



IMS NOW

International

National Institute for Materials Science

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Ecomaterials - From Japan to the World -

Special
Features

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Nanotechnology/Materials Research
Supporting the Creation of a Sustainable Society

Ecomaterials are the materials which support a sustainable society. As representative approaches, the NIMS Ecomaterials Center (EMC) is involved in research on (1) **eco-circulation materials** which consider a wide range of problems from purification of harmful artificial/natural substances in the large global circulation system to circulation of artificial products in the human sphere, (2) **eco-lightweight materials** which are environment-friendly and easy-to-use, for example, in automobile weight reduction, (3) **ecodevices** as an environment-friendly packaging technology for electronic materials, (4) **eco-energy materials** for clean energy systems, including fuel cells, hydrogen energy, and thermoelectric materials, and (5) **environmental purification materials** using photocatalysts. *< Continued on p.3*

Warsaw, October 2005 (7 members)
Materials Workshop for a Sustainable Society in the 21st Century
•Material flow analysis
•Easy-to-recycle materials
•Fuel cells •Purification materials
•Photocatalyst •Fullerene whiskers

Shanghai, March 2003 (3 members)
China Eco-Design Conference
•Eco-design •Pb-free solder

Thailand, January 2005 (7 members)
Asia/Pacific Conference on Nanotechnology and the Environment
•Ecomaterials and nanotechnology
•Fuel cells •Purification materials
•Pb-free solder •Fullerene whiskers

Netherlands, October 2004 (6 members)
International Symposium on Inorganic and Environmental Materials
•Guidelines for ecomaterials
•Fuel cells
•Hydrogen functional materials
•Purification materials
•Fullerene whiskers

Vancouver, July 2006 (now in planning stage)
Thermec 2006
•Ecomaterials session

Madrid, July 2003 (6 members)
Thermec 2003
•Guidelines for ecomaterials
•Design for recycling
•Hydrogen functional materials

Singapore, July 2005 (14 members)
International Union of Materials Research Societies (IU-MRS), Ecomaterials International Conference
•Material flow analysis
•Easy-to-recycle materials •Fuel cells
•Hydrogen functional materials
•Photocatalysts •Pb-free solder
•Nanotechnology risk



The EMC has exchanged MOU on joint research with institutes in these nations, as well.



- NIMS-EMC Materials Environmental Data (English Edition)**
- No. 1 Estimating Environmental Load Generated During the Smelting and Refining of Metallic Elements
 - No. 2 Fundamental Survey for Lead Material Flow in Japan
 - No. 3 Worldwide Supply and Demand of Platinum Group Metals and Trends in the Recycling of Autocatalysts in Japan
 - No. 4 LCA-Based Investigation of Technological Scenarios of Expanding Use for Iron Scrap in Converter and Electric Furnace and the Consumption Trend of Iron Scrap
 - No. 5 Calculation of Mineral Resource Depletion Factors (now in printing stage)

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ICYS Starts Collaboration with UCSB, U.S.

NIMS
News



Dr. Ozawa of the ICYS shakes hands with Prof. Cheatham, Director of the ICMR.

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Development of Platinum/Cerium Oxide Fuel Cells Electrodes for Application to Mobile Devices

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Fuel cells which use a polymer as a solid electrolyte, termed polymer electrolyte fuel cells (PEFC), are now being investigated for application to automobiles and mobile electronic devices.

In particular, use of methanol as a fuel in fuel cell power sources for mobile electronic devices is an important current topic. However, methanol fuel generates carbon monoxide on the surface of the platinum electrode, damaging the Pt electrode, which also greatly reduces fuel cell output. The platinum-ruthenium (Pt-Ru) electrode has been proposed as a solution to this problem, and development as a fuel cell electrode for mobile devices is now in progress.

From the viewpoint of reducing use of precious metals, which are a scarce natural resource, we developed a Pt-cerium oxide (Pt-CeO₂) electrode as an alternative to the Pt-Ru electrode. Among the distinctive features of our electrode, the CeO₂ used in the electrode is a nanosized spherical particle (average particle diameter: 40 nm; Fig. 1), and the electrode reaction mechanism is different from that in the Pt-Ru electrode. It is possible to investigate the electrode reaction mechanism by measuring the change over time in the current value at a constant potential. In ordinary electrodes, the surface reaction is rate-controlling, but in contrast, it has been found that diffusion is rate-determining step in the Pt-CeO₂ electrode. This result suggests that the process in which the O₂ generated from CeO₂ oxidizes and removes the CO adsorbed on the Pt surface is extremely important for our electrode reaction. The Fig. 2 shows the activation energy of a Pt-Ru electrode manufactured by the Johnson Matthey Company, which is the highest performance electrode currently available in the market, and the Pt-CeO₂ electrode fabricated by the authors. Although commercial electrodes show low activation energy, the Pt-CeO₂ electrode, in which diffusion is rate-determining step, is expected to display lower activation energy than commercial electrodes as technical innovation realizes more active production of O₂ from the CeO₂.

