NIMS NOW
National Institute Materials Science
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SPECIAL REPORT

International Center for Young Scientists Opening This Summer

—Promoting interdisciplinary research toward creation of an international research base—

In this initiative, NIMS has selected a task proposed in the Special Coordination Fund for the Promotion of Science and Technology/Strategic Research Base Upbringing of Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). The purpose of this program is to promote organizational reforms at research and development institutions and create a preeminent research base with attractiveness at the international level. This is part of a drive to create a research and development system which produces outstanding results and more generally, to advance into new areas of knowledge with systems appropriate to a new era. Among numerous concepts which have been advanced by universities, independent administrative institutions, and other research organizations across Japan, the NIMS "International Center for Young Scientists (ICYS)" was chosen as a selected program for fiscal year 2003. The project will end on March 31, 2008.

The distinctive features which NIMS is attempting to realize in the ICYS are as follows.

1 Youth-centered: Composed of outstanding young scientists in their 20s and 30s.
2 International: Including 50% or more non-Japanese using English as a common language.
3 Interdisciplinary: Promotion of research in interdisciplinary fields by bringing together scientists in heterogeneous fields and to stimulate discussion and work together.
4 Independence and autonomy: Topics will be selected and groupings implemented autonomously in an organization without an assigned research leader.

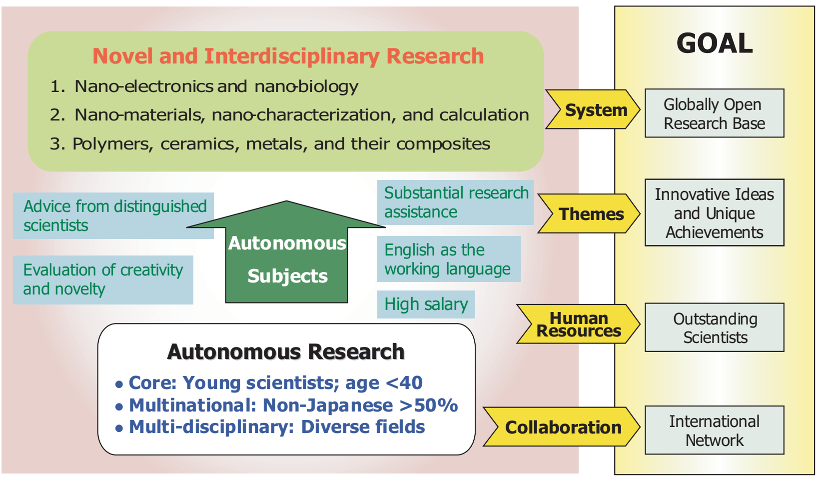


Fig.1 Concept of ICYS.

Since its creation, NIMS has repeatedly carried out reorganizations and introduced new systems, resulting in a greatly increased research output, as seen in the substantially larger number of published research papers, patent applications, etc. However, real our goals are to continue creating the seeds of new research, not only by ongoing work in existing fields, expanding on the results achieved with metals and ceramic materials thus far, but also by boldly exploring new fields, and ultimately to become one of the world's key research centers in the field of material science in fact as well as in name. To achieve these goals, even greater changes will be required.

< Continued on p9

In this issue

Cobalt Oxide Superconductors

—Unconventional superconductivity—

Eiji Takayama-Muromachi
New Materials Group
Superconducting Materials Center

In joint research with the Soft Chemistry Group of the Advanced Materials Laboratory, we discovered the first cobalt oxide which shows superconductivity (reported in the August 2003 issue of NIMS NOW). This superconductor ($Na_xCoO_2 \cdot yH_2O$) is a substance in which water molecules are introduced into a sodium cobalt oxide comprised of CoO_2 layers. The superconductivity transition was observed at approximately 5K (-268℃). An extremely unique feature of this superconductor is the fact that it can be synthesized using a solution, as shown in Fig. 1. Moreover, recent research has also revealed that it shows superconducting properties significantly different from the conventional type.

Among superconducting properties, the superconductivity transition temperature (T_c) and critical field (H_c) are extremely important. Because the cobalt oxide is a class 2 superconductor, two critical fields, the upper critical field (H_{c2}) and lower critical field (H_{c1}) can be defined as critical fields. When the magnetic field is increased, flux begins to enter the superconductor at H_{c1}, and a condition in which flux and superconductivity are coexistent continues to until H_{c2} is reached. However, as the magnetic field is increased above H_{c2}, superconductivity disappears completely.

Fig. 2 shows changes with temperature in the magnetization of the cobalt oxide in a high magnetic field (40 kOe = 4T) and low magnetic field (20 Oe). Even under the high magnetic field, the superconductivity transition could be clearly observed as a decrease in magnetization. Because the decrease in T_c due to the magnetic field is small, H_{c2} can be assumed to be fairly large. In fact, according to more detailed experiments, the value of H_{c2} at absolute zero is large, at 61T, and conversely, H_{c1} shows a small value of 28 Oe. From this, it is possible to estimate various parameters relating to superconductivity, and in all cases, the values are inconceivable in conventional type superconductors. Thus, it has become increasingly clear that this substance possesses properties similar to those of high temperature superconductors. The anomalous superconductivity of this cobalt oxide has aroused the interest of researchers around the world, and future developments will be closely watched.

