from Tsukuba, Japan to the world

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National Institute for Materials Science

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Special Features

Manufacturing Frontier I

A Message on Publication of this Special Issue on Manufacturing

Mutsukazu Kamo
Ex-Vice President

In the course of history, humans have created innumerable things. In fact, it is no exaggeration to say that civilization has developed through the creation of these artifacts. Creation of new products is also extremely important on materials science. Materials are the very essence of things, and without the creation of new products of human ingenuity, there could be no materials science.

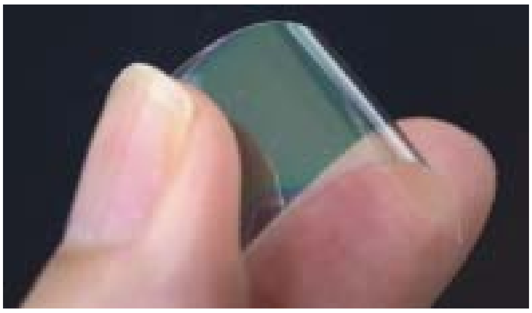


Fig. 1 Photocatalyst TiO_2 thin film fabricated on a PET resin film without heating.

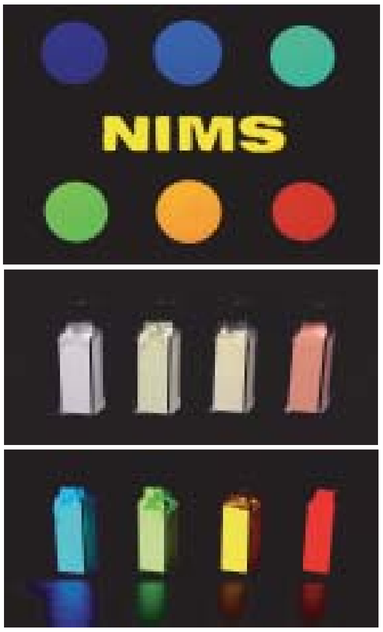


Fig. 2 Top: Nitrooxide fluophor developed by NIMS. Middle and bottom: Fluorescent powder developed by NIMS.

In recent years, manufacturing has been reviewed in various respects. The Manufacturing Infrastructure Technology Promotion Basic Law has been established, and efforts are being made at the national level to improve manufacturing technology and promote the growth of manufacturing industries. Likewise, public research institutes, local public organizations, and others have also recognized anew the importance of manufacturing, and manufacturing-related education is being given in universities and high schools.

Manufacturing is not solely an activity of manufacturing industries; in the broader sense, there is also much creation of new products in actual research. For example, NIMS is extremely active in this process, and has created a diverse range of products in the form of research outcomes. These include new materials, new devices, new processes, software, and databases. Based on the spirit that "Materials are of value only when they are really used," NIMS is also making great efforts to realize practical applications of these research achievements, for example, through joint research in cooperation with industry. To heighten awareness and further promote research on manufacturing, NIMS has incorporated "Manufacturing" as an element in evaluating researchers' results and is encouraging manufacturing activities. < Continued on p.3

in this issue

NIMS News

MOU with Sichuan University, China

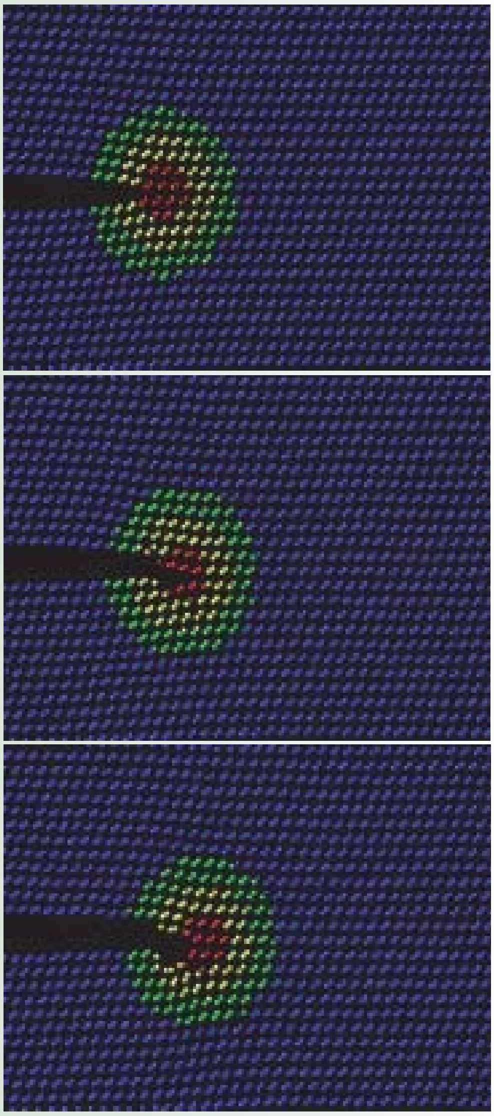
Dr. Zhang (right) with Dr. Kamo, ex-Vice President of NIMS (center), and Dr. Tanaka, Director-General of BMC.