On the other hand, a critical point in evaluating electrode performance is that the onset potential for oxidation of CO must be low. If the onset potential is high, a large overvoltage will be generated on the electrode and cell output will be reduced. The onset potential of commercial electrodes is 0.46 V, whereas that of the Pt-CeO₂ electrode is 0.50 V. Although this is only slightly higher, we are attempting to achieve higher performance, aiming at the development of an electrode which displays performance equal or superior to that of commercial electrodes, by fabricating Pt-CeO₂ nanoclusters.

For more details: <http://www.nims.go.jp/eoenergy/top-e.htm>

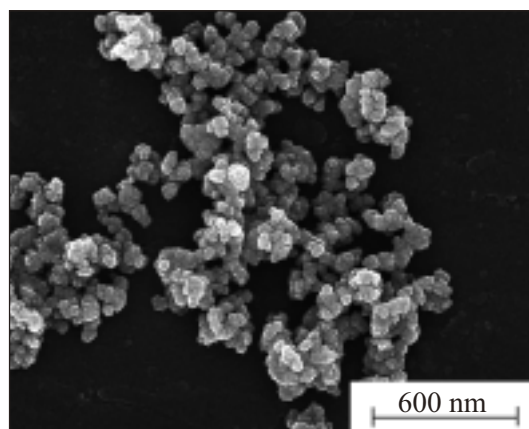


Fig. 1 Nanosized spherical CeO₂ particles used in Pt-CeO₂ electrode.

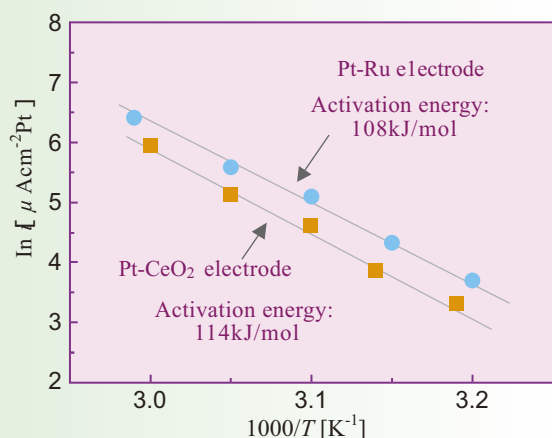


Fig. 2 Comparison of activation energy of electrode reaction. Electrolyte: 0.5 mol H₂SO₄ + 0.5 mol methanol. Potential: 0.6 V vs. reversible hydrogen electrode.

Visit by Executive Vice President of the Chinese Academy of Sciences



(July 7, NIMS) -- A delegation from the Chinese Academy of Sciences (CAS) led by its Executive Vice President, Prof. Chunli Bai, visited NIMS. Prof. Bai has held various key posts, including President of the CAS Graduate School and Director of the National Center for Nanoscience and Technology. After being greeted by tens of Chinese researchers engaged in research at NIMS, the Chinese delegation held informal discussions with President Kishi of NIMS and enthusiastically observed research groups involved in work on photocatalysts, organic materials, nanomaterials, nanoelectronics, and other fields. With more than 100 Chinese researchers currently at NIMS and joint research with institutes in China increasing annually, China is an indispensable partner for NIMS. NIMS and CAS agreed to a further deepening of their cooperative relationship in the future.



The delegation poses with NIMS executives and Chinese scientists.

For more details: <http://www.nims.go.jp/eng/topics/050707/>

Pioneering Thermoelectric Materials in Polymer Systems

- The Quest for Substances which Do Not Exist in Inorganic Systems -

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The thermoelectric phenomenon refers to a phenomenon in which energy is transported by movement of charge carriers (electrons, holes, ions, etc.). This phenomenon was first discovered in metals more than 100 years ago and is currently a subject of materials research in inorganic systems such as intermetallic compounds, borides, and oxides. BiTe and PbTe systems are typical examples. Development for a wide range of applications is now in progress, ranging from refrigerators, LSI cooling devices, and ultra-small heat pumps which do not use flons or other global warming substances to power generation using close-at-hand waste heat (including body heat). However, from the viewpoint of the life cycle cost, which considers manufacturing energy, safety, costs, resources, and recyclability as elements in a comprehensive assessment, many inorganic material systems display a poor total balance. Polymer systems have attracted attention as materials with an excellent total balance which also offers a high degree of freedom in structural design.