(This research was carried out jointly with the Superconductor Research Center, Advanced Materials Laboratory, and Osaka University.)

Fig.1 Synthesis of $NaxCoO_2 \cdot yH_2O$
(Top, filtration treatment; bottom, bromine treatment).

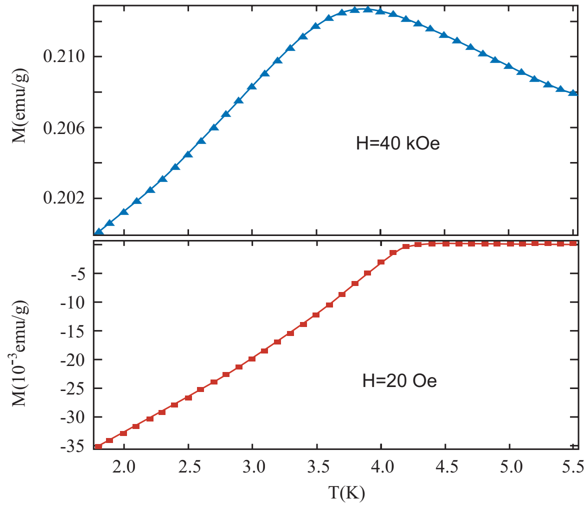
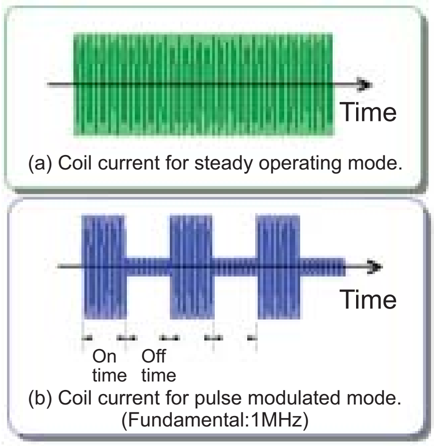


Fig.2 Change in magnetization of $NaxCoO_2 \cdot yH_2O$ with temperature.

Plasma Processing Group

Plasma Processing Group, a new group established in Advanced Materials Laboratory (AML), is aiming to synthesize functional materials by controlling the chemical reaction field through plasma technology. Based on the development of plasma generation methods, we are working on the functionalization of nano-structured ceramic materials, such as the plasma synthesis of nano-scale particles of titanium oxide and diamond, the development of zinc oxide UV emitting materials with the help of plasma hydrogen doping, and the synthesis of oxide thin films by a pulse-modulated sputtering method.



Generation of pulse-modulated induction thermal plasma (a)(b)

In the newly developed pulse-modulated RF induction plasma, the time-domain control can be utilized by switching the power level in the order of milliseconds. In the unique plasma process, high concentration of chemically reactive species are formed. Recently, we demonstrated the increase of UV fluorescent efficiency in zinc oxide by hydrogen doping.

Development of MgB_2 superconducting tape

—Progress in achieving higher performance—

Akiyoshi Matsumoto and Hiroki Fujii
Oxide Superconducting Wire Group
Superconducting Materials Center

Because the metal-type superconductor MgB_2, discovered in January 2001, has a high superconductivity transition temperature and its constituent elements are relatively inexpensive Mg and B, this material has been the object of active research aimed at practical applications.

Since the discovery of MgB_2, the Oxide Superconducting Wire Group has been engaged in the development of tapes for practical use. MgB_2 superconducting tape are manufactured by the method of packing materials in powder form into a metal tube, which is termed the "powder-in-tube" method. As shown in Fig. 1, this manufacturing method can be classified into two types, *ex-situ* and *in-situ*. Initially, we used the *ex-situ* method, in which pre-mixed MgB_2 powder is packed into the metal tube, making it possible to pass a superconducting current with only simple processing. However, it was not possible to obtain an adequate critical current density (J_c) for practical applications with this method. We therefore attempted fabrication by the *in-situ* method and succeeded in obtaining the world's current highest level of Jc values of MgB_2 tapes.

In the *in-situ* method, as shown in Fig. 1, MgB_2 is formed in the tube by post-process heat treatment, using Mg and B as raw materials. Because heat treatment is required in order to form MgB_2, this method naturally incurs higher manufacturing costs than the *ex-situ* method. However, additives can be introduced easily, which should make it possible to achieve further substantial improvements in the J_c property. Benefits can also be expected by applying various processing techniques to optimize the raw material powders.

As one example, Fig. 2 shows the MgB_2 tapes with which the present highest J_c value was obtained. The blue line shows the properties of the ex-situ tape produced. An improvement in the J_c property of more than one order of magnitude on the high magnetic field side was observed in the *in-situ* tape when MgH_2 was used as a raw material. Properties on the high magnetic field side were further improved when fine SiC powder with a size of several tens of nm was added to the MgB_2 tapes, and a superconducting current was verified even in a high magnetic field of 23T. The properties of this SiC-added wire material are equivalent to those of Nb-Ti wire material, which is already used in practical applications, meaning that the new MgB_2 wire material has virtually achieved the practical level.