< Continued on p.6

A Quantum-Classical Hybrid Method for Molecular Dynamics Simulations

—Software made available on the Internet—

Takahisa Ohno
First-Principles Simulation Group (1)
Computational Materials Science Center (CMSC)



(a) (b) (c)

Fig. Snapshot of simulation of crack propagation in silicon crystal. Quantum mechanics and classical mechanics were used in analyzing the regions shown in red and blue, respectively. The yellow and green regions represent a hybrid of quantum and classical mechanics. From the top, (a) structure of crack in initial stage, (b) structure after progress of cracking, and (c) structure after change of propagation direction.

In actual complex material systems, there are frequently cases where separation of atomic bonds or substitution of atomic bonds (chemical reaction) in the nanometer-order microscopic region has a large effect which is deeply related to material properties at the macro level. Examples include the deformation of semiconductor elements during operation and the enzyme reactions which occur in the human body. Computations from the electronic state based on quantum mechanics are necessary in order to accurately analyze atomic behavior in the nanometer region, but because computations based on quantum mechanics involve a huge volume of calculations, it is difficult to analyze the entire semiconductor element or enzyme molecule. This has been an obstacle to understanding complex phenomena.

We substantially reduced the volume of calculations by performing analysis by quantum mechanics only on the region of particular interest, such as the tip of a crack or the active part of an enzyme reaction, and analyzing the remaining region by classical mechanics, and thereby developed a computational method which makes it possible to analyze the effect of the separation of atomic bonds at the tip of a crack or the chemical reactions in active part of an enzyme molecule on the semiconductor element or molecule as a whole. Beginning in December 2003, this hybrid molecular dynamics (MD) method combining quantum mechanics and classical mechanics (CAMUS) was made available on the internet (http://matex.nims.go.jp/camus/). When used in combination with visualization software, it is possible to express crack propagation (see **Fig. (c)**), the behavior of atoms on the surface of semiconductors, self-assembly of carbon nanotubes, and a variety of other phenomena by computer graphics. Because the performance of semiconductors and new biomaterials can be confirmed in the design stage, this new method is also expected to be useful in improving development efficiency. Our future objectives include the development of simulation software which will enable free use of quantum mechanics and classical mechanics, also including the finite element method, as required by the purpose, and will make it possible to analyze macro level products and phenomena from deformation and behavior in the nanometer region.

For more details: http://www.nims.go.jp/cmsc/fps1/index.html

MOU with Max-Planck Institute of Microstructure Physics, Germany

The Nanomaterials Laboratory (NML) signed a memorandum of understanding (MOU) with Germany's Max-Planck Institute of Microstructure Physics (MPI-Halle) on November 9, 2004. The MOU covers development of composite materials consisting of photonic crystals and organic molecules and joint research to discover new growth processes for organic nano-crystals, among other topics.

MPI-Halle boasts some of the world's top achievements in research on photonic crystals and new regular porous materials, while the NML has succeeded in developing a new nano-crystal growth process for organic molecules and realizing high ordering with this method. In the future, the two institutes intend to promote joint research, taking advantage of their high potential.

For more details: http://www.nims.go.jp/nanomat_lab/index.html
http://www.mpi-halle.mpg.de/

Dr. Werner of MPI-Halle (right) with Dr. Wakayama of NIMS (center), and Mr. Frommfeld of MPI-Halle.

Development of Web System for Prediction of Thermal Properties of Composite Materials

Yibin Xu, Masayoshi Yamazaki, Koichi Yagi
Materials Database Group
Materials Information Technology Station (MITS)

Thermal properties such as thermal conductivity and thermal expansion are important basic properties which are indispensable in the development of industrial materials. With composite materials, thermal properties can be controlled by applying ingenuity to the structure and selection of the materials comprising the composite material. For this reason, composites have attracted attention as new materials which can be applied in electronic packaging, heat sink, automobile brake disk, and other products. However, due to an infinite number of combinations available in the selection of materials and structures, it is not possible to cope with the requirements of composite material development by conducting experiments with different combinations. Thus, in searching for candidates for the optimum materials and structure of a composite material, a simulation system which can determine their optimum values is necessary.

We therefore designed unit elements for the materials and structures comprising composite materials and developed a Web system which is capable of predicting the thermal properties of those unit elements. This system consists of a composite material thermal property knowledge base, a thermal property prediction system, and a material thermal property database (see **figure**). The composite material thermal property knowledge base contains the basic concepts of the composite materials and their thermal properties and linkage between the concepts and equations, and provides the fundamental knowledge for predicting the thermal properties of composite materials. The thermal property prediction system consists of two subsystems, an analytical method system and a numerical simulation method (finite element method: FEM) system. The analytical method has the advantage of fast computation, and is therefore effective in investigating the dependency of physical properties on the material structure in the initial stages of designing composite materials. The numerical simulation method is effective in precise computations of thermal conductivity of the designed composite, considering the anisotropy and temperature dependency of thermal conductivity of the component materials. The material thermal property database is a database which contains the material properties necessary for calculating the thermal properties of composite materials by extracting thermal property data on various kinds of materials from NIMS Materials Databases and literatures, etc.