Requirements for thermoelectric materials include high electric conductivity and a large thermoelectromotive force. (Thermoelectric force is

the potential difference when a temperature differential is created in the material; the thermoelectromotive force per degree Kelvin (K) is termed the Seebeck coefficient.) In polymers, these physical properties are determined by the molecular structure, molecular weight, molecular arrangement, and amount of doping. Important differences with inorganic systems include the fact that the 3-dimensional structure within molecules and between molecules of the same type is unclear; the details of the mechanism of electric conduction in molecules and between molecules are unknown; polymer systems are chemically doped, meaning that doped polymers are unstable because additives simply accumulate in the vicinity of the main chain; the position of these additives in the material is unknown; and quantitative measurement of physical properties is difficult. Thus, while polymer systems provide a high degree of structural freedom, as a drawback, there had been a feeling that many of their features existed in a black box.

In research being conducted as part of personnel exchanges between NIMS and Tohoku University's Institute of Multidisciplinary Research for Advanced Materials (IMRAM), researchers from the two institutes carried out a study of control of the molecular structure and molecular weight and stabilization of additives, centering on polythiophene systems, and developed a polythiophene system which is stable and has a larger Seebeck coefficient than other polymers (see figure). However, this material has still not reached the performance level required in a practical material, as its Seebeck coefficient is small (only 1/10 that of BiTe systems).

At present, we are attempting to elucidate the black-box aspects of the material and carrying out material development to realize higher performance, making active use of the joint laboratory system with the IMRAM.

For more details: <http://www.nims.go.jp/ecoenergy/top-e.htm>

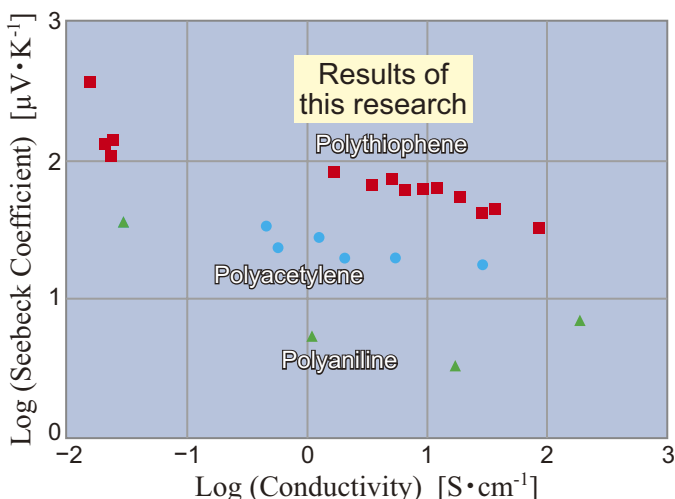


Fig. 1 Relationship between conductivity and Seebeck coefficient of synthesized polythiophene. Values for polyacetylene and polyaniline are taken from the literature.

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Ecomaterials - From Japan to the World -

In all of these areas, our aim is to develop materials which can serve as the basis for a new eco-conscious lifestyle in Japan and the other industrialized nations. Moreover, by sharing scarce energy and natural resources, and thereby improving the quality of life, if only slightly, this will also become the foundation for technologies necessary for those seeking freedom from sickness, cold, and hunger.

However, even though the aim of this materials research is the creation of a sustainable society, which is among the most important issues facing mankind today, Japan is currently the only country which has created a regular organization like the EMC and is conducting comprehensive research in this area. For this reason, the Ecomaterials Center cooperates in forums where researchers in various countries and regions gather interested researchers and students in their regions, and is contributing to the creation of topics and sessions through the participation of EMC researchers in conferences to create opportunities for efforts rooted in particular regions. We call this program the "Ecomaterials Caravan."

The following figure traces the Ecomaterials Caravan to date and also shows its future schedule. Simultaneously with this, the EMC is publishing NIMS-EMC Materials Environmental Data in Japanese and English editions, and is conducting information exchanges and bringing together researchers from around the world to realize materials development which contributes to a sustainable society.