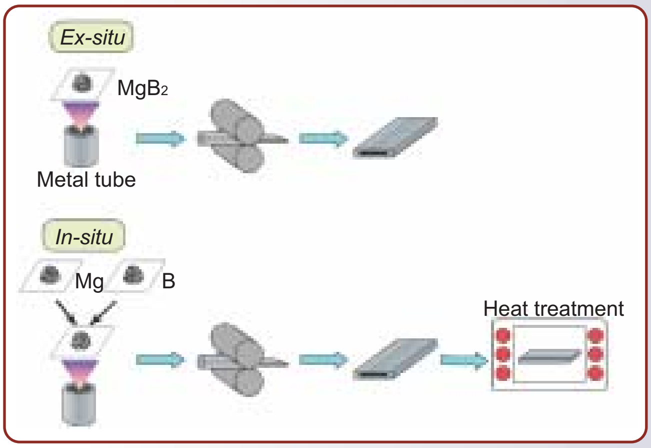


Fig.1 Manufacturing processes for MgB_2tape by powder-in-tube process.

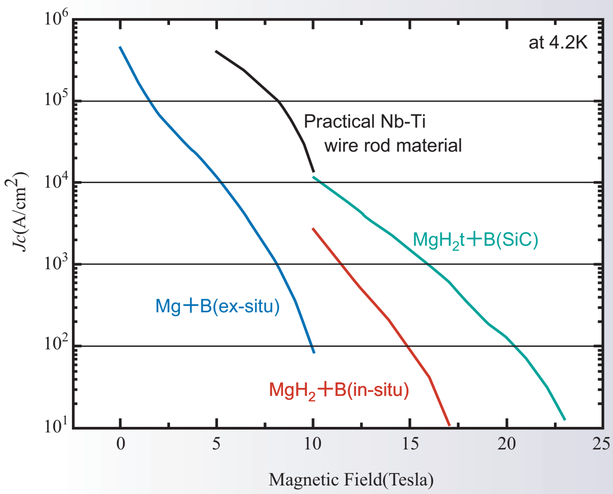
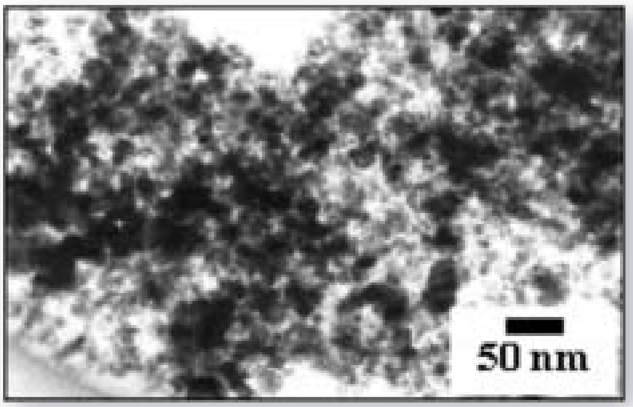


Fig.2 Magnetic field dependency of critical current density (J_c) of MgB_2 tape.



Plasma-synthesized TiO_2 nanoparticles

Nano-scale particles below 50 nm in size can be easily synthesized through thermal plasma processing. Nanoparticles of titanium oxide, which have been used for the photocatalyst, have also the potential for the application as photonic materials by making nano-scale composites and controlling particle size and crystal phase precisely.

Associate Director
Takamasa Ishigaki

Nb_3Ga Superconducting Wire Prepared by Rapid-Heating & Quenching Process

—Emergence of a new practical superconducting wire—

Kiyoshi Inoue
Superconducting Materials Center

The intermetallic compound Nb_3Ga, with a composition ratio of 3:1 has a superconductivity transition temperature, T_c, of approximately 20K, which is superior to that of practical Nb_3Sn superconductors (T_c=17.7K), and the magnetic field for breaking superconductivity is also high. For these reasons, it attracted much practical interest and was a subject of intense research activity for almost two decades. However, Nb_3Ga synthesis requires a high temperature environment of around 1800℃, causing grain coarsening, which reduces the grain boundary density. For this reason, it was not possible to obtain a large critical current density (J_c), and following the discovery of high T_c oxidesuperconductors, research and development on Nb_3Ga was virtually abandoned.

In order to produce Nb_3Al wire, we proposed the Rapid-Heating & Quenching (RHQ) process, in which the wire is rapidly heated by directly passing an electric current, followed by quenching in liquid Ga. Because the RHQ method enables high-temperature heat treatment at temperatures around 2,000℃ in an ultra-short time on the millisecond order or less, we conjectured that it might also be possible to synthesize fine-grained Nb_3Ga by this same method, which we applied to the production of Nb_3Ga wire. .

As the manufacturing method, first, Ga is plated on an Nb wire, and a $NbGa_3$clad composite wire material is obtained by heat treatment of the wire. Several hundred of these clad wires are then packing into an Nb tube, and wire-drawing is performed to make an Nb/$NbGa_3$ composite wire. RHQ is applied to this wire at this point, forming Nb_3Ga with a disordered crystal structure and T_c=16K. When annealing is performed, a higher degree of crystallographic ordering is restored and T_c improves to 19.7K. As expected, the J_c of this Nb_3Ga are high, and as shown in the figure, compare favorably with those of the commercialized Nb_3Sn wire and the next-generation practical superconducting Nb_3Al wire produced by the Rapid-Heating, Quenching & Transformation (RHQT) process. In particular, we found that J_c are very high in high magnetic fields, which is an extremely interesting result from the practical viewpoint. In the future, we plan to pursue research on the new practical superconducting wire, which will be useful in various applications such as NMR spectrometer for high-order structural analysis of proteins, nuclear fusion reactors, etc.

