaying interesting information. Titled the "Superconductivity Museum," NEDO demonstrated acceleration, running, deceleration and stopping of a model train in a georama, simulating the operation of a flywheel by the regenerative brake of an electric train. In the museum, NEDO demonstrated the existence of a super weak magnetic field by a SQUID (superconducting quantum interference device). NEDO used the venue to allow the visitors to experience superconductivity as a familiar every-day phenomenon. Additionally, NEDO demonstrated a human levitation experience every hour (7 times per day) using a system supplied by ISTEC. The system used a repulsion force between many bulk superconductors and a permanent magnet, promoting the

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superb power of superconductivity in this setup also. The attraction was crowded by many on-lookers during every demonstration. NEDO's "Forefront of Superconductivity Business" exhibiting panels of NEDO projects in the past 20 years briefly and with attention to the main points attracted the attention of those interested in superconductivity.

Compared with the NEDO exhibits which were mainly targeted at beginners in superconductivity, ISTEC/SRL exhibited exhibits for those who had some knowledge of superconductivity. ISTEC/SRL explained and exhibited exhibits using panels and monitors on the development of Y wires, bulk superconducting materials and superconducting devices that are ongoing projects to SRL. Furthermore, ISTEC exhibited panels on its international standardization activities and distributed more than 500 copies of a pamphlet on its activities for the understanding of the general public.

Sumitomo Electric Industries showed VCR footage of an automobile installed with a superconducting motor and an actual superconducting motor, appealing to the visitors that the superconducting motor was a reality in our everyday life. The appeal was impressive. Sumitomo Electric also showed a motor for electrically propelled ships, a cut model of a superconducting power transmission cable used in tests in the United States and other exhibits under the theme "Superconductivity Fast Becoming a Reality" in an easy-to-understand fashion. Chubu Electric Power Co. exhibited a small SMES (superconducting magnetic energy storage) model made of yttrium wires and immersed in liquid nitrogen. A current was fed to the SMES to store energy and LEDs were emitted and extinguished, promoting the fast response speed of SMES.

Kyushu Electric Power Co. exhibited a model transformer that used high-temperature superconductivity, promoting the effect of superconductivity when it is applied to transformers. Furukawa Electric exhibited panels plainly showing the method to fabricate metallic superconducting wires and a cut model manufactured and delivered for accelerators in Europe. Furukawa also exhibited a power cable and other items made of yttrium wires. Fujikura exhibited a real 500m yttrium wire that had strong appeal for the on-lookers. Showa Electric Wire & Cable showed a real, long Rutherford cable made of Bi2212 wire, which had a strong impact on the on-lookers. Fuji Electric exhibited various pulse tube refrigerating machines and placed high expectations on its future sales. Iwatani International exhibited a real, compact nitrogen liquefaction system. The system is likely to attract attention when more yttrium wires are sold in the future. JASTEC displayed products of its low-temperature superconducting wires and magnets, focusing especially on the sale of coolantless magnets.

Before the fair was held, there was concern that the fair might become a small fair venue with 25 booths exhibited by 14 exhibitors. When the fair was opened, the venue resembled an excellent superconductivity corner. According to the sponsor, the superconductivity EXPO is planned to be held every year. We hope that more companies and organizations will exhibit their displays in 2008. The subtitle for the SUPERCONDUCTIVITY EXPO2007 was "Superconductivity Technology & Business Fair." It will be wonderful if this subtitle speaks for itself in name and reality in 2008 and onward.

ISTEC booths at SUPERCONDUCTIVITY EXPO2007

(Osamu Horigami, SRL/ISTEC)

(Published in a Japanese version in the January 2007 issue of *Superconductivity Web 21*)

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What's New in the World of Superconductivity (January & February)

Power

Universitat Autonoma de Barcelona (December 18, 2007)

The Universitat Autonoma de Barcelona (Spain) announced that together with the Institute of Material Science of Barcelona and Nexans, researchers in the UAB Research Park and UAB Department of Physics have received the NOVARE Prize in Energy Efficiency from the Spanish energy company, ENDESA. The €500,000 prize will be utilized to develop a 30-m, 20 kV BSCCO superconductor cable and its terminals (the SUPERCABLE project). The cable will have a current value of 3200 amperes RMS and an electrical strength of 110 MVA. Construction of the cable should be completed by 2010. The project's framework also includes the development of YBCO superconductors. The SUPERCABLE will be the first superconducting cable to be installed in Spain.

Source:
"CSIC and UAB will build the most advanced superconductor cable for electricity network"
Universitat Autonoma de Barcelona press release (December 18, 2007)
http://www.uab.es/servlet/Satellite?c=Page&cid=1096476786473&noticiaid=1197958947063&pagename=UAB%2FPage%2FTemplatePlanaDivsNoticiesdetall

Oak Ridge National Laboratory (January 9, 2008)

Oak Ridge National Laboratory (ORNL) has announced that SuperPower Inc. has signed a license agreement to use an ORNL-developed technology that lowers the cost of producing superconducting wires. The licensing agreement is part of a national effort led by the U.S. Department of Energy to research, develop, and transfer energy technologies from DOE national laboratories to the global marketplace. The license will enable SuperPower to utilize ORNL's lanthanum-manganese-oxide buffer, a material that can be rapidly formed using commercial film-deposition processes. Venkat Selvamanickam, vice president and chief technical officer of SuperPower, commented, "SuperPower has successfully integrated ORNL's buffer technology into our 2G wire manufacturing process. The license agreement provides SuperPower the opportunity to commercially benefit from this and ORNL's future advancements in 2G HTS wire technology."

Source:
"ORNL, SuperPower Inc. Sign High Temperature Superconducting Wire Agreement"
Oak Ridge National Laboratory press release (January 9, 2007)
http://www.ornl.gov/info/press_releases/get_press_release.cfm?ReleaseNumber=mr20080109-00

Zenergy Power plc (January 14, 2008)

Zenergy Power plc has been granted a core German patent relating to a low-cost industrial manufacturing process for second-generation HTS materials and wires. The patent is of particular significance to Zenergy's long-term commercial competitiveness as it protects a unique process that eliminates the use of harmful fluoride compounds during the manufacture of second-generation HTS materials, yielding both cost and environmental benefits. From a commercial perspective, the patent will safeguard the long-term value of its ongoing development activities with both Converteam SAS and ThyssenKrupp VDM GmbH for the development of new-generation renewable power generators and second-generation HTS components, respectively.

Source:

"Core Patent for Low Cost 2G HTS Wire Production"
Zenergy Power plc press release (January 14, 2008)
http://www.trithor.com/pdf/press-en/2008-01-14-Core-Patent-2G.pdf

Zenergy Power plc (January 22, 2008)

Zenergy Power plc has exercised options for 73,119 new ordinary shares of £0.01 each ("Ordinary Shares"). An application has been made for the new Ordinary Shares to be admitted to trading on the AIM stock exchange. The new Ordinary Shares will rank pari passu with Zenergy's existing ordinary share capital. Following the admission of the new Ordinary Shares, Zenergy's total issued share capital with voting rights will be 44,020,931 Ordinary Shares.
Source:
"Issue of equity and total voting rights"
Zenergy Power plc press release (January 22, 2008)
http://www.trithor.com/pdf/press-en/2008-01-22-Options-Exercice.pdf

BCC Research (January 23, 2008)

BCC Research has published a new technical market research report entitled, "Utility Power Storage Technologies (EGY056A)," in which they predict the global market for electric energy storage (EES) to be worth $2.6 billion in 2008. They further predict this figure to increase to more than $3.8 billion by 2013, resulting in a compound average annual growth rate of 8.0%. The report breaks the market down into EES core applications ($1.9 billion in 2008 and $2.7 billion by 2013), including SMES systems, and the power conversion systems ($711 million in 2008 and $1.1 billion by 2013) that are needed to control and interface these technologies with the power grid. The report further explains that the convergence of higher fuel prices, the increasing demand for power, and escalating environmental concerns have produced a surge of interest in grid-level energy storage. Not only will renewable generation benefit greatly from storage, but a number of legislative actions in the U.S. are also expected to have a direct impact on this growing industry
Source:
"Global Market for Electric Energy Storage Worth $3.8 Billion by 2013"
BCC Research press release (January 23, 2008)
http://www.bccresearch.com/pressroom/REGY056A.htm

American Superconductor Corporation (January 24, 2008)

American Superconductor Corporation (AMSC) has received a contract from the U.S. Department of Homeland Security (DHS) for Project HYDRA. DHS will provide up to US $25 million in total funding for the $39 million-dollar project. The DHS has already provided $3.8 million to AMSC and its partners under a letter agreement for work completed in the last 8 months. This project, which began in May 2007, focuses on the development and deployment of AMSC's Secure Super Grids technology in Consolidated Edison Company's Manhattan power delivery network. AMSC's Secure Super Grids technology is a proprietary, system-level 'smart grid' solution that utilizes HTS power cables (made from AMSC's proprietary 344 superconductors) and ancillary controls to deliver up to 10 times more power than a conventional grid while simultaneously suppressing fault currents. System redundancy will be ensured using multiple paths of electricity flow in the metropolitan power grid; this feature will enable grid service to continue uninterrupted even if individual circuits are disrupted by severe weather, traffic accidents, or willful destruction. AMSC and its partners have achieved all project milestones on schedule since the launch of Project HYDRA in May 2007. The next milestone will be the manufacture and testing of a 50-m-long prototype HTS cable, expected to be completed by the end of 2008. The full-scale, 300-meter-long HTS power cable system will

connect two of Con Edison's Manhattan substations and is scheduled for installation and operation in 2010. Approximately 150,000 meters of 344 superconductors will be required for this system. Greg Yurek, AMSC founder and Chief Executive Officer, commented, "The response from the market to our Secure Super Grids system-level solution has been tremendous." Yurek continued, "Utilities worldwide are seeking ways to relieve choke points and instantly suppress power surges in their grids, and Secure Super Grids technology accomplishes both goals simultaneously. With Con Edison as the first proposed adopter of this unique, proprietary technology, we believe Project HYDRA will be the first of many installations of Secure Super Grid solutions in cities around the world."
Source:
"American Superconductor Received Department of Homeland Security Contract for Project HYDRA"
American Superconductor Corporation press release (January 24, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1099521&highlight

Zenergy Power plc (January 24, 2008)

Zenergy Power plc released an update regarding its ongoing project to build and install an HTS hydro-generator in a commercially operating hydroelectric power station. Previously, Zenergy announced that E.ON Wasserkraft GmbH (E.ON-WK), Germany's largest producer of hydroelectric power, planned to install a 1.25-MW HTS hydro-generator utilizing Zenergy's proprietary HTS technology. E.ON-WK has now informed Zenergy that it wishes to upgrade the HTS hydro-generator - on fully commercial terms – to a 1.7-MW HTS hydro-generator. E.ON-WK also plans to replace the station's existing turbines with higher capacity models specifically to drive the new HTS generator. Furthermore, E.ON-WK is hoping to promote the upgraded HTS generator to the hydropower station's 'pole position' generator – meaning that the generator will be responsible for providing the ongoing 'base load' supply of electrical power to over 3,000 homes. Ulrich Fuchs, Head of Electrical Engineering, E.ON-WK, commented, "The exceptional benefits offered by Zenergy's technology have the potential to pave the way for a new generation of electrical equipment that, whilst being significantly smaller than conventional generators, has proven itself capable of producing increased levels of electrical power, and in a manner that contributes to the overall level of stability of our grid operations. We are very proud to be the first utility in the world to adopt superconductive materials in this way and very much look forward to continuing the evaluation of their capabilities."