For more details: http://www.nims.go.jp/emc/emc_eng/index_e.html

Development of High Strength Lightweight Metal Material by Nanostructural Control

- High Expectations for Dramatic Weight Reduction in Transportation Equipment -

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Kazuhiro Hono
Metallic Nanostructure Group
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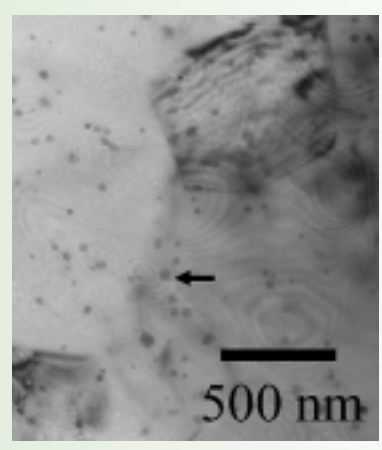


Fig. 1 Example of nano-spherical particle-dispersed Mg alloy (Mg-1.8 Zn-0.3 Ca (at.%); extruded material).

From the viewpoints of decreasing emissions of CO₂ gas by weight reduction in structural parts of transportation equipment, as well as resource productivity, magnesium alloys have attracted attention as lightweight metal materials which are also advantageous for recycling. However, because Mg alloys produced by conventional casting have low strength and are extremely brittle, high strength

is, to the nanometer order, the material displays double the strength of the conventional alloy with no impairment of ductility.

As can be seen in Fig. 1, our work revealed that nanometer-order spheroidizing and uniform dispersion of the particles of intermetallic compounds (shown by arrows in figure) which form in the grain interior and at grain boundaries make it possible to improve ductility and toughness as well as strength. The important point is to identify the elements and arrangement of these nanoparticles. We are currently studying the optimum combination of elements using a 3-dimensional atom probe. For example, as shown in Fig. 2, we have found that it is possible to achieve high strength, even with a small addition of alloying elements, by optimizing the arrangement of Ca and Zn atoms.

and improved ductility and toughness to guarantee safety in use will be necessary if these materials are to be developed to various structure applications.

We are reviewing the internal structure of Mg alloys at various scales as part of a study of effective structure elements for realizing improved mechanical properties. For example, like other metal materials, Mg alloys consist of aggregates of crystals, but due to their anisotropic crystal structure, their strength and deformability differ greatly depending on the orientation of crystal planes with densely arranged atoms in the crystal interior region. For this reason, control of the crystallographic orientation is one guideline for improvement.

We found that refinement of the grain size dramatically improves strength while simultaneously eliminating inhomogeneous deformation. When the grain size is refined to less than 1 μm, that

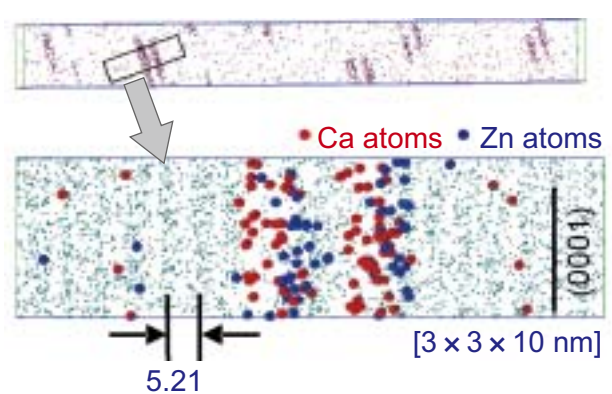


Fig. 2 Example of component atom mapping of strengthening particles (Mg-0.3 Zn-0.3 Ca (at.%); aging at 473 K for 60 ks).

5th Meeting of the NIMS Advisory Board

(July 28-29, Tsukuba) -- The 5th meeting of the NIMS Advisory Board was held for the 2-day period. The Advisory Board was established in so that NIMS can receive advice on its operation from leading Japanese and foreign researchers with particularly high expertise in the field of materials science, who are invited to serve as Advisers. Because NIMS will embark on its new 2nd Mid-Term Program in fiscal year 2006, this year's meeting was devoted to study of the next Mid-Term Program and future concepts. Domestic and foreign Advisers gathered for the recent meeting and gave numerous suggestive opinions and advice on the institute's achievements to date and proposed plans for research projects under the next Mid-Term Program.



Members of the Board of Advisers and top leadership of NIMS.

Aiming at Chemical Sensing in the Nanoregion

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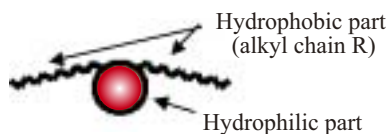


Fig. 1 Horizontal-type amphiphilic molecule: 2 alkyl chains are extended in the horizontal direction with respect to the central hydrophilic part.