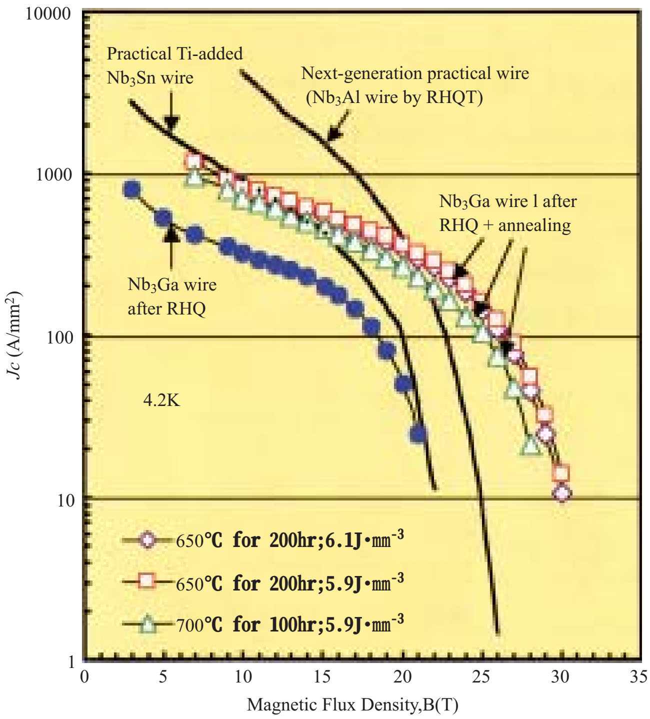
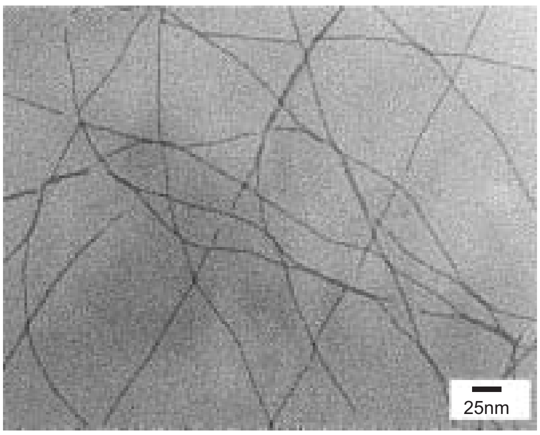


Fig. Magnetic field dependency of J_c in typical Nb_3Ga manufactured by RHQ process. We show the energy density of the electric current passed during RHQ treatment and annealing conditions in this figure. For comparison purposes, the figure also shows the properties of Ti-added Nb_3Sn produced by the bronze process, which is a practical superconducting wire l, and Nb_3Al wire material produced by the RHQT process, which is expected to become a next-generation practical wire.

Macromolecular Function Oxides Group

When molecular units are arranged with a certain rule, new properties that were not seen in individual units are emerged. Macromolecularity is the origin of excellent features of organic materials such as polymers, liquid crystals, and proteins. Our group aims at creating inorganic materials that behave as if they were macromolecules (Macromolecular Function Oxides) and opening up a new frontier of materials science. It will be possible to produce metal oxides with unique morphology, conformation, chirality, and other molecular information by means of self-assembly of small oxide units and control of surface energy. These new materials are indispensable for advancement of innovative chemical process and separation technology.

Cadmium oxide nano-fibers



We succeeded in spontaneously forming cadmium oxide nano-fibers with 3-nm width and length of a few micrometers. The nano-fibers that are highly soluble in water are expected to strongly interact with rigid polymers. This will be a key element of bio-sensor and new organic/inorganic nanocomposite materials.

Ideal Spherical Nb Superconductor

—Creation of spherical single crystal by electrostatic levitation—

Hiroyuki Takeya and Yeon Soo Sung
Thin Films & Single Crystal Group
Superconducting Materials Center

With plans for the International Space Station at last progressing, Japan's experiment module, "Kibo," is also scheduled for launch and will be used for research and development of a variety of materials in special environments. One of the heating furnaces included in the module is a laser heating-type electrostatic levitation furnace. This is a device for developing new materials which cannot be created on the earth's surface by utilizing free flotation and non-convection in the special environment of zero gravity.

At present, although still in the ground experiment stage, we are conducting experiments with the suspended solidification process using a furnace of the same type. In this method, as shown in Fig. 1, a specimen is given a positive electrical charge by irradiation with an ultraviolet rays and levitated by the electrostatic force generated between the upper electrode(-) and lower electrode(+). The specimen position is controlled to be in the center at all times by adjusting the voltage between the electrodes, and the specimen is melted with a laser while in a suspended condition. With this method, temperatures as high as approximately 3000 ℃ can be achieved rapidly.

