World Premier International Research Center Initiative (WPI)
FY2011 WPI Project Progress Report (Post-Interim Evaluation)

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Common instructions:
* Unless otherwise specified, prepare this report from the timeline of 31 March 2012.
* So as to base this fiscal year's follow-up review on the document "Post-interim evaluation revised center project," please prepare this report from the perspective of the revised project.
* Use yen (¥) when writing monetary amounts in the report. If an exchange rate is used to calculate the yen amount, give the rate.

Summary of State of WPI Center Project Progress (write within the space of this page)

In FY2011, AIMR established a research environment to promote mathematics – materials science collaboration by expanding the Mathematics Unit, setting the three target projects, and establishing new types of researcher positions for the collaboration. These attempts were performed as part of the introduction of a new system towards progress from FY2012, and led to the following achievements.

"Conducting research of the highest world level"

The level of research at AIMR in the materials field has always been the highest in the world. In FY2011, AIMR's full-time PIs and their co-workers published 209 papers, with many appearing in high-impact journals such as *Nature*, *Science*, *Nature Materials*, and so on. They gave 117 invited presentations at international meetings, playing active roles in the global arena. External research funds increased in FY2011 (about 2.8 billion yen), indicating the world's high evaluation of AIMR's science level.

"Advancing fusion of various research fields"

Important results were produced by interdisciplinary fusion research. Based on these results, three target projects were established with the aim of seeking further achievements. Mathematics will play the role of a catalyst for the fusion of disciplines and this will give birth to a new paradigm for materials science methodologies. New researcher positions for such fusion have also been created.

"Globalization of the Institution"

Joint workshops at satellite institutions were held at the University of Cambridge in June 2011, and at the University of California, Santa Barbara, in January 2012. Global collaborations have been strengthened. The 5th Annual Workshop gathered 246 participants from 10 countries in February 2012, and the GI^3 (Global Intellectual Incubation and Integration) Laboratory Program promoted personal exchanges between AIMR and partner institutions. AIMR helped non-Japanese researchers apply for external research funds, submitting successful applications to KAKENHI and CREST (Core Research for Evolutional Science and Technology), in order to create an environment attracting foreign researchers.

"Implementing organizational reforms"

A new evaluation system based on an international peer review was established to replace PIs and promote young researchers to such positions as Independent Investigators (IIs). The Research Support Center was established to provide researchers with a world-class research environment in which they can quickly begin experiments and theoretical calculations just after arrival. These new systems will attract great brains from around the world.

・Please concisely describe the progress being made by the WPI center project from the viewpoints described below.

・In addressing the below-listed 1-6 criteria, please place emphasis on the following:

(1) Whether research is being carried out at a top world-level (including whether research advances are being made by fusing fields).

(2) Whether a proactive effort continues to be made to establish itself as a “truly” world premier international research center.

(3) Whether a steadfast effort is being made to secure the center’s future development over the mid- to long term.

・Please prepare this report within 10-20 pages (excluding the attached forms).

1. Conducting research of the highest world level

The level of research at AIMR in the materials field has always been the highest in the world (the percentage of top1% papers produced is 2.6%). In FY2011 AIMR full-time PIs and their co-workers published 209 papers, with many appearing in high-impact journals such as *Nature*, *Science*, *Nature Materials*, *Nature Nanotechnology*, *Nature Physics*, *Nature Communications*, *Physical Review Letters* (*PRL*), *Journal of the American Chemical Society* (*JACS*), and *Advanced Materials*. They gave 117 invited presentations at international meetings in FY2011, with many being plenary lectures and keynote presentations.

In addition, researchers have received domestic and international scientific awards, including Fellow of the American Ceramic Society (Y. Ikuhara PI) and the Presidential Early Career Award for Scientists and Engineers Award (A. Khademhosseini Junior PI). External research funds increased over the fiscal year (about 2.8 billion yen), indicating the world’s high evaluation of AIMR’s science level. These facts are strong evidence of the high scientific level of AIMR.