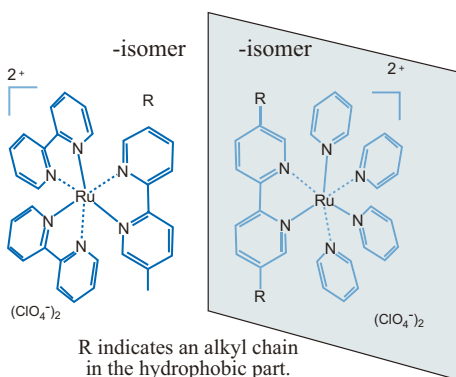


Fig. 2 Enantiomer of horizontal-type Ru () complex (bivalent cation, counterion $(\text{ClO}_4^-)_2$): $-$ -isomer and $+ -$ -isomer. In this case, chirality occurs due to the 3-dimensional arrangement of 3 bipyridyl ligands. The arrangements of the ligands are expressed by the symbols $-$ and $+ -$.

chains in the horizontal direction with respect to the hydrophilic part (called a horizontal-type molecule; see Fig. 1).

Three kinds of molecules, viz., a racemic mixture (mixture of equimolar amounts of enantiomers) of this amphiphilic Ru () complex, and optically-active materials ($-$ -isomer and $+ -$ -isomer; see Fig. 2), were each floated on the surface of water containing chiral bis[(+)-tartrato] diantimonato () dipotassium ((+) and (-) denote the dextrorotatory property and levorotatory property respectively). We then investigated the change in the surface pressure of the monolayer (Fig. 3).

As a result, when the subsurface water did not contain chiral molecules, the surface pressure-molecular area ($-A$) isotherms of all specimens coincided and no changes were observed (blue line in figure), but in contrast, when chiral molecules were dissolved in the subsurface water, the $-A$ isotherm shifted to the large molecular-area region only with the $-$ -isomer film (green line). This is thought to be because the interaction between the $-$ -isomer of the horizontal-type Ru () complex and the bis[(+)-tartrato] diantimonato () dipotassium increased, resulting in the preferential diastereomeric effect. This phenomenon was not found with the vertical-type amphiphilic Ru () complex. Thus, in this research, we discovered a new molecular recognition capability which is dependent on changes in molecular structure. Based on this knowledge, application to high selectivity chiral sensors, high sensitivity sensors capable of detecting extremely small amounts of chemical species in the living environment, and other devices can be expected.

With increasingly high expectations placed on nanotechnology, materials technology for molecular recognition with a high order of selectivity, equivalent to the biological response to trace amounts of chemical substances in the living environment, is now demanded in a wide range of fields, including medicine, environmental science, and the life sciences.

Many of the biomolecules which play crucial roles in life phenomena, such as amino acids and sugars, have enantiomers (optically-active materials) in which the original image and its reflected mirror image are not perfectly superimposable in 3 dimensions (this is also called chirality). Pairs of enantiomers of chiral molecules differ only in their optical behavior with respect to polarization (showing rotary polarization), and all other physical and chemical properties are completely the same. However, biological systems show different responses to pairs of enantiomers of chiral compounds. This explains why substance with identical molecular formulas but different 3-dimensional structures are sensed as having completely different smells or tastes.

In the present research, we synthesized an optically-active amphiphilic ruthenium () complex, which contains both hydrophilic and hydrophobic parts in one molecule. To investigate the chiral recognition capability of this molecule, we formed a monomolecular film (monolayer) of this amphiphilic chiral complex on an aqueous solution in which a different chiral molecule had been dissolved, and observed the interaction between the monolayer and the chiral molecules in the solution. Molecules which extend a hydrophobic alkyl chain in the perpendicular direction with respect to the hydrophilic part (perpendicular-type molecules) are generally considered to be suitable in the monolayers which form at an air/water interface (Langmuir film). However, in this research, we synthesized a molecule which extends hydrophobic alkyl

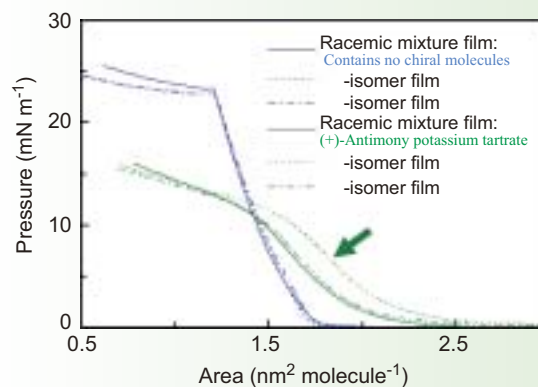


Fig. 3 Molecular area-surface pressure ($-A$) isotherm of Ru () complexes. Blue line: Film formed on water not containing chiral molecule. Green line: Film formed on aqueous solution of bis [(+)-tartrato] diantimonato () dipotassium.