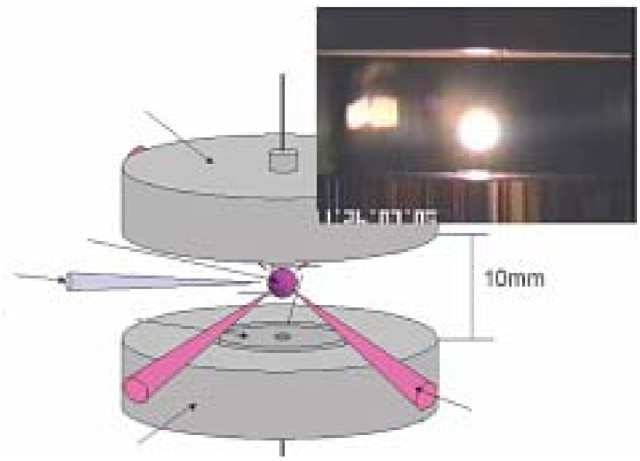


Fig. 1 Mechanism of electrostatic levitation furnace and condition during melting.

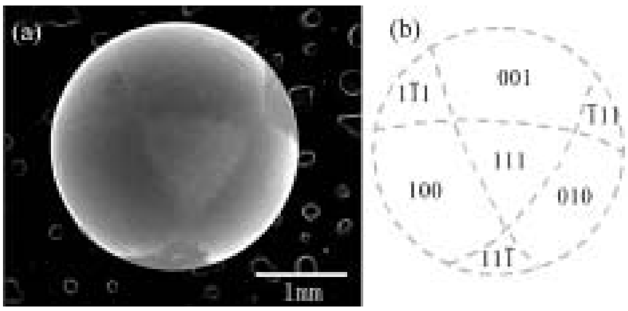
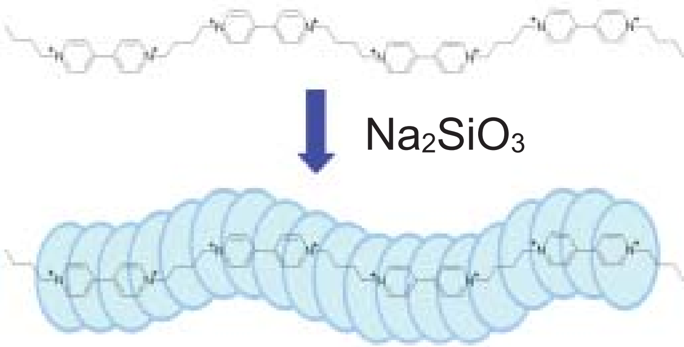


Fig. 2 Spherical Nb single crystal and crystallographic orientation.

The following describes experimental results using the representative superconductor Nb as an example. This process differs from conventional methods in that, when laser heating is stopped from a suspended and melted condition, the specimen is suspended in vacuum and free of contact of any kind; therefore, its temperature decreases due only to radiant cooling, and it remains in a liquid state (supercooled condition) from the solidification point to a temperature as low as approximately 400℃, after which it begins to solidify. Solidification is accompanied by the light emission phenomenon known as recalescence.

The condition of Nb spheres (approximately 3mm in diameter) formed by this process are different from the average materials produced by conventional solidification, displaying a dendritic pattern over the entire surface of the sphere and other unique features. Investigation by X-ray and surface-etching methods revealed that the entire sphere consisted of one single crystal (Fig. 2).

There are substances which by nature exclude a magnetic field under superconducting conditions, but in actuality, this property is impaired by defects, impurities, grain boundaries, etc. Spherical single crystal Nb prepared by the suspended solidification method has extremely few defects and excludes 100% of the magnetic field in a low magnetic field. Moreover, because it is spherical, it shows no dependence on the directionality of the external magnetic field. Taking advantage of these features, simplified magnetic field calibration with physical property measuring devices and similar equipments is possible using the new substance as a standard reference material in magnetic fields.



Wrapping of a polymer chain

A new technique for encapsulating individual polymer chains was developed. The polymer chain wrapped with ultrathin metal oxide layer is physically isolated from the surrounding environment and is expected to show the features of single molecule. Wrapping technique makes it possible to change the usual polymers into completely new materials.

Associate Director
Izumi ICHINOSE

Scanning High-temperature Superconducting SQUID Magnetic Microscope

Hideo Itozaki
SQUID Group
Superconducting Materials Center

Recent years have seen a considerable increase in material research using magnetic technologies. Since the magnetic fields permits a non-contact method of detecting electric current, a technology which can accurately detect very small magnetic sources is needed. Therefore, in this work, we developed a magnetic microscope using a high-sensitivity magnetic sensor called a SQUID (Superconducting Quantum Interference Device), which is capable of detecting even the very weak magnetic fields generated by the human brain and heart as shown in Fig. 1.

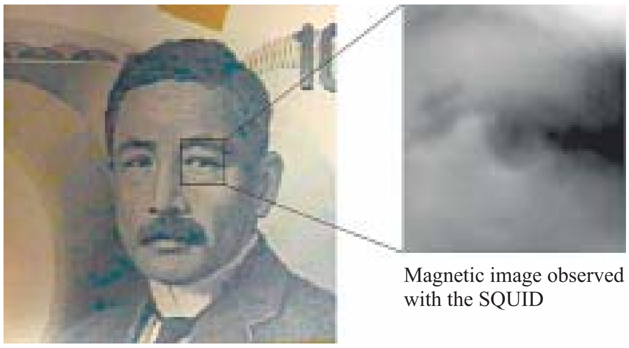
Since it is necessary to cool the SQUID sensor to the temperature of liquid nitrogen, it must be placed in a vacuum heat-insulated container and cooled in advance. On the other hand, to improve the resolution of the SQUID magnetic microscope, the specimen being observed must be brought close to the SQUID sensor. However, the proximity of the specimen and sensor is limited by various factors, and particularly by the cooling container. To solve this problem, we positioned a high-permeability needle between the SQUID sensor and specimen, making it possible to guide the magnetic field from localized regions to the sensor. Moreover, by scanning the needle over the specimen, it is possible to separate and observe microscopic magnetic fields with a resolution 0.1 mm and smaller.