The decision to upgrade the HTS generator to the station's 'pole position' was made following an extensive electricity stability analysis performed by Kema Nederland B.V. Kema found the HTS generator's design to have a number of technical merits, making the generator highly suitable for handling the complex demands of retrofit installations. Because of the higher efficiency of HTS generators, retrofitting will allow utility companies to increase their electrical generation using their existing hydro-dam structures – producing more 'clean' electricity without further environmental impact. Zenergy regards the expansion of this project as a significant validation of the impact that HTS materials can have on improving the economics of energy production and conversion.
Source:
"Commercial Upgrade and Grid Qualification of World's First HTS Hydro-Generator"
Zenergy Power plc press release (January 24, 2008)
http://www.trithor.com/pdf/press-en/2008-01-24-EON-upgrade.pdf

American Superconductor Corporation (January 29, 2008)

American Superconductor Corporation (AMSC) announced that it has received more than US $3 million in orders for its wind turbine core electrical components and systems from two customers: China's CSR Zhuzhou Electric Locomotive Research Institute ("CSR-ZELRI") and Canada's AAER, Inc.

CSR-ZELRI has ordered the electrical systems for 20 additional wind turbines, whereas AAER has ordered 10 electrical systems from AMSC for its first 1.5-MW wind turbines. Greg Yurek, founder and chief executive officer of AMSC, commented, "These most recent orders demonstrate AMSC Windtec's unique ability to get new wind turbine manufacturers up and running quickly in a dynamic marketplace. With ZELRI placing repeat orders for electrical systems and AAER making its first purchases, our customers are signaling the commencement of their production ramp ups to meet the growing demand for zero-emission wind turbines worldwide." Including these recent orders, AMSC's technologies will now be supporting approximately 6.5 GW of wind power globally.

Source:
"AMSC Receives Orders for Wind Turbine Electrical Systems from Customers in Canada and China"
American Superconductor Corporation press release (January 29, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1101176&highlight

American Superconductor Corporation (January 31, 2008)

American Superconductor Corporation (AMSC) has reported its financial results for the third quarter of fiscal 2007, ending December 31, 2007. Revenues for the third quarter were a record US $32.6 million, a 245% increase from the $9.5 million in revenues reported for the same quarter in the previous fiscal year. The gross margin was also a record 28.7%, compared with a negative gross margin of 21.1% for the same period in the previous fiscal year. The net loss for the quarter was $7.3 million, including $2.9 million in restructuring and impairment charges related to the consolidation of AMSC's operations in Massachusetts. The net loss for the same quarter in the previous fiscal year was $9.5 million. The company's cash, cash equivalents, and marketable securities totaled $107.8 million as of December 31, 2007. Their backlog as of the end of the third quarter was $168 million; this figure does not include the more than $25 million in bookings received in January for Project HYDRA and recent orders for wind turbine electrical components and systems. The company remains on track to achieve its financial objectives for fiscal 2007, with total revenues expected to be in the range of $105 million to $110 million and a net loss in the range of $27.0 million to $29.0 million.

Source:
"AMSC Reports Third-Quarter Fiscal 2007 Financial Results"
American Superconductor Corporation press release (January 31, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1102544&highlight

NYSERDA (February 4, 2008)

The New York State Energy Research and Development Authority (NYSERDA) has awarded nearly US $6 million in funding to 14 contractors for the development of advanced technologies to improve the efficiency and delivery of electric power. Together with matching funds from the contractors, the total value of these programs is $60 million.

Of these programs, Project HYDRA – valued at $37.5 million for the development of a superconducting cable with fault current limiting capabilities to be installed in Manhattan – is the largest. The utility Consolidated Edison is partnering with the Department of Homeland Security and American Superconductor Corporation to develop this cable technology. NYSERDA will contribute $1 million to this project and anticipates that the technology could also be applied to network distribution circuits in downtown Albany and Buffalo.

The second largest project involves a prototype superconducting fault-current limiter for use in a high-voltage transmission cable. SuperPower is heading the design, construction, and testing of this device, which could significantly improve the overall reliability of the transmission system statewide. Sumitomo

Electric Industries, Linde Gas, American Electric Power and Oak Ridge National Laboratory are also participating in this project. NYSERDA will contribute $500,000 toward this initiative.
Source:
"NYSERDA Awards $6 million in Power Delivery R&D Projects; Efficient, Reliable Electric Grid, Reduced Emissions Are Goals"
NYSERDA press release (February 4, 2008)
http://www.nyserda.org/Press_Releases/2008/PressRelease20080402.asp

American Superconductor Corporation (February 12, 2008)

American Superconductor Corporation (AMSC) has received orders from two electric utilities – Entergy Mississippi Inc. and a foreign utility – for its proprietary D-VAR® reactive compensation solution. D-VAR (Dynamic VAR) systems are classified as Static Compensators, or "STATCOMs," and are a member of the FACTS (Flexible AC-Transmission System) family of power electronic solutions for alternating current (AC) power grids. D-VAR solutions detect and instantaneously compensate for voltage disturbances by dynamically injecting leading or lagging reactive power into the power grid. AMSC has now received orders for over 60 STATCOM devices worldwide, more than all other STATCOM manufacturers combined. AMSC's STATCOM customers include more than 20 electric utilities worldwide.
Source:
"AMSC Receives Orders for Its D-VAR ("STATCOM") Solution from Two Electric Utilities"
American Superconductor Corporation press release (February 12, 2008)
http://phx.corporate-ir.net/phoenix.zhtml?c=86422&p=irol-newsArticle_Print&ID=1107126&highlight

U.S. Department of Energy and SuperPower, Inc. (February 21, 2008)

The U.S. Department of Energy (DOE) and SuperPower, Inc. announced the re-connection of the 350-m HTS cable to the National Grid power system between the Riverside and Menands substations in Albany, N.Y. The cable now contains a new 30-m cable segment fabricated using SuperPower's second-generation (2G) HTS wire. This is the first in-grid demonstration in the world of a device that incorporates 2G HTS wire. The re-connection of the cable marks the successful installation and energization of Phase 2 of the US $27-million HTS Cable Demonstration Project, which is being funded by the DOE and the New York State Energy Research and Development Authority (NYSERDA). Kevin Kolevar, DOE Assistant Secretary for Electricity Delivery and Energy Reliability, commented, "High-temperature superconductivity has repeatedly demonstrated that it has the potential to play a pivotal role in modernizing our electric infrastructure and ensuring the stable and affordable delivery of electricity to our homes, businesses and industry. As the nation's demand for electricity continues to grow, so too do the pressures on our electric utilities to continue to provide the reliable electric service that is so important to our economy and way of life." Paul D. Tonko, president and chief executive officer of NYSERDA, also commented, "NYSERDA has been pleased to provide support for this very successful demonstration of an important new technology that will help to address the concerns about meeting the constantly rising demand for additional, high-quality power in New York State and around the nation and the world."

Meanwhile, SuperPower also announced that Royal Philips Electronics has committed to continuing the work being done at SuperPower, which will be retained within the Philips organization.
Source:
"SuperPower Completes World's 1st Integration of 2G HTS Wire on Live Power Grid – Philips to continue support of SuperPower's development and commercialization of advanced HTS technology"

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SuperPower, Inc. press release (February 21, 2008)
http://www.superpower-inc.com/news.php?n=147
"U.S. Department of Energy and SuperPower, Inc. Increase Energy Efficiency in Nation's Electric Grid"
U.S. Department of Energy press release (February 21, 2008)
http://www.energy.gov/news/5992.htm

Cryocooler

Oxford Instruments (January 11 and 22, 2007)

In response to the rising cost and the unreliable supply of liquid helium, Oxford Instruments has reported two testimonies regarding their cryogenic solutions. First, a new cryogenic system with a re-condensing capability is being tried at Harvard University. The Harvard group is using an Integra™ AC re-condensing cryostat with a Kelvinox®MX dilution refrigerator and a 14-T superconducting magnet from Oxford Instruments. By re-condensing the helium, the research group is able to reduce their liquid helium usage and, in turn, their research costs. Paul Noonan, Chief Engineer at Oxford Instruments, reported, "The lab results were even better than we had anticipated. The Integra™AC helium consumption with the dilution refrigerator at base temperature was zero, with some cooling capacity still available within the system. Even with the superconducting magnet running, the helium consumption was close to zero in persistent mode". Although some helium loss does occur, the system consumes < 6% of the helium required to run an equivalent system using a conventional cryostat – an enormous saving in time, running costs and experimental up-time.

In a second testimony, Oxford Instruments described the use of their radical new Cryofree® dilution refrigerator at Chalmers University of Technology (Göteborg, Sweden). This system, known as the TritonDR™, is a closed-cycle mechanical cooler that provides an alternative means of reaching ultralow temperatures. The TritonDR is fully automated and very simple to use; cooling can be accomplished in as little as 24 hours. Researchers at Chalmers also report that the device has helped them to overcome the so-called "cryophobia" that is sometimes associated with funding applications for projects involving cryogens, allowing them to compete more easily with non-cryogenic research proposals. The TritonDR has been successfully operated at 35 mK. The device is already being used for research in the areas of nanotechnology, electrical engineering, and materials science, and Oxford Instruments anticipates that the TritonDR may become an enabling technology for ultralow temperature research where the use of cryogenics would have previously been unacceptable.

Source: "
Rising cost of liquid Helium prompts new ways of doing research"
Oxford Instruments press release (January 11, 2007)
http://www.oxinst.com/wps/wcm/connect/Oxford+Instruments/Internet/Press/Current+News/Rising+cost+of+liquid+Helium+prompts+new+ways+of+doing+research
"New technology levels the playing field for cryogenic research proposals and opens doors to new Ultra Low Temperature applications"
Oxford Instruments press release (January 22, 2007)
http://www.oxinst.com/wps/wcm/connect/Oxford+Instruments/Internet/Press/Current+News/New+technology+levels+the+playing+field+for+cryogenic+research+proposals+and+opens+doors+to+new+Ultra+Low+Temperature+applications.