This system is being developed with availability on the Internet scheduled for April 2005. It is expected to be a powerful support tool in the development of composite materials with thermal property requirements.

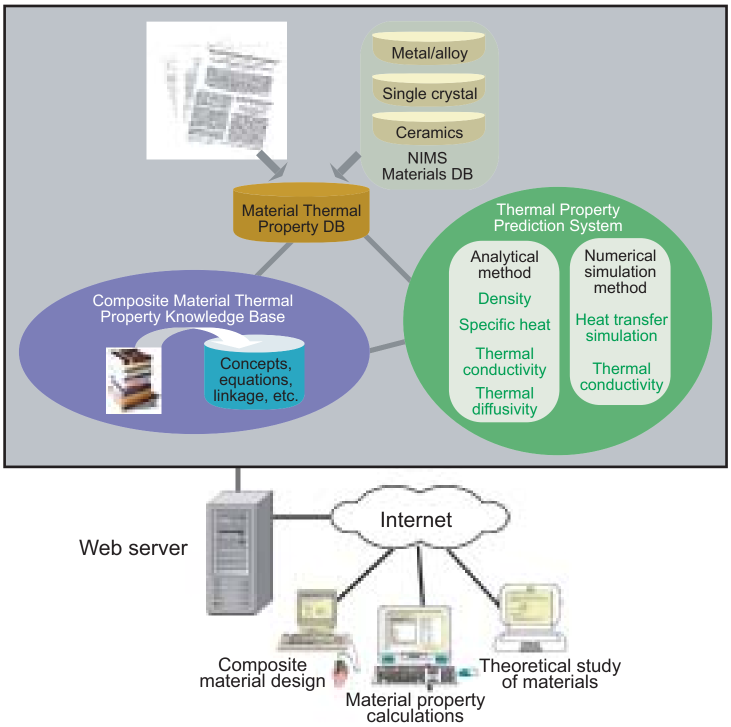


Fig. Structure of Web system for prediction of thermal properties of composite materials.

For more details: http://mits.nims.go.jp/mdg/Staff_eng.html

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A Message on Publication of this Special Issue on Manufacturing

We therefore planned this two-consecutive Special Features entitled "Manufacturing Frontier," which introduces research achievements at NIMS from the viewpoint of manufacturing. We hope that this will provide the opportunity for a deeper understanding of diverse aspects of manufacturing at NIMS among our readers.

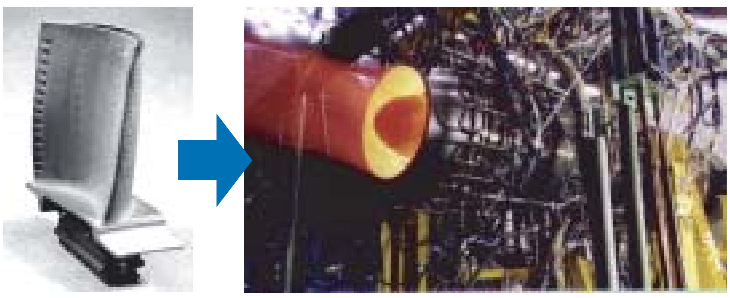

Fig. 3 Actual machine test of advanced jet engine using high pressure turbine single-crystal rotor blades made from TMS-138 alloy. (This engine set a world's record of 1650 ℃ for gas turbine combustion gas temperature.)

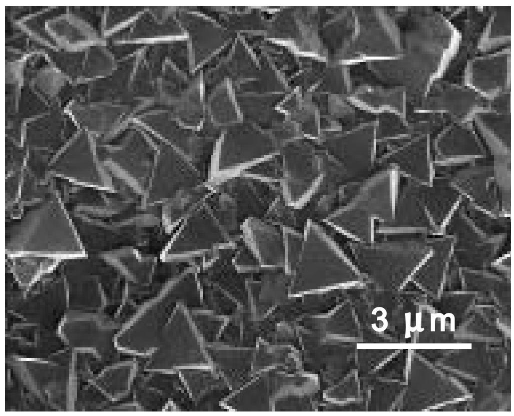

Fig. 4 Electron microscopy image of superconducting diamond thin film synthesized by chemical vapor deposition.

Preparation of Metallographic Atlas of Long-Term Crept Materials and Construction of Database

Hideo Tanaka, Masaharu Murata, Kazushige Kamihira
Materials Database Group
Materials Information Technology Station (MITS)

In the Creep Data Sheet Project, long-term creep tests of various high temperature structural materials are being performed systematically to obtain an extremely large number of fractured specimens. Creep is the phenomenon in which materials gradually deform over time when subjected to force under high temperature conditions, ultimately resulting in fracture. NIMS has clarified the microstructure of creep fractured specimens in tests extending over 200,000 hours (approximately 23 years) and is now preparing a "Metallographic Atlas of Long-Term Crept Materials."