The outcomes of research at AIMR vary widely from basic studies to applications (Figure 1). We have categorized the achieved research goals of FY2011 from the micro to macro level: **(1) observe and understand atoms and molecules**, **(2) control atoms and molecules**, **(3) create new materials**, and **(4) create new devices and systems**. These categories are based on a viewpoint of the hierarchy of structures and functions of materials, and correspond to our research strategy. Some example research results are listed below.

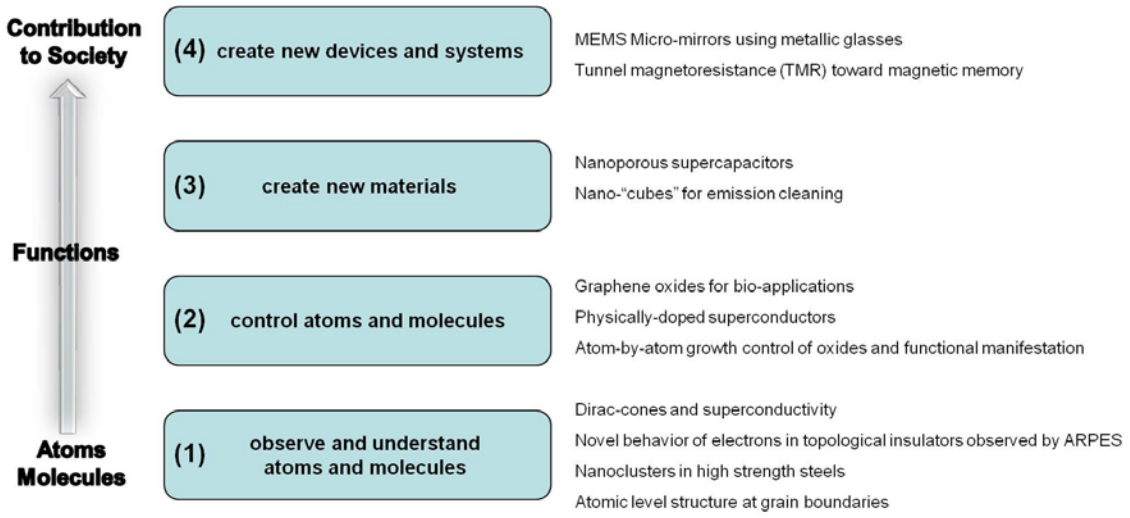


Figure 1 Outcomes obtained at AIMR in FY2011, listed from basic research (bottom) to applications (top).

(1) observe and understand atoms and molecules

Atomic level structure at grain boundaries

Structural defects play a crucial role in determining the physical and electronic properties of materials; especially, grain boundaries essentially influence the properties of polycrystalline materials. The self-trapped grain boundary defect is an important defect and should be investigated in terms of the distribution and role. However, it has been difficult to study due to the very low concentration of such defects. The researchers from AIMR developed a new methodology to elucidate such defects using an artificial 'bicrystal' consisting of two crystals cut along different crystallographic directions. The researchers analyzed the sample with a combination of electron energy loss spectroscopy, transmission electron microscopy measurements, and first-principles calculations using density functional theory. They discovered that titanium and calcium impurities segregate into grain boundaries. This atomic-scale information on point defects provides insight into structure-property interplay at the quantum level.

Z. Wang, M. Saito, K.P. McKenna, L. Gu, S. Tsukimoto, A.L. Shluger and Y. Ikuhara, Atom-resolved imaging of ordered defect superstructures at individual grain boundaries. *Nature* **479**, 380-383 (2011).