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Sensor

Science and Technology Facilities Council, U.K. (February 21, 2008)

The Science and Technology Facility Council's UK Astronomy Technology Center (UK ATC) at the Royal Observatory Edinburgh has shipped the largest and most complex instrument ever to be produced at the facility. The giant camera, known as SCUBA-2, will be transported to the James Clerk Maxwell Telescope located at the top of a 4,267-meter high mountain in Hawaii; there, it will be used to study the origins of galaxies, stars, and planets. The SCUBA-2 camera detects submillimeter radiation that is sensitive to the heat emitted by extremely cold dust in the universe. This material is associated with the earliest phases of the formation of galaxies, stars, and planets and has been, until now, largely undetectable. To detect these low levels of heat, the camera utilizes superconducting detectors that are the most sensitive thermal detectors ever to be built. The National Institute of Standards and Technology (U.S.) and the Scottish Microelectronics Centre of the University of Edinburgh collaborated on the design and construction of these detectors. Professor Ian Robson, Director of the UK ATC, said "SCUBA-2 is an incredible achievement; it is almost certainly one of the most complex projects that UK astronomers have ever attempted, but it is also a project that is expected to produce amazing results. After seven years of construction in Edinburgh, the world's most powerful submillimeter camera by a huge margin is poised to open up a new frontier in astronomical research."
Source:
"Edinburgh astronomers deliver 'origins' camera"
Science and Technology Facilities Council press release (February 21, 2008)
http://www.roe.ac.uk/roe/support/pr/pressreleases/080221-scuba2/

Quantum Computer

D-Wave Systems (January 31, 2008)

D-Wave Systems has closed a $17 million Series C round of financing. The round was led by International Investment and Underwriting (IIU; Dublin, Ireland) and was strongly supported by D-Wave's existing investors. The company will use the funds for product development, operations, and business development activity. D-Wave plans to deploy their quantum computer as a co-processor, available online globally to provide acceleration to applications executing on classical digital computer systems. Such applications are likely to involve discrete optimization, pattern matching, machine learning, or constrained searches with preferences. The quantum computer should be available for on-line access in early 2009.
Source:
"D-Wave Secures $17 Million Financing Led by International Investment and Underwriters"
D-Wave Systems press release (January 31, 2008)
http://www.dwavesys.com/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=10&cntnt01origid=15&cntnt01returnid=21

Electronics

Hypres Inc. (February 28, 2008)

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Hypres Inc. reported that fiscal 2007 (January – December 2007) was one of the company's most significant years in its 20-plus-year history. During 2007, Hypres successfully demonstrated and delivered two record-setting prototypes of its All Digital Receiver to the U.S. Army and U.S. Air Force. The company also secured more than US $10 million in new defense and commercial contracts and added key executives to its management team.

Hypres' most significant achievement was the successful demonstration of its satellite communications All Digital Receiver, which confirmed the validity of superconductor Digital-RF™ technology. The X-band All Digital Receiver was used to digitize a wideband signal centered at 7.68 GHz (thought to be a world record) from an XTAR communications satellite.

A second prototype equipped with a high-resolution low-pass analog-to-digital converter was also demonstrated and delivered to the U.S. Air Force. This was an improved version of a previous prototype delivered to the U.S. Office of Naval Research in 2005. The new prototype has a 25-GHz sample rate (twice as fast as that of the first prototype), and its digital circuitry is twice as complex. The prototype has been used to digitize signals from 0 – 1.75 GHz, and its potential to capture previously unobserved signals is being explored. Dr. Deep Gupta, Vice President of Research and Development at Hypres, commented, "With its ability to directly digitize RF signals up to 20 GHz, the All Digital Receiver family has the potential of eliminating most of the costly and bulky analog components associated with the front-end of a typical radio receiver. Our latest addition to the All Digital Receiver (ADR) family is the Ka/EHF-band ADR, which digitizes signals in the 20.2-21.2 GHz range. Advances in these enabling superconductor components and system integration technology put us in a strong position to realize our multi-band, multi-channel Digital-RF™ receiver architecture, particularly for satellite communication applications."

Also during 2007, Hypres secured several Small Business Innovation Research (SBIR) and other research and development contracts from the U.S. Department of Defense as well as a large commercial contract with SELEX Communications, a Finmeccanica company. For the latter contract, Hypres will develop an All Digital Receiver to provide high-performance, multi-channel wideband reception for a software radio that SELEX Communications is developing. These contracts are collectively valued at more than $10 million.

Source:
"Digital-RF™ Live Demos, Numerous Contract, And Key Executive Additions Highlight Outstanding Year For Hypres"
Hypres Inc. press release (February 28, 2008)
http://www.hypres.com/pages/new/bnew_files/pr_hypres_2007_pr_final.pdf

NMR

National Institute of Standards and Technology (February 19, 2008)

The National Institute of Standards and Technology (NIST) and the University of California have developed a super-sensitive mini-sensor that can detect nuclear magnetic resonance (NMR) in tiny samples of fluids flowing through a novel microchip. The NMR chip could have wide range of applications as a sensitive chemical analyzer – such as screening assays for drug development. The prototype device detected magnetic signals from atomic nuclei in tap water flowing through a customized silicon chip that juxtaposes a tiny fluid channel and the NIST sensor. A "remote NMR" technique for tracking small volumes of fluid or gas flow inside soft materials like biological tissue of porous rock has also been developed, with potential applications in industrial processes and oil exploration. The chip could also be used for NMR

potential applications in industrial processes and oil exploration. The chip could also be used for NMR spectroscopy. The NMR chip is a type of atomic magnetometer. Unlike SQUIDS, which require bulky cryogenics equipment, or conventional copper coils, which require very high magnetic fields typically produced by large superconducting magnets, the small size and extreme sensitivity of the NIST sensor make it ideal for use in microchip devices. The prototype has been described in the *Proceedings of the National Academy of Sciences*.
Source:
" 'NMR on a chip' features NIST magnetic mini-sensor"
National Institute of Standards and Technology press release (February 19, 2008)
http://www.nist.gov/public_affairs/techbeat/tb2008_0219.htm#nmr

Bruker BioSciences Corporation (February 25, 2008)

Bruker BioSciences Corporation announced that its stockholders have overwhelmingly approved the acquisition of the companies comprising the Bruker BioSpin Group. The stockholders also approved an amendment to the Company's certificate of incorporation to change the name of the Company to 'Bruker Corporation'. Frank Laukien, President and CEO of Bruker BioSciences, stated, "We are very pleased to receive this clear vote and mandate from our non-affiliated shareholders to move forward with the acquisition of the Bruker BioSpin Group, which is now expected to close in February. The Bruker BioSpin Group is very complementary to Bruker BioSciences and the transaction should allow us to expand our combined market reach, leverage the Bruker brand, and enhance our ability to grow our profitability and cash flows."
Source:
"Bruker BioSciences Non-Affiliated Shareholders Overwhelmingly Approve Acquisition of Bruker BioSpin Group"
Bruker BioSciences Corporation press release (February 25, 2008)
http://www.bruker.com/index.php?id=2005

Accelerator

CERN (January 22, 2008)

CERN announced that the final element of the Compact Muon Solenoid (CMS) detector has been lowered into its underground experimental cavern in preparation for the start-up of the Large Hadron Collider (LHC) later this summer. The CMS detector was the first of its kind to be constructed above ground and then lowered into its experimental cavern, and its completion marks the culmination of an eight-year long project. The aboveground construction of the detector had many advantages, including time saved by the simultaneous construction of the detector and excavation of the experimental cavern and the ability to test elements of the detector together before lowering them for installation. The construction of the CMS detector was a worldwide collaboration involving over 2500 scientists and engineers from 180 institutes in 28 countries and regions.
Source:
"CERN celebrates the lowering of its final detector element"
CERN press release (January 22, 2008) CERN Copyright
http://press.web.cern.ch/press/PressReleases/Releases2008/PR01.08E.html

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CERN (February 29, 2008)

The ATLAS collaboration at CERN has lowered the last of the instrument's large detector elements. The ATLAS muon spectrometer is 46 m long, 25 m high, 25 m wide, and weighs 7000 tonnes; it is the world's largest general-purpose particle detector, containing 100 million sensors that will measure particles produced in proton-proton collisions in CERN's Large Hadron Collider (LHC). Installation in its underground cavern began in 2003 and required each element to be lowered with millimeter precision. The lowering of the last element – one of two elements known as the 'small' wheels – marks the end of more than a decade of development, planning, and construction. The ATLAS collaboration comprised over 2100 scientists and engineers from 167 institutions in 37 countries and regions.

Source:
"ATLAS completes world's largest jigsaw puzzle"
CERN press release (February 29, 2008)
http://press.web.cern.ch/press/PressReleases/Releases2008/PR02.08E.html

Basic

National Science Foundation (January 25, 2008)

An interdisciplinary team of Cornell University scientists has reported that lithium (Li) and beryllium (Be) may bond under high pressures, forming stable Li-Be alloys that may be capable of superconductivity. The computational study predicted four stable Li-Be alloys; of these alloys, the one with a ratio of one Li atom to one Be atom shows the greatest potential for superconducting applications. One very unexpected finding is the predicted existence of two-dimensional electron gas layers within a tightly compressed three-dimensional LiBe compound. When the layers of Li an Be are squeezed together at high pressures between 5 – 10 times greater than the pressure at which diamond forms, the outer electrons from the Li layer are squeezed into the vicinity of the Be layer, forming the two-dimensional gas layers. Whether these theoretical Li-Be alloys will actually become superconductors remains uncertain, but creating and testing such compounds would be relatively simple. The project was supported by the National Science Foundation's Inorganic, Bioinorganic, and Organometallic Chemistry program in the hopes of stimulating interest regarding the properties of metals under high pressure. The group's research was published in the January 24 issue of *Nature*.

Source:
"Lithium and beryllium no longer 'lack chemistry'"
National Science Foundation press release (January 25, 2008)
http://www.nsf.gov/news/news_summ.jsp?cntn_id=111031&org=NSF&from=news

Massachusetts Institute of Technology (February 12, 2008)

Researchers at the Massachusetts Institute of Technology (MIT) have made a surprising discovery that may re-write theories about the state of matter in which superconducting materials exist just before they start to superconduct. The group examined the nature of the pseudogap state by using scanning tunneling microscopy to study the properties of the electron states surrounding impurities in superconducting materials. They showed that scattering caused by impurities occurs not only during the superconducting state, but also during the pseudogap state. This finding challenges the notion that the pseudogap state is only a precursor to the superconductive state and instead suggests that the two states may coexist. The group's method of comparing the pseudogap and superconducting states using scanning tunneling

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microscopy may help physicists to understand why certain materials are able to superconduct at relatively high temperatures. The group's findings were published in the February issue of *Nature Physics*.
Source:
"MIT reveals superconducting surprise"
Massachusetts Institute of Technology press release (February 12, 2008)
http://web.mit.edu/newsoffice/2008/superconducting-0212.html

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

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Feature Articles: ISS2007 Topics
- The 20th International Symposium on Superconductivity (ISS2007) -

The International Superconductivity Technology Center (ISTEC) sponsored the International Symposium on Superconductivity (ISS2007) at the Tsukuba International Congress Center for three days between Monday, November 5, and Wednesday, November 7, 2007. The International Symposium on Superconductivity held every year is designed to accelerate the development and commercialization of the superconducting technology and its spreading and enlightenment to the general public through presenting the results of research and technology development on superconductivity inside and outside of Japan and international exchange.

The event in 2007 marked the 20th event. The symposium in 2007 was attended by 704 persons, including 166 presentations from foreign countries representing 19 countries. The event was successful registering more than 700 participants as in the previous year. A total of 514 lectures were delivered, including 74 by invited lecturers, 122 oral lectures and 392 poster sessions. The lecture theses are scheduled to be published in the academic journal Elsevier "Physica C Special Issue." At the same time, ten companies exhibited their superconducting materials, products and technologies in a fair.