To date, metallographic atlas has been published in printed volumes and CD-ROM form, as shown in **Fig. 1**, for austenitic stainless steels which are widely used as materials for high temperature structures, including SUS304 (18Cr-8Ni), SUS316 (18Cr-12Ni-Mo), and SUS321 (18Cr-10Ni-Ti). These metallographic atlas present images of the microstructure centering on optical micrographs, as well as the scanning and transmission electron micrographs, and also include data and information related to the microstructure, such as hardness, precipitate size and chemical composition, creep damages, and creep fracture mode, etc. **Fig. 2** is an example of the optical micrographs of SUS321 steel which fractured at approximately 300-150,000 hours at temperatures from 550-750 ℃. Large changes in the microstructure can be observed, depending on the temperature and time. This metallographic atlas is an unprecedented resource which brings together microstructures and their related information in long-term tests over a wide range, including also service conditions with actual components. It is actively used as reference data for evaluating material deterioration and evaluating the useful life/remaining life of high temperature structural parts in long-term use, and is making an important contribution to improving the reliability of high temperature plants.

In addition, based on the microstructures and their related data which were obtained in preparing the metallographic atlas, the Materials Database Group is constructing an interrelational "Microstructure Database for Crept Materials" which mutually links creep properties, microstructure, and their related data.

Fig. 1 Metallographic Atlas of Long-Term Crept Materials.

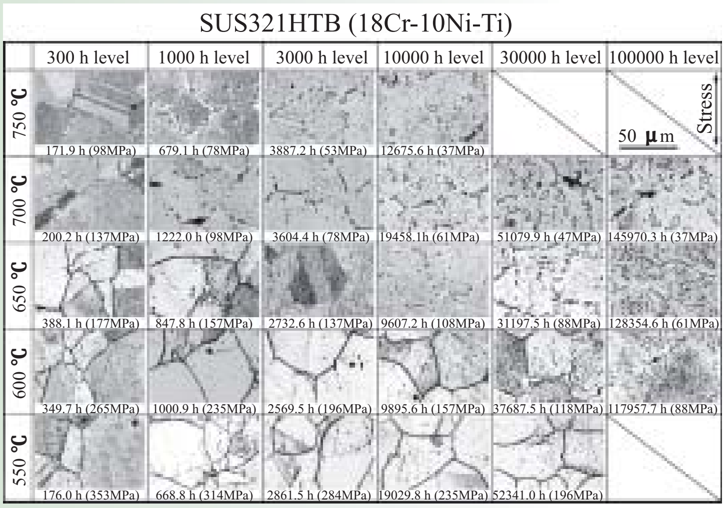

Fig. 2 Summary of optical micrographs of creep fractured specimens.

For more details: http://mits.nims.go.jp/mdg/Staff_eng.html

NIMS News

MOU with 3 Laboratories at Xi'an Jiaotong University, China

On November 29, 2004, the NIMS Materials Engineering Laboratory (MEL) signed an MOU on research cooperation with the State Key Laboratory for Mechanical Behavior of Materials, State Key Laboratory of Electrical Insulation for Power Equipment, and Multi-disciplinary Materials Research Center of China's Xi'an Jiaotong University (XJTU). The MOU aims to promote exchanges of researchers, exchanges of research information, and joint research of both sides in the field of functional materials.

Xi'an Jiaotong University is one of China's oldest universities with a history of more than 100 years. As one of the country's top 10 universities, it has enjoyed a significant development in recent years and has gained prioritized support from the government. Researchers who graduated from XJTU and students are also actively involved in work at NIMS.

Dr.Wang, Head of the State Key Laboratory of Electrical Insulation for Power Equipment (left) and Dr. Ren of MEL.

For more details: http://www.nims.go.jp/MEL/index_E.htm
http://www.xjtu.edu.cn/en/

Development of Low Transformation-Temperature Welding Consumables

—New Welding Consumables for High Safety Steel Frame Components—

Terumi Nakamura, Kazuo Hiraoka
Welding Metallurgy Group
Steel Research Center (SRC)

Welding generally causes tensile residual stress in welds. This type of stress is generated by local volumetric expansion caused by the high temperature of the weld and surrounding area, and the contraction which accompanies cooling of the weld metal itself. For this reason, residual stress is unavoidable with conventional welding methods. Furthermore, because residual stress reduces the fatigue strength of joints, post-heat treatment (stress relieving annealing) is performed to reduce residual stress.

We have been engaged in developing new welding consumables (low transformation-temperature welding consumables) which reduce the residual stress generated in welds by controlling the amount of expansion of the weld metal and, at the same time, do not cause weld cracking due to high strength. At the same time, we have also been involved in developing a new arc welding method (ultra-narrow groove welding) which minimizes unnecessary welding heat and achieve deep weld penetration efficiently with a small heat input so that the low transformation-temperature welding consumables can fully demonstrate their excellent properties.