Using the magnetic microscope, we observed a paper banknote printed with magnetic ink. A magnetic image of this ¥1000 note could be observed clearly, as shown in Fig. 2. It was also possible to observe magnetic images of characters printed with a laser printer, as shown on the cover (top photo).

As this magnetic microscope makes it possible to obtain magnetic images by simple observation of specimens in air at room temperature, and requires absolutely no pretreatment of the specimen, it is expected to be developed for applications such as observation of materials with magnetic properties, non-destructive inspection for minute inclusions and contaminants, non-contact electric current testing of packaging boards for electronic parts, etc.

SQUID is an acronym for Superconducting Quantum Interference Device.

Fig. 1 View of the SQUID magnetic microscope.



Magnetic image observed with the SQUID

Optical image

Fig. 2 Example of an observation with the SQUID magnetic microscope, showing the eye of the novelist Natsume Soseki on the ¥1000 bill.

Outlook for Mass Production of Ultra-Fine Grain Steel Wire Rod Material Coils

- Successful test manufacture of long lengths at the practical level -

The Steel Research Center launched a Commercialization Research Team in April 2002 and is actively engaged in technology transfer to the private sector and joint development of super steel products and technologies.

Recently, at the request of Osaka Seiko Co., Ltd., the Center provided technical guidance for improving the company's rolling technology for ultra-fine grain steel, which was developed by the Center, resulting in successful test manufacture of long coils. The test-manufactured coils center on wire rod material with a diameter of 1.3 mm and were produced in long lengths of several kilometers. The tensile strength of the material exceeds 800 MPa, which is more than double the strength level of conventional products.

This work demonstrated for the first time proved that industrial mass production of ultra-fine grain steel is possible. Applications of ultra-fine grain steel wire rod material coils are expected to include machine screws, bolts, and other high strength precision parts.

The test-manufactured coils were exhibited at the Automotive Engineering Exhibition (Technology for People and Cars 2003), which was held March 21-23, drawing the attention of many visitors.

The Quest for the Origins of Meteorites

—Shock experiments help clarify the mechanism of interplanetary dust—

Toshimori Sekine
High Pressure Group
Advanced Materials Laboratory

Kazushige Tomeoka
Department of Earth and Planetary Sciences
Kobe University

Meteorites and interplanetary dust are gifts from the cosmos with the potential to unlock the secret origins of the solar system. Although meteorites have occasionally caused catastrophic upheavals in nature, endangering the planet's ecological system, like comets, they also inspire dreams and feelings of romance in humankind.

The majority of meteorites and dust which fall to earth originate in the numerous asteroids which lie between the orbits of Mars and Jupiter. Recently, research to elucidate the distinctive features of space dust (particles with sizes of 1 mm and smaller) has been carried out by collecting dust from the deep sea bottom, stratosphere, and polar regions. The composition of dust closely resembles that of meteorites (sizes of several cm and larger), but one important difference in comparison with meteorites is the percentage of dust that contains hydrous minerals. Hydrous-type dust is overwhelmingly common, while hydrous meteorites are extremely rare, at approximately 3%. The conventional explanation for this small percentage is that hydrous meteorites are porous and brittle, and therefore tend to break up into fine particles (i.e., dust) when they enter the atmosphere, and then become meteors and burn up before reaching the earth's surface.

In the present experiment, samples of these two types of meteorites were subjected to shock waves and the recovered specimens were investigated. The meteorite samples were from the hydrous-type Murchinson meteorite, which fell in Australia, and the anhydrous-type Allende meteorite, which fell in Mexico. Remarkable differences were observed in the crack characteristics of the two types. With the Murchinson meteorite, fine cracks occurred in the entire sample when the pressure exceeded 25 Gpa, and the sample broke into fine particles with sizes of 20-400 μm. However, with the Allende meteorite, the crack density was small even at pressures exceeding 37 Gpa, and only large localized cracks formed (see figure). When a specimen with water, such as hydrous-type meteorite, undergoes adiabatic expansion after compression by shock, it appears that explosive expansion occurs due to the escape of water vapor, producing a high density of fine cracks.