The opening address by S. Tanaka

On the first day of the symposium, ISTEC's Vice President S. Tanaka delivered the opening address and Minister A. Amari of the Ministry of Economy, Trade and Industry read a congratulatory message (read by M. Fujita, Director General, Kanto Bureau of Economy, Trade and Industry, on behalf of the minister). The speeches were followed by two special plenary lectures and six plenary lectures MC'ed by two program committee chairpersons, S. Uchida of The University of Tokyo and H. W. Weber of TU Vienna (Technical University of Vienna). The two special plenary lectures were delivered by O. Tsukamoto, Professor Emeritus, Yokohama National University, titled "Overview of Superconductivity Technology in Japan - Strategy Road Map and Status of R&D" and by G. Crabtree of the Argonne National Laboratory titled "The Superconducting Challenge." The six plenary lectures were given under the following titles:
S. Uchida, The University of Tokyo, "Road to Higher T_c"; H. W. Weber of TU Vienna, "Local Supercurrent Flow in High Temperature Superconductors for Applications"; N. Sakai of ISTEC/SRL, "Recent Progress of RE-BaCuO Bulk Processing and Their Applications"; O. A. Mukhanov, HYPRES, Inc., "Digital –RF Superconductor Electronics"; H. Koch of German National Physical-Technical Laboratory (PTB), "SQUIDS - QUO VADIS?"; and S. Nishijima of Osaka University, "Application of Superconductivity for Magnetic Force Control in Medical and Industrial Application." A banquet was held in the evening, providing a venue for active interchanges among the participants.

The second and third days were devoted to oral presentations in five fields, namely, Physics and Chemistry/Vortex physics, Bulk/Characterization, Wires and Tapes/Characterization, Films and Junctions /Electronic Devices, and Large Scale System Applications, and to second poster sessions. Enthusiastic reporting and discussions took place.
In the Physics and Chemistry field, a mini-symposium titled "Quantum Critical Point and Superconductivity"

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was planned and latest topics such as new superconducting materials and analysis of the superconducting mechanism were discussed. In the Bulk/Characterization field, most recent topics and results such as the research of manufacturing toward bulks and higher critical current and assessment technology toward product production were reported and discussed. In the Wires and Tapes/Characterization field, reporting and active discussions took place on the results of the development of state-of-the-art technology on yttrium high-temperature superconducting wires and tapes in Japan, the US and Europe, characteristics assessment method for current density, AC loss and other characteristics of tapes and wires, application to the power equipment field and other topics. In the Films and Junctions /Electronic Devices field, reports were made on the development of a yttrium high-temperature superconducting SQUID and filter, Nb low-temperature superconducting AD converters, routers, SFQ processors and other high-integration devices, as well as ultra fast, low power consumption servers. In the Large Scale System Applications field, reports were made on the progress of development including verification tests of superconducting magnets, motors, generators, transformers, magnetic levitation bearings and other industrial applications and on cables, SMES, current limiters and other electric power applications.

Oral sessions

In the closing sessions in the afternoon of the third day, wrap-ups of presentations were presented by H. Eisaki of the National Institute of Advanced Industrial Science and Technology and by T. Chikumoto of ISTEC/SRL covering the Physics and Chemistry/Vortex physics field. M. Strasik of Boeing Phantom Works made a presentation covering the Bulk/Characterization field. K. Marken of Los Alamos National Laboratory made a presentation covering the Wires and Tapes/Characterization field. D. Winkler of Chalmers University of Technology made a presentation covering the Films and Junctions/Electronic Devices field. T. Nakamura of Kyoto University made a presentation covering the Large Scale System Applications field. Lastly, ISTEC's Vice President S.Tanaka delivered a closing speech as the chairperson of the ISS2007 Organizing Committee, adjourning the symposium, which was a successful event, by wishing for a reunion at ISS2008 to be held in Tsukuba for three days between October 27 and 29 , 2008.

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

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Feature Articles: ISS2007 Topics

- Physics and Chemistry -

Hiroshi Eisaki,
Nanoelectronics Research Institute
National Institute of Advanced Industrial Science and Technology

In the physics and chemistry field, symposiums are usually held selecting central issues in this field as themes. In 2007, a symposium titled “Quantum Critical Point and Superconductivity” and a session focusing on reports on new superconductors were planned. The discussions that took place in the symposium centering on oral presentations including invited lectures are summarized in the following.

The “quantum critical point,” which was the title of this symposium, is the point at which the long-range quantum order such as ferromagnetism and antiferromagnetism is suppressed to an absolute zero temperature, by changing control parameters including pressure, magnetic field and dopant concentration. Normally, fluctuations of the order parameters increase near phase transition. Near a quantum critical point, however, its critical fluctuations become ‘quantum’, and various anomalous physical properties are expected to emerge as a result. In fact, in 4f and 5f compounds, so-called heavy electron systems, exotic superconducting phase appares near a quantum critical point where the antiferromagnetic order disappears almost entirely by applying pressure. In copper oxides also, at present, research is conducted intensively on the relationship between the high-Tc mechanism and quantum critical phenomenon, because their superconducting base state adjoins the antiferromagnetic order. Results of various experiments showing the existence of a quantum critical point in high temperature superconductors were introduced at the symposium.

Segawa of Osaka University measured the thermal conductivity of YBCO and LSCO single crystals in a magnetic field and showed that the base state below the superconducting transition temperature changed from an insulator to a metal in both systems simultaneously with doping. Segawa proposed that its boundary corresponds to the quantum critical point. Kitano of Aoyama Gakuin University conducted a microwave measurement using an LSCO thin film and analyzed that a quantum critical point existed near an optimum doping region ($x = 0.15$) by scaling analysis of critical fluctuations near the superconductive transition temperature.

Bourges of CEA-CNRS and Masui of Osaka University respectively introduced the results of experiments of neutron scattering and Raman scattering in an excessive doping region of YBCO, showing that the superconductive gap qualitatively varied before and after $x = 0.19$. These results suggest that a quantum critical point exists in an excessively doped region.

On the other hand, Bonn of the University of British Columbia reported the results of microwave measurement in the low doping region using YBCO of an ultra low doping region where the superconductive transition temperature reaches below 4K. Their results provide evidence that the d-wave symmetry is maintained up to the low doping region in which superconductivity extinguishes almost entirely.

Two neutron scattering experiments regarding electron doped superconductors were reported. Greven of Stanford University asserted that the phase boundary ($x = 0.15$) between antiferromagnetism and superconductivity was a quantum critical point at which the magnetic correlation extinguishes. On the

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other hand, Fujita of Tohoku University introduced a result that showed an antiferromagnetism correlation existed up to the point (x = 0.20) at which superconductivity extinguished in high concentration.

Reviews of heavy electron systems and the organic conductors were made by Miyake of Osaka University, Sato of Tokyo Metropolitan University and Ogata of Tokyo University. A similarity with copper oxide superconductors was discussed.

In the field of new materials, Shirage of the National Institute of Advanced Industrial Science and Technology reported a success in synthesizing a new superconductor $Ba_2CaCu_2O_4F_2$ (T_c = 108 K) containing fluorine. In the field of non-copper oxide superconductors, Minakawa of Tohoku University introduced a low temperature synthesis process method of $Ba_{1-x}A_xBiO_3$ (A=K, Rb, Cs) (T_c = 30 k). Nakajima of Tokyo University reported a result of specific heat measurement of $Lu_2Fe_3Si_5$ (T_c = 6 K) and showed that this system was a dual-gap superconductor as in the case of MgB_2.

- Vortex Physics -

Noriko Chikumoto
Division of Material Science & Physics
SRL/ISTEC

In the field of vortex physics, ten oral presentations including three invited presentations and 29 poster presentations were made. Fifteen presentations were related to magnetic phase diagrams and vortex dynamics, followed by 11 presentations on a critical current, nine on the mesoscopic system, three on magnetic flux observation and one presentation on another topic. The topics of the various fields are summarized below with a focus on oral presentations.

On magnetic phase diagrams, first, B. Rosenstein of Chiao Tung University made a review comparing magnetic phase diagrams obtained from theoretical calculations incorporating the effects of thermal fluctuations and disorder based on the GL theory and experiments. L. Miu of the National Institute of Material Physics, Bucharest, suggested the possibility of the ordering of magnetic fluxes by an induced current in a creeping magnetic flux system based on the magnetic relaxation data. The foregoing topics relate to the copper oxide system. It is interesting that Okazaki, et al., of Kyoto University reported first observation of a “sharp drop” in resistivity in the heavy electron system URu_2Si_2 which is likely to be caused by melting transition of flux line lattice.

Kato, et al., of Osaka Prefecture University reported the results of simulation on magnetic flux dynamics in an asymmetrical shape of superconducting networks, suggesting that a DC magnetic field is generated by the rectifying work of an applied AC current.

Horide, et al., of Kyoto University reported on the magnetic phase diagrams of YBCO thin films with various shapes and spatial distributions of nanorods and nanoparticles and concluded that the pinning strength does not modify the critical exponent, while the anisotropic distribution of disorders largely affect it. Chikumoto et al., of SRL-ISTEC reported the heavy ion irradiation effect on the critical currents of YBCO tapes. By comparing the results of various irradiation conditions, such as the ion species, energies and fluences, they showed an optimum radiation condition to enhance the critical current.

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The group of RIKEN (The Institute of Physical and Chemical Research) and the Tokyo Institute of Technology reported the “artistic” observation of vortices made by STM., which attracted much attention. Hanaguri of RIKEN observed the structure of a vortex core of $NbSe_2$ using a high-resolution STM (~10 μeV). As a result, a novel structure that could not be explained by gap anisotropy was found and its possibility by the multi-band effect was pointed out. On the other hand, Matsuba, et al., of the Tokyo Institute of Technology reported that the magnetic flux core of Bi2212 showed anti-phase modulation with a directionality. Uchiyama, et al., in the same group of the Tokyo Institute of Technology observed magnetic flux dynamics at a magnetic field where the magnetization exhibit the peak effect in YNi_2B_2C . They successfully observed dislocation-mediated motion of vortex lattice for the first time.

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Feature Articles: ISS2007 Topics

- Bulks and characterization -

This section introduces presentations on bulks. The presentations on bulks covered two sessions, Bulks and Characterization (BL) and Large Scale System Application (SA). In Session BL, 34 reports were made on methods to manufacture REBCO bulks, assessment of physical properties and applications, followed by 12 presentations on the enhancement of physical properties of MgB_2, six presentations on methods to manufacture Bi single crystals and assessment of their physical properties and four presentations on assessment methods. In Session SA also, about nine presentations were made on bulk body application proposals and applied basic characteristics assessment. All in all, 65 presentations were made on bulks. The writer of this section is sorry that presentations limited only to REBCO bulks, which are the specialty area of the writer, are selected, but several interesting presentations among them are reported below.

First, in his plenary lecture, N. Sakai of SRL reviewed the recent progress in REBCO bulks and studies for their application. In small samples, materials that show a very high J_c and irreversible magnetic field are obtained by controlling nano-structure. The advances in the crystal growth technology have enabled the manufacture of thick bulks with a large diameter exceeding 140 mm and 60 mm thick, showing that a system to supply the requirements of the application side is being built. Some of the application studies being made by the various organizations were introduced and the research and development of magnetic poles for compact bulk NMR jointly developed by RIKEN, Imura Material Research, JEOL and others were reported. Bulk NMR is aimed at providing transportable NMRs that can be installed anywhere, which could not be accomplished before, by miniaturizing magnets, to expand the NMR market.

S. Nishijima of Osaka University reported a study on the utilization of a bulk magnet in a magnetic induction type system to deliver drugs. The system utilizes the feature of a small bulk magnet that provides a large magnetic grade. Its concept was introduced and the results of experiments and calculations for verification of the principle were shown.