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ICYS Starts Collaboration with UCSB, U.S.



NIMS
News

(June 24, Santa Barbara) -- The International Center for Young Scientists (ICYS) signed a memorandum of understanding (MOU) on the joint creation of an international materials research network with the International Center for Materials Research (ICMR) of the University of California, Santa Barbara (UCSB). The ICMR is operated with the financial support of the internationalization program in materials science from the America's National Science Foundation (NSF). Under the agreement, the two sides will actively implement international joint use of research facilities, hold workshops centering on young scientists, and plan and conduct various educational programs based on a philosophy of creating an international network in the field of materials research, training young scientists, and supporting the developing nations.

For more details: <http://www.nims.go.jp/icys/>

Achievement of High Performance in Polymer Materials with 1 nm-Thick Silicate Nanosheet

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Clay-polymer nanocomposites in which individual clay nanolayers are uniformly dispersed in a polymer matrix are lightweight, have excellent mechanical properties, and display a gas barrier effect when compared with conventional composites. With this technology, we are attempting to create nanocomposites with a variety of polymer materials using smectite (a kind of clay mineral) and synthetic fluorine mica with a swelling property.

Layered silicates include a large number of similar substances other than clay minerals such as smectite. For example, the mica produced in nature has a crystallographic structure similar to that of smectite, but in general, the obtained particle sizes are large in comparison with smectite. Smectite also has the property of swelling when water or other liquids are intercalated between its layers, and the property of exchanging interlayer cations with other ions (ion exchange property), but the swelling property is not observed in natural mica, and natural mica has virtually no ion exchange property. For these reasons, natural mica had never been used in nanocomposites until now.

In the present research, we succeeded in exfoliating of mica layers in polymers by applying an organic treatment to natural mica under special conditions. **Figure 1** shows transmission electron microscope images of a natural mica/epoxy composite (observing the cross-sectional direction of the mica layers). In the case of the conventional composite, rigid sheet-shaped mica (condition in which several 10 to several 100 layers of mica sheets exist in a stacked form) is dispersed in the epoxy (**Fig. 1a**). With the nanocomposite, exfoliating of the mica layers produced silicate nanosheets with a high aspect ratio, having a thickness of 1 nm (thickness equivalent to 1 layer) and a cross-sectional length extending more than 10 μm, and these silicate nanosheets are dispersed in the epoxy matrix (**Fig. 1b**).

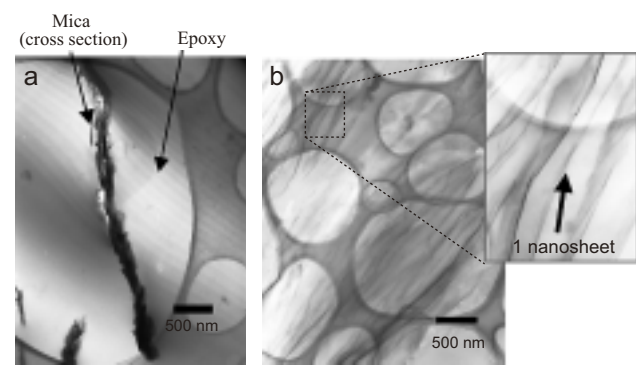


Fig. 1 TEM images of natural mica/epoxy composite system (ultra-thin sections are seen on microgrid). (a) Conventional composite: Dispersion of mica platelet in un-exfoliated condition. (b) Nanocomposite: Uniform dispersion of mica nanosheets with thickness of 1 nm.

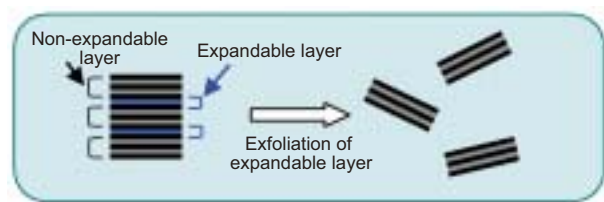


Fig. 2 Schematic diagram of mixed-layer silicate exfoliating process: Non-expandable layers are dispersed in a stacked condition after exfoliating the expandable layers.