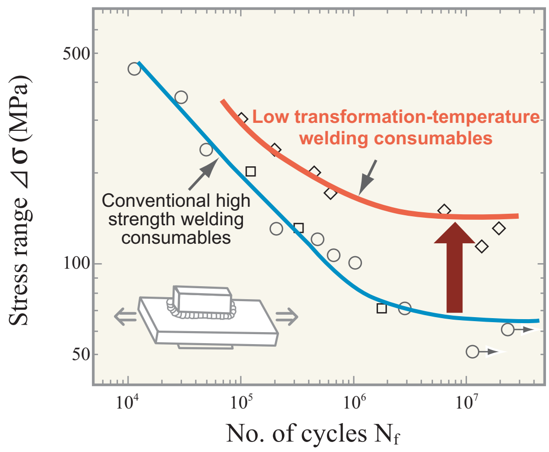

Fig. 1 Improvement in fatigue strength of joint by low transformation-temperature welding consumables.

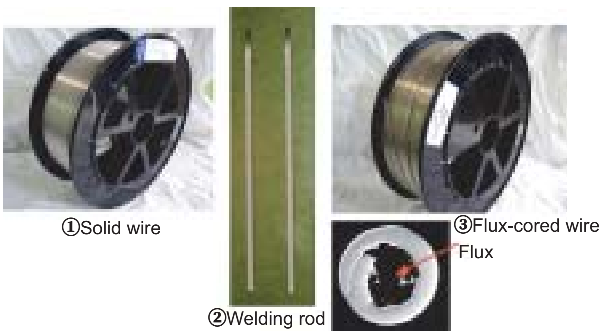

Fig. 2 Developed low transformation-temperature welding consumables (Cross section of flux-cored wire is shown at lower right).

By utilizing the martensite transformation expansion which occurs near room temperature, low transformation-temperature welding consumables make it possible to reduce tensile residual stress and change this to compressive stress. As a result, the fatigue strength of joints was more than doubled (see **Fig. 1**).

High strength of 1000 MPa class can be achieved in the weld metal, making it possible to apply the new welding consumables to high strength materials. With conventional high strength welding consumables, cracking tends to occur during welding. To prevent this, the joint must be preheated, but this is a disadvantage, as it increase welding costs. With low transformation-temperature welding consumables, a composition design which avoids weld cracking was adopted, eliminating the need for preheating. Moreover, because the residual stress in joints is also reduced, the weld metal is more resistant to cracking, thus improving cracking resistance.

The corrosion properties of welded joints are on the same level as those of conventional welding consumables (welding consumables for HT780 use), and the new consumables have been confirmed to be problem free in practical use. Thus, the new welding consumables offers substantial advantages when applied to high strength steels, including improved fatigue resistance and pre- and post-heating free performance.

Three types of welding consumables were developed for use in actual welding (see **Fig. 2**). These are (1) solid wire for use in semi-automatic welding, (2) welding rods for use in manual welding, and (3) flux-cored wire which improve the welding workability of the solid wire. Application to high strength steels is possible by using these welding wires with the proper material in the proper location. Use as reinforcing and repair welding consumables for various kinds of steel structures is also expected.

For more details: http://www.nims.go.jp/cgi-bin/wmg/menu.cgi/wmg/wmg.en.html

MOU with Seoul National University, Korea

Prof. Kuk of SNU (left) and Dr. Aono, Director-General of NML.

On November 30, 2004, the Nanomaterials Laboratory (NML) exchanged MOU on research cooperation with the College of Natural Science, Seoul National University (SNU), Korea. NML and SNU have collaborated for years in the fields of nanotechnology and nanoscience. Through this MOU, a closer and broader spectrum of cooperative research is expected. In the present stage, the two institutes will conduct a joint research on the development and application of the organic/inorganic one-dimensional nanowire with excellent conductivity.

For more details: http://www.nims.go.jp/nanomat_lab/
http://cns.snu.ac.kr/index.html

Development of Terahertz Band Detector using High Quality Grain Boundary Josephson Junction

Kyungsung Yun
Nano Quantum Electronics Group
Nanomaterials Laboratory (NML)

Terahertz (THz) band electromagnetic waves, with much attention focused on, are promising candidates for developing a wide range of possible applications: plasma measurement/material structure analysis by transmission imaging, radio astronomy, safe physiological measurement as a substitute for x-rays, explosives detection, and so on. However, due to the difficulty of generating and detecting of THz waves, at present, its development is far behind in comparison with other frequency ranges. Some methods of generating/detecting THz band electromagnetic waves are already available, and among these, which employ superconducting Josephson effects are particularly prospective. Nevertheless, no obvious progress has been made in device applications of high-TC oxide superconductors (HTSC). The main reason lies in the process of fabricating high quality HTSC thin films at the single-crystal level by a conventional vapor deposition technique.