M. Strasik of Boeing is conducting R&D of a flywheel that uses a bulk superconductor as an axial magnetic bearing. M. Strasik mainly reported the status of tests of equipment in the 5 kWh and 100 kW classes for use in uninterruptible power supplies (UPS). A spoke of the wheel was broken once at 15000 rpm and the flywheel failed. Since then, the wheel has been refined further and a spin test at 72000 rpm was successful also. Boeing seems to have started developing a large system for load leveling as a next challenge. The power storage system of the flywheel type can output for a longer duration than the SMES type system and they have different demands from that of the SMES system, according to Mr. Strasik.

U. Mizutani, et al., of the Toyota Physical and Chemical Research Institute reported a study on the application to magnetron sputtering. By using a bulk material that traps a high magnetic field, plasma can be generated even in a high vacuum. As a result, the film deposition speed can be increased, film quality is enhanced, linear propagation is upgraded and other advantages can be obtained. Mizutani announced the fabrication of Mo/Si multilayer reflection films jointly undertaken with Nikon and others, reporting that fairly good results were obtained, but that there were still some points that needed to be improved.

M. Izumi, et al., of Tokyo University of Marine Science and Technology reported characteristics enhancement by dispersion of nano-particles in bulk materials, pulse magnetization by an eddy coil and a bulk motor for electrically propelled ships. The bulk motor features compactness and light weight and is expected to be applied to small and midsize ships.

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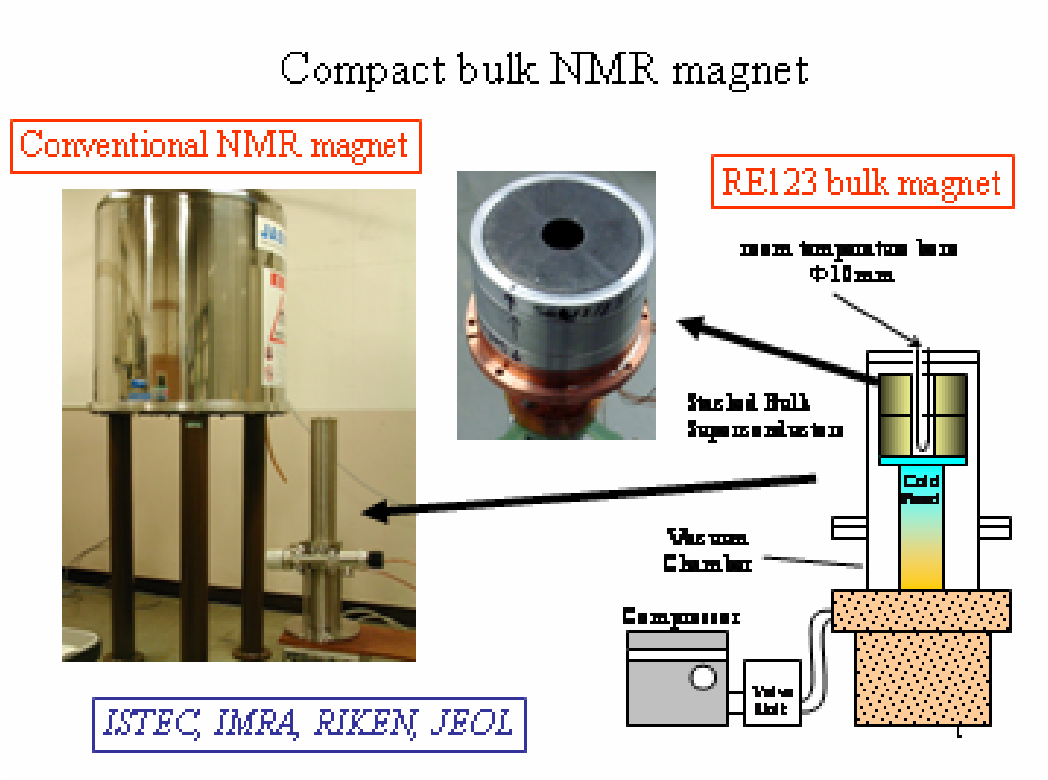
N. Haribabu, et al., of Cambridge University of Britain showed that J_c would be enhanced by dispersing the M2411 phase of nanosize (M = Zr, Nb, Ta, W, Bi, etc.) in a fused bulk superconductor. When metal element M is modified, the tissue becomes non-uniform or causes grain growth. At present, the system substituted with W achieves a balance and produces a high effect. Much is expected in future research of this.

Other reports included the research of various processes, research and development of doping and assessment methods, application of non-contact stable levitation, which is a feature of bulks, application of a compact super strong magnet and studies on application to conductors.



(Naomichi Sakai, Division of Material Science & Physics SRL/ISTEC)

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Feature Articles: ISS2007 Topics

- Films, Junctions and Electronic Deviices -

A total of 105 presentations, similar to the total number for the previous year, were made in this field that covers thin film and junction processes, digital devices, sensors, quantum bits, high frequency devices, SQUIDs and other topics, including oral lectures and poster presentations.

In the field of thin films, many presentations were made on MgB_2. The report by Xi of Pennsylvania State University on the characteristics of high quality thin films fabricated by the HPCVD method (hybrid physical chemical vapor deposition) and junction fabrication attracted particular attention. Very clean films, whose mean free path is limited by the film thickness and not by defects or the crystalline grain boundary, were fabricated. T_c of thin films was higher (40.3 K) than that of bulks owing to stress. SQUID operation was observed up to the high temperature of 29 K with an SNS junction of the nanobridge type using an MgB_2 film grown on a TiB_2 thin film. In the fabrication of an SIS junction that had MgB_2 in both upper and lower electrodes, the prevention of diffusion in the interface by reducing the thin film growth temperature, however, remains as a major challenge.

In digital application using single flux quantum (SFQ) devices, significant advances have been made in the development of circuitry, interface technology with room-temperature electronics and refrigerator implementation technology. In his plenary lecture, Mukhanov of Hypres Inc. of the United States introduced a demonstration of a digital receiver system whose circuits consisted of about 10,000 Nb junctions, developed with the support of the military. The system converts wireless communication signals into digital signals at a high speed and processes them. In the oral lecture session, Hashimoto and Suzuki of SRL respectively reported the development and demonstration of a switch system that used an Nb SFQ technology and a desktop sampler system that used oxide SFQ technology. Electromagnetic wave sensors are mainly used in the basic science field and can utilize low noise and high sensitivity that are the unique features of superconducting devices. Winkler of Chalmers University of Technology reported the development status of a hot electron bolometer that uses NbN and MgB_2 and that can be used at a THz frequency, which is higher than the frequency of the SIS mixer.

On the other hand, as reported by Nam of NIST, a transition edge sensor (TES) of the bolometer type that uses a sharp superconductive transition at a cryogenic temperature as a thermometer and a single photon sensor of a higher speed type that uses an NbN ultra thin film meander line are attracting attention as superconducting photon sensors. Expectations are placed on the application of these sensors to quantum information communication. Application of MgB_2, with which faster speed can be expected, is studied for the latter. Ohkubo of the National Institute of Advanced Industrial Science and Technology (AIST) studied the application of a similar sensor to a time-of-flight (TOF) mass analyzer and reported success in the macromolecular detection that cannot be detected by semiconductor sensors because of their large masses.

In the field of quantum bits, proposals for a cooling method to less than several mK using the state transition by microwave radiation or the Lorenz force on a mechanical resonator structure embedded in a micro superconducting loop attracted attention. In the field of high-frequency devices, Yamanaka of Fujitsu reported the current status of the development of a base station transmitting filter and a frequency tunable filter undertaken in a project sponsored by the Ministry of Internal Affairs and Communications. An

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excellent low distortion characteristic is obtained even with power of 10 W using a disc-like thin film resonator. However, problems have to be solved before a multi-pole filter is developed.

In SQUID application, Koch of PTB pointed out in his plenary lecture that infiltration of MEG (magnetoencephalogram) and MCG (magnetocardiogram) into medical fields might be accelerated by combining a SQUID with the low-frequency MRI imaging technology that has been receiving attention recently. By using a SQUID, NMR would become feasible in a low magnetic field similar to the earth's magnetic field in intensity and a very sharp line width can be achieved. Trahms of PTB introduced the results of NMR measurement in the earth's magnetic field using a high temperature superconducting SQUID. Enpuku of Kyushu University reported liquid-phase magnetic immunoassay technology using an antibody with a magnetic marker, while Hatsukade of Toyohashi University of Technology reported a non-destructive SQUID inspection system installed on a robot arm. The high temperature superconducting SQUID fabricated with bicrystal junctions is unable to operate normally even in a very small magnetic field of less than 1 μT due to a flux trap. In the latter report, the magnetic field was compensated using a coil. On the other hand, Wakana of SRL reported that by using ramp-edge junctions, a low-noise SQUID gradiometer could be fabricated allowing the use in a magnetic field of about 1 mT or more.

(Keiichi Tanabe, Director, Division of Electronic Devices, SRL/ISTEC)

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Feature Articles: ISS2007 Topics

- Large Scale System Applications -

Taketsune Nakamura, Associate Professor
Graduate School of Engineering
Kyoto University

In the system application related field, one presentation was made in the plenary lecture, while 17 presentations including seven invited lectures were given in the oral session and 39 presentations were made in poster sessions. By country, Japan made 28 presentations, followed by the Republic of Korea with 19, China with 5, Britain with 2, Italy with 2 and Germany with 1. Due to the limited space available, only some of the presentations are reported hereunder.

S. Nishijima of Osaka University delivered a plenary lecture on the technology to control magnetic forces by means of the superconductivity technology in the medical and industrial applications. Nishijima introduced research and development cases including purification of wastewater in paper mills using a strong magnetic field and magnetic gradient produced by superconductivity and a drug delivery system using a bulk high temperature superconductor, describing them as powerful system application fields of the superconductivity technology.

T. Masuda of Sumitomo Electric Industries introduced high temperature superconducting cable projects at Sumitomo Electric Industries. Masuda explained about the Albany Project in the United States and KEPCO Project in Korea, as well as a new cable project in Japan. As a project of the Ministry of Economy, Trade and Industry and the New Energy and Industrial Technology Development Organization (NEDO), the project is targeted at developing a 3-core 66 kV/200 MVA cable 200 to 300 m in length in five years between 2007 and 2011 with the participation of Sumitomo Electric Industries, Tokyo Electric Power Co. and Maekawa Mfg. Co. The cable will be connected to the grid and will be put in operation for the prolonged period of one year.

W. Schmidt, Corporate Technology, Siemens AG, Germany, reported the development status of a resistance-type current limiter that used 2 G high temperature superconducting wire. Fifteen pancake coils (3 coils were stacked and were serially connected, five stacked coil sets were connected in parallel, coil diameter 50 cm, total wire length 750 m) were made into a single-phase current limiter. Schmidt reported that at 7.7 kV, a fault current of 28 kA_{rms} could be current-limited to about 700 kA_{rms} after 5 half-cycles. T. Yazawa of Toshiba reported a high resistance achieved by providing a NiCr layer to the YBCO wire to build a current limiter of the 6.6 kV/600 A class. Yazawa reported current-limiting characteristics of a coil that was prototyped using this wire.