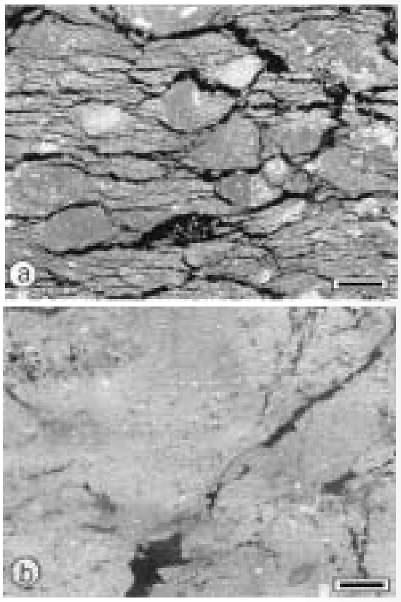


Fig. Scanning electron microscope images of meteorite specimens recovered after shock experiment: (a) Cross section of Murchison meteorite (hydrous) recovered from 30 Gpa, and (b) cross section of Allende meteorite (anhydrous) recovered from 37 Gpa. Scale=100 μm.

The results of this meteorite shock experiment suggest a new explanation for the interplanetary dust which falls to earth in quantities reaching 30,000 tons each year. It now appears that this material has already been reduced to dust by collisions between asteroids before it enters the earth's atmosphere. This also implies that hydrous-type meteorites exist in space more universally than had been thought in the past. Thus, it will be extremely interesting to examine the asteroid samples which the MUSES C asteroid explorer launched in May of this years returns to earth on the scheduled date of June 2007.

(These research results have been published previously in "Nature" (Vol. 423, No. 6935, May 1, 2003), and in Japanese newspapers including the Asahi, Kobe, Sankei, Nikkei, Mainichi, and Yomiuri Shimbun.)

Cooperation with External Organizations

Agreement with Nagoya University

NIMS and Nature COE research base (base leader: Shigeo Asai) of Nagoya University have concluded an agreement to promote research exchanges. Plans call for active mutual exchanges of researchers by receiving graduate school students from Nagoya University at NIMS and open class activities.

Creation of Material Engineering Specialization at Tsukuba University

NIMS and Tsukuba University agreed to create a new Material Engineering specialization, which will be an independent cooperative specialization in the last 3 years of study in the Mathematical Material Research Department (Ph.D course) in Tsukuba's Graduate School. NIMS will serve as the sponsoring institution for the specialization course, which will further strengthen efforts to the promote research and develop higher-level human resources in the field of material engineering.

In this Material Engineering specialization, NIMS researchers will be concurrently assigned as the specialization Head and instructors, and will mainly give guidance in research within the specialization under the policies of Tsukuba University, representing a new step forward in the existing "affiliated graduate school" system.

Improved Lithium-Ion Battery Performance by Plasma Processing

Takamasu Ishigaki
Plasma Processing Group
Advanced Materials Laboratory
Satoshi Maruyama
R&D Center
TDK Corporation

Lithium-ion rechargeable batteries, which offer the advantage of high energy density (i.e., small size and light weight), are widely used as power sources for mobile device terminals and are also expected to enjoy dramatic growth in demand in the future. Carbon powders are used as the cathode material in lithium-ion rechargeable batteries. However, it has been found that stability of the interphase which forms between the electrode surface and the electrolyte, through which ions pass, is extremely important for developing high energy products and preventing thermal runaway, which is an expected problem in case of abnormalities. Therefore, the development of a method of improving the carbon electrode surface has been urgently required.

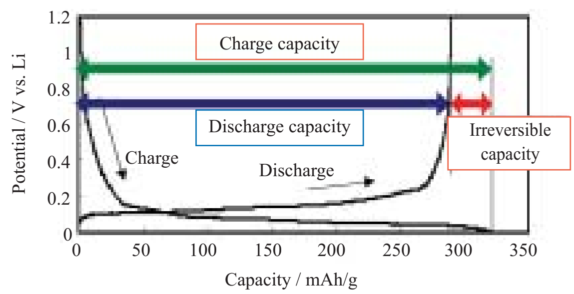
High frequency induction plasma generated at near-atmospheric pressure reaches a high temperature exceeding 10,000 ℃. Furthermore, it is also possible to generate plasma with high reactivity gases such as $Ar\text{-}H_2$ and $Ar\text{-}H_2\text{-}CO_2$.Treatment was therefore performed by feeding mesocarbon micro-beads (MCMB), which are one type of artificial graphite, in these types of plasma. The carbon powder chemically reacted to the plasma in the short time of 10-20 milliseconds during which it passed through the high temperature region of the thermal plasma. This removed the original surface layer and formed a new surface layer with a modified chemical composition and structure. The properties of plasma-treated MCMB powder applied as the cathode of lithium-ion rechargeable batteries were evaluated, showing that the capacity of lithium which go in and out of the carbon electrode (charge-discharge capacity) increased by close to 10%.

Plasma-processed powder was also recovered in an argon gas atmosphere, which prevented exposure to the air, and the charge-discharge efficiency of lithium-ion rechargeable batteries using this material as the cathode was compared, as shown in the figure. Charge-discharge efficiency is an index of the amount of stored electricity which can be recovered from a storage device without loss. It was found that charge-discharge efficiency can be substantially increased by plasma processing and recovery without exposure to the air.