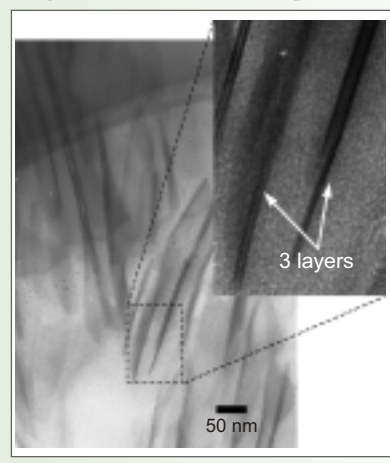


Fig. 3 TEM image of mixed-layer silicate/epoxy nanocomposite (dispersion of 3 layers/group).

With this mixed-layer silicate, it is possible to control the chemical composition, stacking structure, and other properties by controlling the raw materials and synthesis conditions. In fact, we created an organic/inorganic composite by synthesizing a mixed-layer silicate consisting of an expandable layer (smectite) and a non-expandable layer (talc) and inserting an organic modifier into the expandable layers. Next, this was mixed with epoxy, and the organic-modified layers, which have good affinity with epoxy, were exfoliated using the epoxy curing reaction. In this case, silicate nanosheets consisting of 3 layers/group are dispersed uniformly in the epoxy matrix (**Fig. 3**). The nanocomposite technology used in these materials can also be developed to a wide range of various other polymers. In the future, we plan to propose high performance, high function polymer nanocomposite materials by controlling the high-order structure of silicate nanosheets.

In addition to the material described above, we also succeeded in dispersing silicate nanosheets consisting of several layers in one group in the polymer (**Fig. 2**). This was achieved by synthesizing a mixed-layer silicate having a structure characterized by regular stacking of expandable layers and non-expandable layers, and then exfoliating only the expandable layers. With this mixed-layer silicate, it is possible to control the chemical composition, stacking structure, and other properties by controlling the raw materials and synthesis conditions. In fact, we created an organic/inorganic composite by synthesizing a mixed-layer silicate consisting of an expandable layer (smectite) and a non-expandable layer (talc) and inserting an organic modifier into the expandable layers. Next, this was mixed with epoxy, and the organic-modified layers, which have good affinity with epoxy, were exfoliated using the epoxy curing reaction. In this case, silicate nanosheets consisting of 3 layers/group are dispersed uniformly in the epoxy matrix (**Fig. 3**). The nanocomposite technology used in these materials can also be developed to a wide range of various other polymers. In the future, we plan to propose high performance, high function polymer nanocomposite materials by controlling the high-order structure of silicate nanosheets.

NIMS Researchers Swept the 2005 Tsukuba Prizes

(July 27, Tsukuba) -- NIMS researchers received the 16th Tsukuba Prize and the 15th Tsukuba Encouragement Prize, which recognize researchers engaged in research in science and technology in Ibaraki Prefecture for remarkable research achievements. Three NIMS researchers, Dr. Yoshio Bando, NIMS Fellow, Dr. Dmitri Goldberg, Associate Director of the Nanosynthesis & Analysis Group, Nanomaterials Laboratory (NML), and Dr. Yihua Gao, Postdoctoral Researcher of the Advanced Beam Analysis Group, Advanced Materials Laboratory (AML), received the Tsukuba Prize for the topic "Creation of Novel Nanotube and Discovery of Nanothermometer."



Dr. Yoshio Bando Dr. Dmitri Goldberg Dr. Yihua Gao

Two NIMS researchers also received Tsukuba Encouragement Prizes. Dr. Kenji Kitamura, Director of the Opto-Single Crystal Group, AML, received the Practical-Use Research Award and Dr. Xiaobing Ren, Senior Researcher of the Materials Physics Group, Materials Engineering Laboratory (MEL), received the Young Investigator's Award.

For more details: <http://www.nims.go.jp/eng/topics/050727/>

Formation of Photocatalyst Thin Film on Unheated Substrate

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Advanced Materials Laboratory (AML)

- Toward Realization of Soiling-Resistance Glass and Plastics -

Recently, the word "photocatalyst" is appeared in a variety of contexts, including literature explaining the functions of home electric appliances. Although it seems that the deodorizing effect of photocatalysts was realized before other functions, the most important application of photocatalysts in the market is the soiling-resistance effect. This refers to cleansing of the photocatalyst material surface by decomposition and removal of soil from the surface when it is irradiated with ultraviolet rays. If this technology can be applied to window glass in office buildings, the dangerous job of cleaning windows in high-rise buildings will become a thing of the past. Moreover, application to easily-soiled plastics will also make it possible to maintain the cleanliness of plastic surfaces.