J. F. Hills of Coverteam Ltd., UK, explained the feasibility of a superconducting wind power generator. N. Hirano of Chubu Electric Power Co. reported the current status of SMES development in Japan. The Changwon University/KERI group, Korea, also reported on SMES and explained about the storage of energy of more than 1 MVA in a system that used Bi2223 coils.

H. H. J. Ten Kate of the European Organization for Nuclear Research (CERN), Italy, introduced the development status of CERN's ATLAS superconducting magnet. CERN is fabricating a magnet 20 m in diameter and 25 m in length using 90 km of superconducting wire. Upon its completion, the magnet will store 1.5 GJ of energy when energized at 20.5 kA (4.1T) and will become the world's largest system. A. Ballarino of CERN, Italy, reported a 3 MA high temperature superconducting current lead for LHC.

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There were other interesting lectures on an MgB_2 coil of a persistent current mode and on rotating machines. Unfortunately, these lectures cannot be reported here due to the limited space available. Recently, prominent advances have been made in material characteristics of high temperature superconducting wires and bulk bodies. The practical use of high temperature superconducting devices and equipment is finally in our sights. It is hoped that more lectures will be made in 2008 on system application.

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Feature Articles: Advances in Superconducting High Frequency Technology - Trends of Superconducting High Frequency Technology -

Shigetoshi Oshima, Professor
Faculty of Engineering
Yamagata University

"Superconducting filters" are products that are sold on the market among high frequency devices of high temperature superconductors. In the USA, there are more than 7000 systems comprised of HTS bandpass filter systems already working as the base stations for mobile phones, and recently five base stations in Beijing, China, also. However, many of the superconducting high frequency devices other than filters have high possibilities for commercialization. At present, buds for them are growing in various places. In this report, we focus on the following items concerning the superconducting high frequency technology;
1. Microwave region, 2. Submillimeter wave, millimeter wave and Terahertz wave region and 3. X-ray region. The next chapter introduces examples of technologies in superconducting filters, radio astronomy, radiation detection.

1. Microwave region

The current status of superconducting filters for base stations of mobile phones is described first. STI of the United States has installed superconducting filters in more than 7000 of its base stations and has established its position as a heavy user of superconducting filters. (See http://www.suptech.com/home.htm) In Korea, a venture company, RFtron, is developing a superconducting filter system. Equipment for commercial use has not been produced yet, but the level of its technology is high. (See http://www.rftron.com/) In China, Tsinghua University and Zongyi Superconductivity Science and Technology Co. have developed a high temperature superconducting filter system and are conducting a field test at five base stations in Beijing. Their system has been operating stably for more than two years, contributing to enhanced speech quality of mobile phones. The result of this system has been awarded a prize by the Chinese Information Industry Ministry as one of the "2007 Top-ten Chinese IT Technology Inventions." In Germany, Cryoelectra GmbH is continuing its efforts. Recently, Cryoelectra gave a presentation at an academic meeting on a superconducting front end for CDMA base stations. (See http://www.cryoelectra.de/) At present, the Chinese market is hotly attracting the attention of the world and STI has also announced that it has established a joint venture company in China. There are moves to use the superconductivity technology in not only receiving filters, but also in transmitting filters. Its feasibility warrants attention.

2. Submillimeter Wave, Millimeter Wave and Terahertz Wave Region

Low noise receivers for radio astronomy are first cited as products that are appearing in the market for the submillimeter wave, millimeter wave and terahertz wave region. Please refer to the contribution made by Mr. Sekimoto of the National Astronomical Observatory, Japan, for more information on the receiver. On the other subjects, a millimeter wave spectroscope for ozone observation reported by the Earth Environment Research Center of the National Institute for Environmental Studies is noteworthy. The spectroscope observes the high-level distribution of ozone more than 40 km in altitude using heterodyne spectroscopy by a superconducting radio wave sensor (SIS mixer). (See http://www-cger.nies.go.jp/index-j.html) Sensing of Terahertz waves is beginning to be applied to various fields. The Institute of Physical and Chemical Research (RIKEN) has gathered Terahertz researchers in

Sendai and has launched a Terahertz light research program. Research to incorporate the Terahertz sensing technology that uses a superconducting SIS junction in actual applied equipment has been started. (See http://www.riken.jp/r-world/research/lab/frontier-rs/tera-wave/index.html)

3. X-ray region

X-ray detection is used in various fields ranging from structure analysis on crystal and evolution of the universe. High-sensitivity X-ray sensors that use TES (transition edge sensor) devices have been proposed especially recently and their utilization fields are expanding. (See http://www.astro.isas.ac.jp/~takei/ss2001/shuroku.pdf#search) The importance of detecting harmful materials found in foods and plants in very small quantities has been recognized recently and fluorescence X-ray spectrometers of a higher level are studied. As one example of this, Prof. Taniguchi of Osaka Electro-Communication University reported the effectiveness of a superconducting serial junction sensor.

As briefly reviewed above, the superconducting high frequency device technology is expected to evolve steadily tuned to the market trend. Early introduction of these devices to the market is anticipated.

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Feature Articles: Advances in Superconducting High Frequency Technology - Development of Superconducting Filter for Weather Radar -

Hiroyuki Kayano, Tatsunori Hashimoto
Functional Materials Laboratory
Toshiba Corp.

Recently, high-Tc superconducting (HTS) devices have been extensively studied for use in microwave applications, such as terrestrial digital broadcasting, mobile phone, wireless LAN, and so on. Narrowband filters of receiver and transmitter for an effective utilization of frequency band resource are demanded. In the 5-GHz band especially, the recent explosive increase in the utilization of wireless LANs has made effective utilization of frequencies an urgent task. Anticipating an expansion in the frequency band for 5 GHz-band wireless LANs, Toshiba Corp. is undertaking R&D for the narrower band of 5 GHz-band weather radar systems. (See Fig. 1) The recently developed technology is a narrowband superconducting filter for receiver. The use of this filter will enable receiving only target signals without interference even when narrowband signals are allocated on frequency axes in high density.

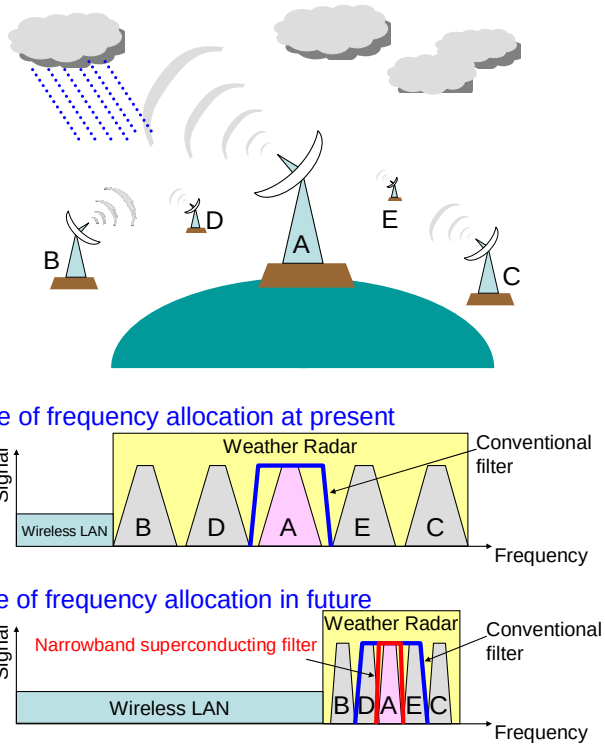

Fig. 1 Weather radar and frequency allocation

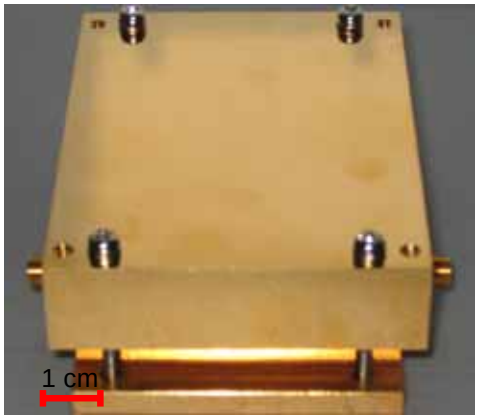

Fig. 2 Test unit for superconducting filter

As illustrated in Fig. 1, if signals are allocated on frequency axes in high density, signals from other adjacent weather radars input to the receiver with conventional filter of wide bandwidth characteristic. The signals cause interference. To solve this problem, a narrow band receiving filter capable of handling respective signals is needed. However, Insertion losses of metal conductors such as copper are large with the conventional filters. Therefore, the conventional filters with both a narrow band characteristic and low loss cannot be realized. A narrowband filter was developed using a superconductor that can be expected to yield a low loss less than 1/100 compared with losses of cupper metal even in a high frequency region. Fig. 2 shows a full view of a test unit for superconducting filter that was developed for this purpose. Fig. 3 plots frequency characteristics when this filter was

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cooled by a refrigerator and was operated. The filter can separate only the target signal and can curb adjacent interference waves 30 dB or more even when the system is operated in a signal density four times that of conventional filters (2.5MHz spacing). The filter can attenuate 30 dB of adjacent interference signals. Therefore this filter separates only a target signal from the radar signals of the density of the quadruple signal compared with the present frequency allocation.

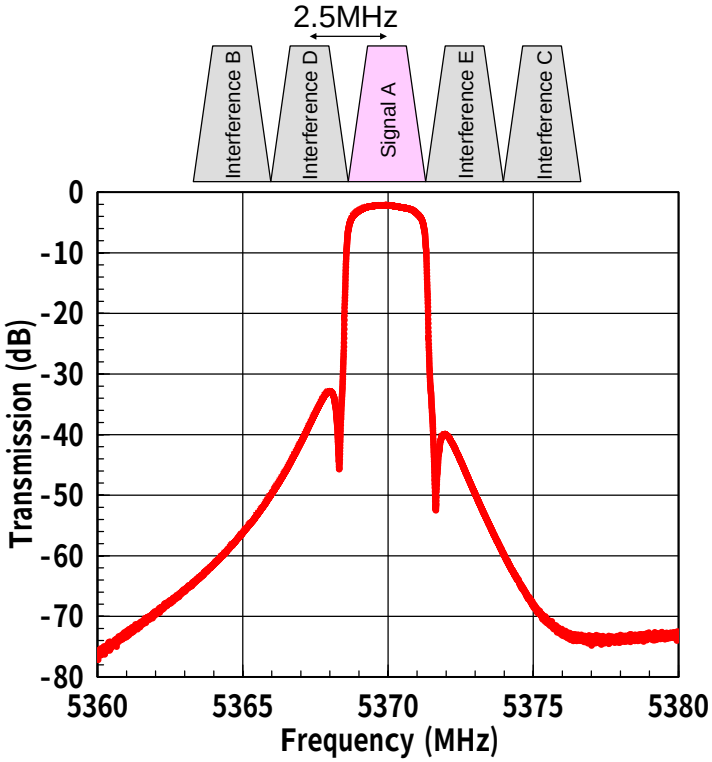

Fig. 3 Frequency characteristic

Development of narrow band filter technology for transmitter with high power handling capability of a kW order as well as development of the filter for receiver has been developed.

This research was supported by the Ministry of International Affairs and Communications, JAPAN.