As a solution to this, a novel fabrication technique of single crystalline $REBa_2Cu_3O_{7-y}$ (RE; rare earth elements, RE123) thin film was established by K.S. Yun et al. at the Tokyo Institute of Technology under the supervision of Profs. H. Koinuma and M. Kawasaki. This is the Tri-Phase Epitaxy (TPE) method (**Fig. 1**), by which liquid phases are made to coexist on the seed layer and the thin film is grown in a quasi-equilibrium state with controlled thickness and smooth surfaces. The TPE method will lead us to the technological revolution in the thin film fabrication of various functional oxide materials. In the work described here, the TPE method was used to grow an $NdBa_2Cu_3O_{7-y}$ (Nd123) thin film on a magnesium oxide (MgO) bicrystal substrate which was composed of two single crystals rotated with respect to each other by some angle, thereby fabricating a grain boundary on the substrate. After deposition of Nd123 film, high quality Nd123 grain boundary Josephson junctions with widths of several hundred nm to several μm were patterned by using electron beam lithography and focused ion beam etching (see **Fig. 2**). Microwave induced sharp Shapiro steps at voltages corresponding to the frequency in the Josephson frequency-voltage relationships were clearly observed in a current-voltage characteristic (**Fig. 3**). The remarkable fact is that, because this Shapiro step was observed up to 4.4 mV at 10 K, response to high frequencies of 2 THz and more is also expected. It is clear that this excellent junction property could be realized by using an extremely high quality superconducting thin film.

These results demonstrated that grain boundary Josephson junction can be fabricated with high reproducibility, reliability, and durability. A variety of applications are possible, including high frequency wave detector/generators capable of operating at the temperature of liquid nitrogen and higher, voltage standards, SQUID, logic devices, and others. We hope that this breakthrough could contribute to accelerate the development of practical device applications of HTSC.

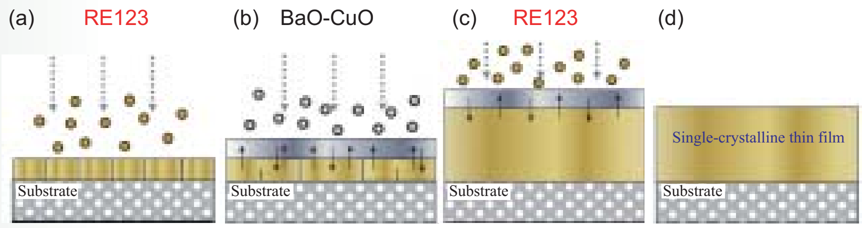

Fig. 1 Fabrication process of RE123 single-crystalline thin film using TPE method; (a) Evaporate the RE123 seed layer on a substrate. (b) Evaporate the coexisting liquid phases, and the seed layer and the liquid phases become quasi-equilibrium state. (c) Single-crystalline thin film is grown in a state of quasi-equilibrium. (d) Remove the solidified liquid phases using chemical etching.

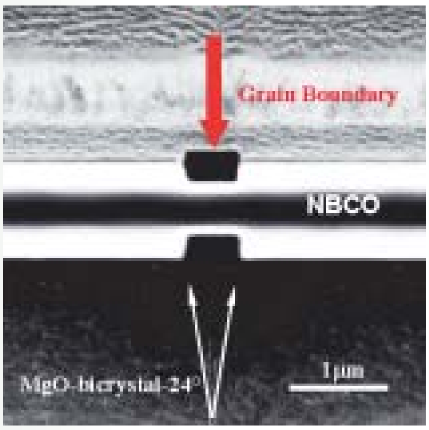

Fig. 2 Scanning ion microscope (SIM) image of $NdBa_2Cu_3O_{7-y}$ grain boundary Josephson junction using nano processing (Bridge size; 600 nm) .

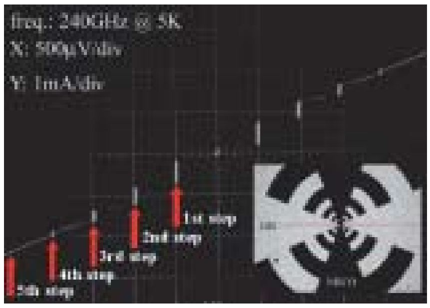

Fig. 3 Current-voltage characteristic of fabricated grain boundary junction at 5 K in a microwave field of 0.24 THz. Microwave induced Shapiro steps are indicated by red arrow. The insert shows the optical microscopic image of junction with wideband planar logarithmic-periodic antenna.