However, with conventional techniques, it was not easy to impart a photocatalytic function to large glass and plastic surfaces. The photocatalytic function is the result of a crystalline material called titanium dioxide (TiO_2). To realize non-soiling glass and plastics, it is necessary to form this crystalline material on the glass or plastic surface in the form of a coating film. Conventionally, a high temperature of several 100 was required to crystallize this coating film. However, glass will crack if heated to such high temperatures, and plastic will deform or degrade. Therefore, to produce building-material window glass and plastics with this function, it was essential to establish a technology for forming a photocatalyst TiO_2 coating at a temperature where window glass and plastic are not damaged.

In this research, a TiO_2 coating film was successfully formed on an unheated PET resin film (same material as in PET bottles) using a new coating method called bipolar magnetron sputtering (see Fig. 1). The activity of the photocatalyst in the coating film was measured by an optical reduction method using silver ions, confirming that the film shows satisfactory high catalytic activity (Fig. 2). This technology is expected to contribute to realizing soiling-resistant glass and plastics.

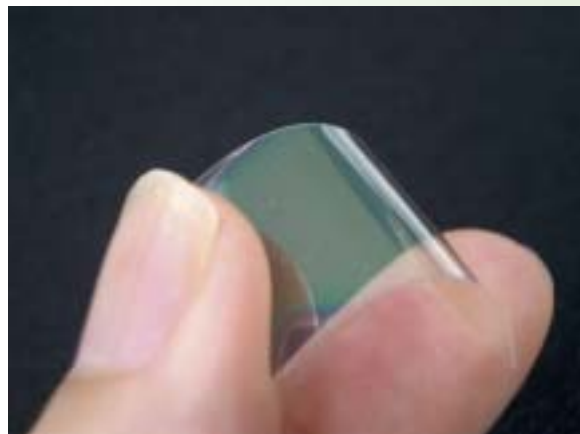


Fig. 1 Photocatalyst TiO_2 film formed on PET resin film.



Fig. 2 Logo mark stands out distinctly using the photocatalytic effect of a TiO_2 film formed on an unheated glass substrate.

For more details: <http://www.nims.go.jp/plasma/>

MOU with Charles University, Czech Republic



NIMS
News



Signing ceremony, with Prof. Matolin of Charles University in the center.

international joint graduate school agreement with NIMS, under which it sends five Ph.D. course students to NIMS each year. Taking advantage of this opportunity, the two institutions expect to achieve a higher level of activity in research exchanges.

(July 22, NIMS) -- The NIMS Nanomaterials Laboratory (NML) and Ecomaterials Center (EMC) signed an MOU for international joint research on "Design of Nano-Scale Reactivity Systems" with the Faculty of Mathematics and Physics of Charles University in Prague, Czech Republic. Charles University was established in 1348 and is a famous university known for having the longest history and tradition in Central Europe. Charles University has been involved in joint research on surface chemistry with the NML for more than 10 years. In February 2002, the university concluded an in-

For more details: <http://www.nims.go.jp/eng/topics/050722/>

Hello from NIMS

James Owen (U.K.)
ICYS Fellow (Nov. 2004 - Oct. 2006)
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[At the Mt. Tsukuba Shrine]

I'm originally from England. I did a B.A. in Materials Science, and then a DPhil at Oxford University. My research career has taken me all over the world since then. I met my wife, Oliya, when I was working in California. (She is actually Russian) Here we are together at the shrine on Mt. Tsukuba. My host researcher and his wife go there every year in January to buy some good luck for the coming year.

Here is a picture of what I have come to Japan to study - the Bi nanoline. This is a model of the "Haiku" structure. We called it that because it is made up of 5 and 7-membered rings of Si, and we came up with it in Japan.



[Bi nanoline ("Haiku" structure)]



[Kinkakuji Temple]

America was more foreign than I expected, but Japan is another thing entirely. However, Tsukuba is a very friendly and safe place to live, and I am happy at ICYS. We have enjoyed many trips to different parts of Japan: Kyoto, Nikko and other places. Here is the Golden Pavilion in Kyoto, the "Kinkakuji". We have also become definite fans of Japanese onsen (hot springs), provided they are outdoors, and in a natural surrounding.

FLOWERS SPEAK LOUDER THAN WORDS!



Lotus Flower ~ Holiness ~
Heian Jingu Shrine, Kyoto



Camellia ~ Admiration ~
NIMS



Magnolia ~ Friendship ~
NIMS



Photos by Ales Jager
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