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Feature Articles: Advances in Superconducting High Frequency Technology - Evolution of Technology to Apply Superconducting Filter to Microwave Power -

Kazunori Yamanaka, Kazuaki Kurihara
Mobile Systems Core-technology Development Div., Mobile Systems Unit,
Fujitsu Limited

Principal problems in the research and development of a high-temperature superconducting power filter for radio transmission application related to the technology to apply a superconducting power filter to microwave power are summarized. Several organizations including Fujitsu are undertaking the contract research and development project [1] sponsored by the Ministry of Internal Affairs and Communications of Japan. Part of the activity is described below.

Superconducting power filters in the low microwave band are expected to be applied to radio base stations, transponders and other equipments. Their R&D has been undertaken in Europe, the United States, Japan and other countries. A solution or improvement of the following problems is desired. [2]
Superconducting filters can achieve high Q compared with filters of room-temperature operation type of the same type that use normal conductors. Utilizing the Q characteristics, superconducting filters for radio receivers have been verified to filter desired signals with a high frequency selectivity and low energy loss by employing appropriate materials and structures. In addition to characteristics that are the same as those for the receiving, superconducting power filters need to handle high power of dozens to over a hundred dB although this also depends on the uses and specification requirements. This fact has been considered to be challenging to the development of the transmitter as compared with the receiver application. The advantages that can be gained from the application will be (a) less radiation of undesired electromagnetic interferences and (b) curtailment of power consumption of RF power amplifiers for radio transmitters, among various features.

The superconducting power filter is required to have (1) the specified power handling capability, (2) a miniaturization of dimensions to a minimum, (3) a small intermodulation distortion and (4) a circuit and packaging structure such as a multi-pole filter, to provide sharp and required frequency-characteristics, while utilizing its high Q characteristic. Additionally, to handle high frequency power and to achieve cryogenic operation, technologies on (5) an efficient and high-reliability least compact cryocooler and (6) cryogenic packaging structure with a minimum thermal load will also be important.

A block diagram of a system that implements the superconducting transmitting and receiving filter developed by this project is illustrated in Fig. 1. [3] (Only principal part is illustrated)

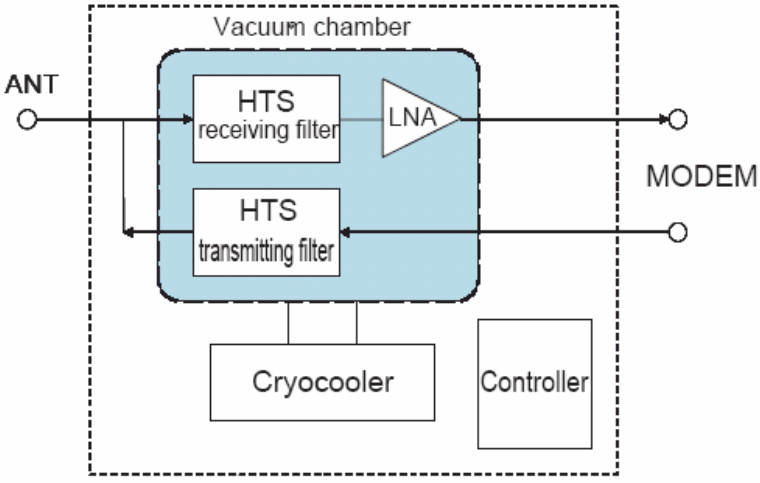

Fig.1 Block diagram of an HTS front-end for radio tranceiver

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In the the transmitting filter R&D, dual resonant-mode generation and provisioning of attenuation poles outside of the passband were studied for planar circuit resonators that had disc patterns as candidates for the resonator used in the bandpass filters, to achieve miniaturization and power operation. [4, 5] After prototyping the transmitting filters, conditions that would obtain a characteristic of less than -70 dBc (at 10 W) in third intermodulation distortion (IMD3) in the 5 GHz band were found. Noticing that side lobe power of the transmission RF signal is relatively small, a study on a band rejection type filter is being conducted using split open ring planar-circuit resonators of the reaction type. [6] Additionally, R&D are being undertaken on superconducting tunable transmitting filters [8), 9)] and cryocooler of the pulse-tube type. The tunable transmitting filter is aimed at varying the center frequency of a passband frequency by several hundred MHz in a low microwave band, and is expected to be applicable to cognitive radio. The cryocooler is aimed at achieving both a higher efficiency and miniaturization [7] .

Lastly, some part of the technologies mentioned in this report was supported under contract by the Ministry of Internal Affairs and Communications (MIC) of Japan. [1] The authors would like to thank the MIC for their support.

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Feature Articles: Advances in Superconducting High Frequency Technology - Development of Low Noise Superconducting Receiver for Radio Astronomy -

Yutaro Sekimoto, Associate Professor
Advanced Technology Center
National Astronomical Observatory of Japan

Electromagnetic radiation from distant celestial objects is faint. For this reason, low noise temperature is required for receivers for radio astronomy. In addition, an optical coupling efficiency to radio telescopes, wide dynamic range, stability are crucial for astronomical receivers.

Among radio telescopes, HEMT (high electron mobility transistor) amplifiers are mainly employed at frequencies lower than 90 GHz. On the other hand, heterodyne SIS (superconductor–insulator –superconductor tunneling junction) receivers are employed for spectrum observation and interferometers in frequency bands from 90 GHz to 1 THz. Multi-pixel direct detectors based on TES (transition edge sensors) and KIDs (kinetic induction detectors) are also being developed.

The construction of the ultimate ground-based interferometer ALMA (Atacama Large Millimeter/submillimeter Array) as a millimeter/submillimeter telescope is going in progress for the start of full-operation in 2012 by international collaboration among Europe, North America and Japan. The interferometer to observe 30 to 950 GHz consists of 80 high-accuracy radio antennas in the Atacama Desert (altitude 5000 m) of Chile in Southern America. Ten frequency-band receivers corresponding to the atmospheric windows are being developed and fabricated by research organizations of Europe, the United States and Japan. The National Astronomical Observatory of Japan is in charge of developing and assembling the receivers of Band 4 (125 to 169 GHz), Band 8 (385 to 950 GHz) and Band 10 (787 to 950 GHz).

The ALMA receivers have a clear cryogenic interface called a cartridge and provide an environment allowing the research organizations to develop the receivers independently. [1] The ALMA instruments are required to have higher performance compared with the existing ones. SIS junction with Nb-AlOx-Nb is the basis in the millimeter/submillimeter wave bands (Bands 3 to 9). Furthermore, Bands 3 to 8 use a sideband separation type mixer (2SB) that employs the waveguide technology. “2SB” is the term used first in ALMA and means a system that can simultaneously observe LSB (lower sideband) and USB (upper sideband) independently in heterodyne receiver. A combination of a cooled HEMT amplifier covering 4 to 8 GHz and a cooled isolator is used for intermediate frequencies (IFs). The low noise receivers currently under development reach 3 or 4 times the quantum noise limit in DSB noise temperature including all losses such as vacuum windows. [2), 3), 4)] As shown in Fig. 1, an SSB noise temperature of 100 K has been obtained at a high

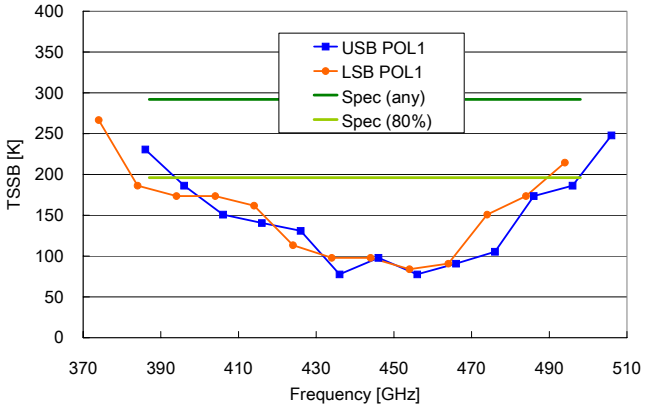

Fig.1 SSB noise temperature of receivers

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frequency such as 450 GHz. This has been accomplished by merging the superconducting thin film deposition, millimeter/submillimeter wave electromagnetic simulation, waveguide precise machining, and high-accuracy measurement technology. The image rejection ratio (IRR) of sideband serration receivers has reached about -15 dB. Simulation and measurement are consistent with dynamic range of 40 dB in receiver beam patterns. It becomes possible even in submillimeter waves due to sophisticated design and fabrication techniques of a corrugated horn, waveguide-type polarization splitter (OMT: ortho-mode transducer) and cooled optics system. With introducing space product assurance , about 80 of these high-performance receivers will be produced for each frequency band in ALMA.

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Feature Articles: Advances in Superconducting High Frequency Technology - Evolution in Radiation Detection Technology Using Superconductivity -

Hiroyuki Takahashi, Professor
Department of Nuclear Engineering and Management
Department of Bioengineering
The University of Tokyo

The implementation of a radiation sensor with an extremely high energy resolution is the technology that impacts not only basic research in space observation, physics and chemistry, but also the industries such as micro element analysis. As radiation sensors that use superconductors, the development of a superconducting tunnel junction (STJ) device, metallic magnetic microcalorimeter (MMC), superconducting single photon detector (SSPD) that uses superconducting thin films and operates at a high speed and other devices is being undertaken. The TES (transition edge sensor) microcalorimeter is a radiation sensor that implements both an excellent energy resolution (about 2 eV to incident energy of 6 keV) and high counting rate (about several kcps). [1), 2)] The TES microcalorimeter is expected to be used in fluorescent X-ray analysis using Synchrotron Radiation, for which the performance of conventional sensors is considered inadequate, PIXE using ion beams, X-ray astronomical observation and other applications.

The microcalorimeter uses temperature rises caused by the incidence of radiation as its detection principle. Lattice specific heat of materials at a cryogenic temperature decreases in proportion to the cube of temperature. Electronic specific heat also decreases in proportion to temperature. Therefore, absorber kept at a very low temperature undergoes sufficiently large temperature variations during the incidence of quantum radiation. A fast thermometer that will operate at a cryogenic temperature will be needed to measure the temperature. A thermometer that utilizes the transition of a superconductor meets this condition. The resistance value rapidly varies near the transition temperature of a superconductor in accordance with temperature variation and the temperature can be measured from this resistance value. Such transition end sensor (TES) operates only within a very limited range near the transition temperature. As if to compensate this disadvantage, the TES has an extremely high temperature sensitivity and high speed. The microcalorimeter, which uses the TES, biases the TES at a constant voltage and measures a current flowing in the TES by a SQUID amplifier, which has an excellently high sensitivity and low noise. By this, a temperature rise generated by individual incidence radiation is converted into a current signal, thereby enabling energy measurement at a high accuracy. An equilibrium is achieved at a point where Joule heating V^2/R by resistance R generated in the transition region of the TES and calorific value (proportional to heat conductance G) escaping from the system become equal as a constant voltage V is impressed on the TES. When radiation is incident on this system, the temperature of the system rises and the resistance of the TES rises along a transition curve. As the TES is biased by a constant voltage, Joule heating decreases. Because an electro thermal feedback that is complemented due to a reduction in Joule heating of the TES is formed, the temperature rise caused by the incidence of X-ray radiation can improve the response speed compared with the original thermal time constant $\tau=C/G$. The TES microcalorimeter can operate fast enough to calculate individual incidence particles in a pulse mode and it is studied as a sensor that has sensitivity with incidence radiation such as X-ray, γ-ray and neutrons. The TES sensor at present is facing challenges including the development of a technique to arraying the sensors to increase the detection area, analysis and control of excessive noise, high-speed operation, and an expansion in particle types and in energy range. Nevertheless, higher performance is being achieved

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through the introduction of the state-of-the-art micro fabrication technology and a new structure of absorbers.