For more details: http://www.nims.go.jp/nanomat_lab/ResGroup/Quantele/qanele.html

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MOU with Sichuan University, China

On November 17, the NIMS Biomaterials Center (BMC) exchanged MOU with the Sichuan University National Engineering Research Center for Biomaterials, which is China's largest biomaterials research organization. In the future, the two institutes will positively promote exchanges of human resources and information and are planning cooperative development of artificial bone/cartilage with high biological functions. On the day of the signing, the Director of the Chinese institute, Prof. Zhang, who is also Vice Chairman of the Chinese Biomaterials Society, presented a guest lecture at the 4th Asian International Biomaterials Symposium at the International Congress Center, EPOCHAL TSUKUBA. Thus, in the field of biomaterials research, as in other areas of advanced science, we have now entered an era when research exchanges with other Asian countries will be increasingly important.

For more details: http://www.nims.go.jp/bmc/index_e.html
http://www.biomater.com

Development of Nuclear Hyperpolarization Technology

Atsushi Goto, Kenjiro Hashi, and Tadashi Shimizu
NMR & Chemistry Group
High Magnetic Field Research Center (HMFRC)

—Toward Realization of Ultra-high Sensitivity NMR Analysis—

Nuclear Magnetic Resonance (NMR) occupies an important position in a wide range of fields as a non-destructive, high accuracy analytical method, but unfortunately, it has the weakness of low sensitivity in comparison with other main analytical methods. For this reason, until now, NMR has been unsuitable for analysis of microscopic sizes and quantities, beginning with nanoscopic substances and materials. However, because in principle NMR has atomic level resolution, it also has the potential to become an important tool in the analysis of nanoscopic materials. Thus, a breakthrough which solves this problem of low sensitivity has been strongly desired.

In NMR, signal intensity depends on the alignment of nuclear spins, that is, polarization. Because the orientations of nuclear spins are virtually random under ordinary magnetic fields and temperatures, the signals from the great majority of nuclear spins mutually cancel each other, making observation difficult. Accordingly, improvement in the alignment of magnetic spins, in other words, polarization, is indispensable for achieving high sensitivity in NMR.

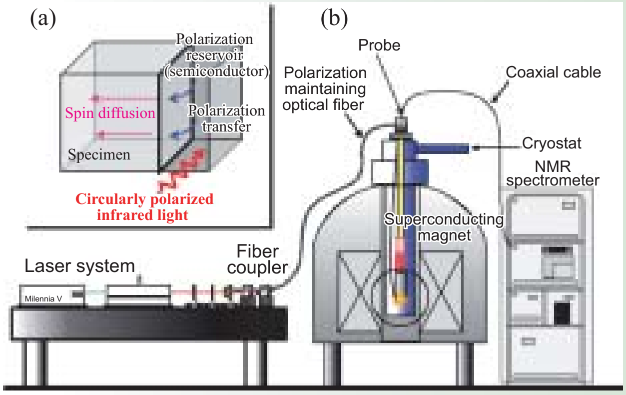


Fig. 1 (a) Schematic diagram of nuclear hyperpolarization technique, (b) nuclear spin polarizer system.

NIMS is engaged in development of a "hyperpolarization technique for nuclear spins" with the aim of dramatically improving nuclear spin polarization. The concept is shown in **Fig. 1a**. First, a compound semiconductor is irradiated by circular polarization light, and a nuclear hyperpolarization condition is formed in the semiconductor by the optical pumping effect. Next, the nuclear hyperpolarization is transferred (interfacial transfer) to a specimen which is in contact with this semiconductor (polarization reservoir), and the high polarization propagates from the interface to the interior of the specimen by the spin diffusion. A high nuclear polarization condition has been achieved in diverse specimens by this method, and high sensitivity NMR is achieved by strengthening of the signal intensity by 2-5 orders.

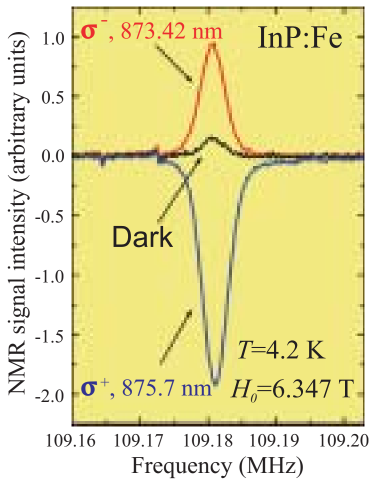


Fig. 2 NMR spectrum of hyperpolarized ^{31}P nuclei in InP:Fe. The red and blue lines show results under irradiation with excitation light (σ^-, σ^+); the black line is the spectrum in the dark.

To date, NIMS has developed the system shown in **Fig. 1b**. The excitation light and high frequency electromagnetic waves generated respectively by a laser system and an NMR spectrometer are introduced into a probe which has been placed in a cryostat. With this probe, simultaneous irradiation of specimens with excitation light and two radio-frequency waves is possible, enabling hyperpolarization of the semiconductor and polarization transfer. Thus far, we have succeeded in achieving hyperpolarization of phosphorous nuclei in indium phosphides (InP; **Fig. 2** shows an example of the spectrum in an InP:Fe specimen). We have also succeeded in experimentally transferring polarization between In nuclei and P nuclei. As future objectives, we intend to apply this system to interfacial transfer of polarization and hope to realize high nuclear polarization in a wide range of specimens.