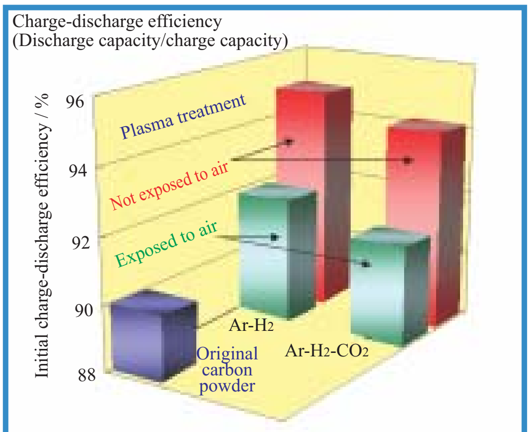
As mentioned above, lithium-ion rechargeable batteries are already used in mobile device terminals, where high energy densities are critical. In the future, they are also expected to be used in applications such as on-board power supplies for automobiles and power storage devices, etc. where size and/or efficiency are important. The new electrode surface modification technique demonstrated in this work is expected to make a large contribution to expanded use of lithium-ion rechargeable batteries.

This research was carried out as part of "Research on Advanced Materials Processing through *Concerted Amplification*," which is a general research topic of the Special Coordination Fund for Promoting Science and Technology, of Ministry of Education, Culture, Sports, Science and Technology, Japan.

(These results have been reported previously in the Nikkan Kogyo Shimbun, Japan Industrial Times, Nikkei Sangyo Shimbun, and Joyo Shimbun.)



Initial charge-discharge behavior of lithium ion battery electrode



Comparison of charge-discharge efficiency under various treatment conditions

Fig. Changes in charge-discharge efficiency with plasma treatment.

Research Cooperation Agreement with Spain's ICMAB

On June 20, 2003, the Advanced Materials Laboratory (AML) concluded a memorandum on research cooperation in the field of ceramic materials with Spain's Insitut de Ciencia de Materiales de Barcelona (ICMAB; Barcelona Institute of Materials Science).

The goals of the cooperative research under this agreement will be to develop element fabrication technologies for filters in the milli waveband and other devices by combining the research potential in oxide superconductors and magnetic materials possessed by the ICMAB and the AML's hetero-structuring technologies for dielectrics, semiconductors, etc., and to discover guidelines for application to actual devices.

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International Center for Young Scientists Opening This Summer

Even though the importance of internationalization and an environment which allows young scientists to spread their wings has been pointed out repeatedly, there is still no public institution in Japan where this is realized in an full-scale way. From this viewpoint, we believe that it is necessary to create a research center with a unique system, unfettered by conventional thinking. Here, our aim is to create an environment where creative young scientists from around the world can gather without language barriers and devote themselves to research autonomously, based on their own ideas, so that each individual can demonstrate his capabilities to the fullest, producing original research results through a fusion of different cultures and numerous fields of research. This is the fundamental concept of the International Center for Young Scientists.

The ICYS will have a research organization with a scale of 30 scientists. We hope that this small-scale research group will experiment with the kind of bold systemic innovations described above, and that step-by-step transplantation of these ideas into the larger NIMS organization will lead to positive changes in NIMS as well. We also believe that this may have a ripple effect on other organizations, outside of NIMS.

To attract outstanding scientists as NIMS employees, we are upgrading both the research environment and compensation. Young scientists will be able to carry out research using the world-class equipment and facilities at NIMS, and we will also provide a complete support system, enabling scientists to devote themselves exclusively to their work. In principle, English will be used as a common language in the Center. English will be used not only in professional discussions, but also in administrative procedures. Although a leader will not be assigned, young scientists will be able to ask advice on research whenever they need it, from scientific advisors selected from the world's top scientists. To attract the most talented people, salary levels will be set higher than those of regular NIMS employees.

Fig. 2 Nano-Bio Building where ICYS will be located.
(scheduled for completion in February 2004.)

The main research fields in the Center will be the following three:

1 Interdisciplinary field between nano-electronics and nano-biology

2 Interdisciplinary field among nanomaterials, nano-characterization, and calculation

3 Interdisciplinary field among metals, ceramics, and polymers

The research results achieved in these three fields are expected to see substantial development through fusion with technologies accumulated in NIMS, and will be necessary and indispensable to the sustained growth of society in the future.

NIMS plans to locate the International Center for Young Scientists on the 4th and 5th floors of the Nano-Bio Building, which is under construction and scheduled to be completed at Namiki Site next spring, and will devote its efforts to the success of this project as a central base for strategic interdisciplinary research.

We welcome the participation of enthusiastic, creative young scientists. For more details, see our homepage at http://www.nims.go.jp/icys/.

The AML is involved in material characterization such as *in situ* cryogenic observation analysis of crystallographic structures using leading-edge crystallographic analysis technologies with the electron microscope, and will bring these technologies to the cooperative research work.

On the other hand, the ICMAB has earned an excellent reputation for research on synthesis of various types of magnetic materials and superconductors. By combining the technologies of the AML and the potential of the ICMAB to date, the agreement is expected to contribute to opening paths in research aimed at discovering and investigating new materials, including various types of magnetic materials and superconducting materials.

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I want to receive more information on :

☐ International Center for Young Scientists Opening This Summer

☐ Cobalt Oxide Superconductors

☐ Development of MgB_2 superconducting tape

☐ Nb_3Ga Superconducting Wire Prepared by Rapid-Heating & Quenching Process

☐ Ideal Spherical Nb Superconductor

☐ Scanning High-temperature Superconducting SQUID Magnetic Microscope

☐ The Quest for the Origins of Meteorites

☐ Enhanced Lithium-Ion Battery Performance by Plasma Processing

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