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Patent Information

Introduction of Published Unexamined Patents in the 2nd & 3rd Quarter of Fiscal 2007

The following are ISTEC's patents published from July through December 2007. For more information, visit the Japan Patent Office's Web site and the Industrial Property Digital Library (IPDL) or other patent databases.

1) **Publication No. 2007-324180 "Superconducting Device and Its Manufacturing Method"**

This invention relates to a superconducting device whose Josephson junction does not deteriorate even if the superconductor thin film is stacked. A multilayer device structure and fabrication of circuit elements such as wires and coils in the top part of its junction layer are indispensable for manufacturing large-scale SFQ circuits and high sensitivity SQUID sensors with a complex structure. It has been difficult, however, to manufacture large-scale superconducting devices that excel in circuit characteristics by stacking a superconducting layer and insulation layer without deteriorating or varying junction characteristics of the Josephson junction and by fabricating circuit elements such as wires and coils on the top layer.

The inventor has found that a required number of Josephson devices with required junction characteristics can be formed in required positions without being affected by the heating process by forming the Josephson junction when stacking a superconducting top layer simultaneously.

(Ichiro Nagano, Associate Director, Research and Development Promotion Division, SRL/ISTEC)

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Standardization Activities

Topics in December

- 1st Superconducting Electronics Panel related Discussions in Tsukuba Cosponsored by NEDO and ISTEC -

The New Energy and Industrial Technology Development Organization (NEDO) and ISTEC cosponsored the 1st Superconducting Electronics Panel related Discussions on November 5, 2007 in Conference Room 406 at the Tsukuba International Conference Hall "EPOCHAL TSUKUBA" in Tsukuba as part of the program "Research on Standardization of Technological Base of Superconducting Electronics Devices" entrusted by NEDO. The discussions took place attended by 28 participants and ended successfully.

1st Superconducting Electronics Panel Discussions

Dr. Masataka Ohkubo of the National Institute of Advanced Industrial Science and Technology (AIST) MC'ed the discussions.
At the meeting, the following six panelists provided information.

1. Prof. Dr. H. Koch, PTB, on SQUID technology and measurement methods
2. Prof. K. EnpuKu, Kyushu University, on SQUID immunoassay and measurement methods
3. Dr. A. Kirichenko, Hypres, on RSFQ technology and measurement method
4. Dr. Y. Hashimoto, SARL/ISTEC, on SFQ digital system and measurement methods
5. Prof. D. Winkler, Chalmers University of Technology, on SC detector and measurement methods
6. Dr. M. Ohkubo, AIST, on article detectors and measurement methods

During the 1st panel discussion, the following recognition of the current technology and an understanding of the necessity for standardization were gained.
1) Information was widely exchanged covering superconducting active devices field ranging from SQUID to THz heterodyne sensors, to recognize how measurements were taken and what specialties there were in their mutual measurement methods.
2) It was recognized that common terms for superconducting active devices and their measurement methods would be effective for all fields even though measurement sensitivities and measurement procedures differed.
3) The necessity of continuous discussions such as this panel discussion and of studies was recognized to understand differences in time series in the needs for standardization between devices that are already on the market, including SQUID magnetometers and voltage standards, and digital devices that are expected to be introduced to the market in the near future.

(Yasuzo Tanaka, Director, Standardization Department, ISTEC)
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Standardization Activities

Topics in December

- 5th Superconducting Power Equipment Panel Discussions in Tsukuba Cosponsored by NEDO and ISTEC -

The New Energy and Industrial Technology Development Organization (NEDO) and ISTEC cosponsored the 5th Superconducting Power Equipment Panel related Discussions on November 6 2007 in Conference Room 406 at the Tsukuba International Conference Hall "EPOCHAL TSUKUBA" in Tsukuba as part of the program "Development of Superconductivity Applied Infrastructure Technology - Study for Standardization" entrusted by NEDO. The discussions took place with 30 participants and ended successfully.

Dr. Kenichi Sato of Sumitomo Electric Industries concurrently IEC/TC90 international secretary, MC'ed the discussions.
Dr. Sato explained the background for convening the 5th panel discussion and introduced the ad-hoc liaison concept on superconducting power cables. At the meeting, the following four panelists provided information.

1. Kozo Osamura, Research Institute for Applied Sciences, on Review of Standardization Activities at IEC/TC90
2. B. Holzapfel, IFW Dresden, on HTS wire development and measurement methods in the EU
3. Takato Masuda, Sumitomo Electric Industries, on HTS power cable technology and measurement methods
4. J. F. Hill, Converteam Ltd., on SC generator for wind and related measurement methods

After the provisioning of the foregoing information, discussions took place as follows.

1) Superconducting wires

- Characterization information such as AC losses needed for product development is required at present. Standardization should be started beginning with test methods for basic characteristics rather than standardization of specific specifications and manufacturing methods of final equipment products.
- In particular, test methods for the basic characteristics of coated conductors have been receiving attention.
- Results of VAMAS were desired for such targets, but actually VAMAS had no experience in handling coated conductors. High expectations are placed on the future activities of VAMAS.

2) Superconducting cables

- Superconducting power cables would be the first commercial application of high-temperature superconducting wires.
- Considering cooling of long distances and converter cost, superconducting cables would be AC superconducting cables.
- Power cables were an integrated system of many technical elements. Standardization of conventional cables required a long time and efforts for standardization are still continuing. Therefore, it will be important to build a long-term standardization system for superconducting cables as well.
- Based on this policy, for the moment, standardization of terms unique to superconductivity and of

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principal characteristic test methods should be undertaken.

3) Building of information network
- As in the past sessions after panel discussions, it would also be important to enhance communications by adding the participants to a new information network.

(Yasuzo Tanaka, Director, Standardization Department, ISTEC)

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Standardization Activities

Topics in December

- 2nd WG12 Meeting of IEC/TC90 in Tsukuba -

WG12 meeting

IEC/TC90 (Superconductivity) convened the second WG12 meeting on Nov. 7 2007 in Conference Room 202 at the Tsukuba International Conference Hall "EPOCHAL TSUKUBA" in Tsukuba attended by five committee members and six observers.

The activity items of IEC/TC90/WG12 for the moment are the following working drafts for standardization.

IEC 61788-14 Superconductivity
- Part 14: Superconducting power devices
- General requirements for characterization of current leads for powering superconducting devices

The IEC/TC90/WG12 meeting proceeded as follows steered by Dr. Toshiyuki Mito (Professor, National Institute of Natural Sciences and National Institute for Fusion Science).

1. Introduction of the IEC/TC90/WG12 members
2. Confirmation of agenda for 2nd WG12 meeting
3. Confirmation of minutes of 1st WG12 meeting
4. Deliberation of comments on international standard working draft (1st WD) presented by Japanese National Committee (JNC).
5. Confirmation of future deliberation schedule of WG12.

Views were exchanged based on a comment sheet that summarized 73 comments from four countries on the international standard working draft (1st WD) presented by JNC.

1) One comment by Dr. Yinshu Wang of China
2) 22 comments by Drs. Laurie Christian and Donald Pooke of New Zealand
3) 34 comments by Drs. Reinhard Heller and Manfred Thoener of Germany
4) 16 comments by Dr. Huub Weijers of New Zealand

After the exchange of views, the following actions were confirmed.

1. JNC would make an observation of the comments presented by the members toward the end of December 2007 and would distribute the observation sheet to the members.
2. JNC would complete a WD incorporating the comments toward the end of February 2008 and would proceed to upgrade the WD to the CD (committee draft) stage.
3. JNC would report the progress made at 11th IEC/TC90 (superconductivity) in June 2008 to be held in Germany.

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Standardization Activities

Topics in December

- Joint IEC/TC90 and VAMAS/TWA16 Meeting at NIMS in Tsukuba -

The regular joint IEC/TC90 and VAMAS/TWA16 meeting was held on Nov. 7 2007 at the National Institute for Materials Science (NIMS) in Tsukuba. The meeting was attended by 19 persons representing four countries and active discussions took place.

Prof.Dr. Hitoshi Wada of Tokyo University (VAMAS/TWA16 chairperson) chaired the meeting and the following sessions took place.

1. WG1-1 Bending strain effect of Bi-base oxide tapes by T. Kuroda
2. WG1-2 New bending test method using ρ-shape sample holder by H. S. Shin
3. WG1-3 Irreversibility field of bulk conductors by E. S. Otabe
4. WG1-4 AC loss of YBCO coated conductors by E. W. Collings
5. WG3-1 The intrinsic surface impedance of HTS film by S. Kosaka and S. Y. Lee
6. WG4-1 Tensile property of oxide superconductors by H. S. Shin, H. Weijers, K. Osamura and M. Thoener
7. WG4-2 Tensile property of Nb_3Sn wires by M Thoener
8. WGx-x Critical current and mechano-electric properties of MgB_2 conductors by K. Osamura
9. WGy-1 IEC/TC90 activity report by Y. Tanaka
10. WGy-2 Ic-T-B measurement of Bi-based tape by H. Kitaguchi

It was reported that two electronic test methods, one tensile test method for Nb_3Sn wires at room temperature and one tensile test method for Bi wires at room temperature would be proposed as new activities at the IEC/TC90 (superconductivity) meeting in Germany in June 2008 as a result of the joint IEC/TC90 and VAMAS/TWA16 meeting.

Methods to raise next-generation coated conductors and MgB_2 coated conductors and test fund for them will be important for future activities of VAMAS/TWA16 and it was recognized that a solution for these problems is urgent.

It was decided to hold the next regular joint meeting of IEC/TC90 and VAMAS/TWA16 one year later during ISS2008.

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Standardization Activities

Topics in February 2008

- One JIS Superconductivity Standard Issued -

After receiving a joint proposal for a JIS working draft from the Japanese Standards Association and International Superconductivity Technology Center (ISTEC) and completing the required deliberation, the Japanese Industrial Standards Committee (JISC) issued the following standard from the Japanese Standards Association designating December 20, 2007 as the date of establishment.

◇ JIS H 7313: 2007-12
Superconductivity - Test method for bulk high temperature superconductors - Trapped flux density

This standard harmonizes with the following IEC (International Electrotechnical Commission) standard.

IEC 61788-9: 2005-04
Superconductivity - Part 9: Measurements for bulk high temperature superconductors -Trapped flux density of large grain oxide superconductors

The draft standard of this JIS standard was developed by JISWG10 installed under Professor Masato Murakami (currently at Shibaura Institute of Technology) beginning 2005 and was upgraded as a JIS working draft through deliberation by the JIS Working Draft Committee of the IEC/TC90 Superconductivity Committee. Through deliberation by the Japanese Industrial Standards Committee (JISC), the standard has recently been issued as a JIS standard.

The outline and composition of this standard is as follows.
◇ Outline
This standard is established to standardize the test methods to measure trapped flux density of bulk high temperature superconductors to rationalize their production and specifications and to enhance their quality.
◇Composition and explanation of the standard
1. Scope
2. Normative references
3. Terms and definitions
4. Principles
5. General
6. Measuring systems
7. Tests
8. Measurement accuracy
9. Test reports
Explanation

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