Results of NIMS Forum 2004

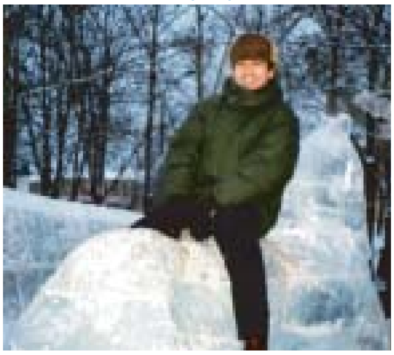
NIMS Forum 2004 was held at the Tokyo Big Sight International Exhibition Center on November 19, 2004. In spite of the bad weather, 695 persons participated in this successful event, far exceeding last year's number, and technology transfer inquiries totaled 572.

Participants were not limited to company representatives interested in licensing, but also included persons who attended in order to learn the current status of advanced research being carried out at NIMS, such as specialists engaged in research in the same fields at other institutes and universities and other students in science and technology courses. Thus, it would seem that NIMS truly achieved its stated purpose in holding this event, "Advanced research in materials science and technology transfer."

The results of questionnaires submitted by this year's participants showed that extremely high expectations are placed on next year's event, with more than 95% of participants saying that they hope to attend. On NIMS side, there was a feeling that NIMS must produce new achievements and hold future NIMS Forums in a form desired by all participants.

■ Let's speak on the whether ■

Oleg Sitdikov (Russia)
Post-Doctoral Fellow (Dec. 2003 - present)
Physical Metallurgy Group
Steel Research Center (SRC)



[In my hometown, Ufa, Russia]

First, I am very glad to use this opportunity to write about something outside of the field of material science and/or engineering. Certainly, I could explain briefly my research in this page, as most of the present articles, but I was very afraid that theme of my scientific work would be not so interesting for all readers. So, I decided to choose another and more common topic to say "hello" to everyone and tell a few words about my home country, and especially about our whether in winter. My Japanese, Chinese and Indian colleagues at NIMS ask me frequently: "How do you live in such a cold country?" Here, I'll try to explain "how".

Every season, Russia is beautiful in its own way. Usually, it gets colder towards the end of September, when the hot and dry summer whether is followed by mists and drizzles. In October, we have some really chilly days. November, in turn, often brings snow. It does not melt up until middle of April and everything is covered with snow and is very white. Sometimes it is very cold during this period, especially in Siberia and in the northern regions of Russia, where the temperature can drop to 60 ℃ below zero. Going out in weather like this isn't very pleasant, is it? Winter is, however, a good time for winter sports and pleasure. People go for skating and skiing. Snowboarding is also popular, not as a kind of sport, but rather just for fun. In addition, we have many holidays and festivities associated to winter and snow, of which the most popular one is New Year's Day. Every winter, we light colored lamps on our New Year Trees and everybody gets presents, a tradition usually reserved for Christmas in other countries.

So, winter in Russia can be very nice, in spite of the fact that it comes too early, finished too late and is quite often too cold. Of course, such long cold season could sometimes generate slight melancholy but we always have hope that everything will be fine in our life. And every year, when winter comes, we are waiting for especial winter fun, a bright New Year Holiday. We also know that warm days will come back again and again as seasons change.

■ Valuable Experience in Japan ■

Dong Hyun Chun (KAIST, Republic of Korea)
Guest PhD Student for Joint Research
(Jan. 2004 - Feb. 2005)
Light Materials Group
Materials Engineering Laboratory (MEL)

[With colleagues and their families, fourth from the right]

Hello. I am Dong Hyun Chun, a PhD student from the Department of Materials Science and Engineering of the Korea Advanced Institute of Science and Technology (KAIST). Here at NIMS, I am working with Dr. Toshiyuki Hirano (Light Materials Group, Materials Engineering Laboratory). My research objective is application of Ni_3Al foils to catalysts for hydrogen production.

When I just arrived in Tsukuba, I worried much about new life in a foreign country. Several weeks later, however, I realized that my fears were utterly groundless. At NIMS, I met a number of nice people and they helped me a lot with kindness not only with my research but also with my daily life. I think that the Japanese people are very kind, rational and diligent. It was a great fortune for me to learn such merits from them during the period of stay in Japan.

Every Sunday, I go to the church in Tsuchiura city. There, I can experience various kinds of Japanese culture. Now, though slowly, I am studying Japanese language. I hope that I can visit NIMS again as a fluent Japanese speaker and deepen my understanding of Japanese culture more.

<Errata for Vol.2 No.14 December, 2004 Issue>
Page 1: C in Fig. 1b should be replaced with B and B in Fig. 1c should be replaced with C.
Please refer to our website for the correct figure: http://www.nims.go.jp/eng/news/nimsnow/Vol2/No14/p1.html

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