Nanoclusters in high strength steels

Using the latest microscopy technology, Cs-corrected scanning transmission electron microscopy (STEM) with a resolution of about 0.1 nanometers, atomic structures of oxide nanoclusters less than 4 nanometers in size were found in oxide-dispersion-strengthened (ODS) steels. Although an imaging of the cluster has not yet been achieved owing to the effect of the magnetic steel matrix so far, the atomic structure of the nanoclusters has clearly been identified by minimizing the magnetic effect through the preparation of ultrathin samples about 5 nanometers thick. The surprising result is that the nanoclusters have very defective rock salt crystal (NaCl-type) structures, yet are incredibly stable at high temperatures. This is the key to solving the mystery of why ODS shows outstanding resistance to radiation damage and high temperatures.

A. Hirata, T. Fujita, Y.R. Wen, J.H. Schneibel, C.T. Liu and M.W. Chen, Atomic structure of nanoclusters in oxide-dispersion-strengthened steels. *Nature Materials* **10**, 922-926 (2011).

Novel behavior of electrons in topological insulators observed by ARPES

Because of their use of electron spin, topological insulators are among the most promising materials for next generation electronics such as low energy computers. One of the most characteristic features of topological insulators is that electrons at the surface behave as particles having no mass (Dirac fermions). However, in this study, AIMR researchers discovered that electrons have mass in some topological insulators, a discovery that may possibly lead to a new type of spin electronics. They used an angle-resolved photoemission spectrometer (ARPES) with the world-best resolution, which they developed themselves. They measured the topological insulator, thallium–bismuth–selenium, and compared it with samples where selenium was partially replaced by sulfur. Increasing the sulfur content toward the thallium–bismuth–sulfur composition (not a topological insulator), "X"-shaped energy dispersion gradually fell and a gap opened up, indicated that the electrons were no longer massless. This discovery suggests new possibilities for applications of topological insulators in information storage.

T. Sato, K. Segawa, K. Kosaka, S. Souma, K. Nakayama, K. Eto, T. Minami, Y. Ando and T. Takahashi, Unexpected mass acquisition of Dirac fermions at the quantum phase transition of a topological insulator. *Nature Physics* **7**, 840-844 (2011).

Dirac-cones and superconductivity

Iron (Fe)-bearing superconductors, known as pnictides, were discovered by Japanese researchers from 2006 to 2008 and attracted much interest as a new type of high temperature superconductor with a special mechanism. At AIMR, a Dirac cone electronic structure has been discovered in this new superconductors (P. Richard, T. Takahashi et

al., *Physical Review Letters* **104**, 137001 (2010)) and investigations have continuously been performed. In 2011, the AIMR team studied the pnictide $Ba(FeAs)_2$ and found that its linear magnetoresistance effect, one of the characteristics of a pnictide, is caused by a combination of two Dirac cones, one for electrons and also one for their opposite number, holes. This is an important finding for the exploration of new superconductors with higher critical temperature.

K.K. Huynh, Y. Tanabe and K. Tanigaki, Both electron and hole Dirac cone states in $Ba(FeAs)_2$ confirmed by magnetoresistance. *Physical Review Letters* **106**, 217004 (2011).

(2) control atoms and molecules

Atom-by-atom growth control of oxides and functional manifestations

When two materials interface there is a high potential of producing new characteristics, for example, the electric conductivity of the interface of the two insulators lanthanum aluminate and strontium titanate. However, atom scale observation has not been achieved in such interface systems. In this study, the AIMR research group developed a high-resolution scanning tunneling microscopy combined with a pulsed laser deposition system and investigated the homo-epitaxial atom-by-atom growth process of a perovskite material, strontium titanate. They found that the specific surface can be prepared in a wide range of oxygen partial pressures in a reproducible manner. These investigations lead to the preparation of new heterostructures, or high quality thin films with exotic multifunctionality.

K. Iwaya, R. Shimizu, T. Hashizume and T. Hitosugi, Systematic analyses of vibration noise of a vibration isolation system for high-resolution scanning tunneling microscopes. *Review of Scientific Instruments* **82**, 083702 (2011).

R. Shimizu, K. Iwaya, T. Ohsawa, S. Shiraki, T. Hasegawa, T. Hashizume and T. Hitosugi, Atomic-scale visualization of initial growth of homoepitaxial $SrTiO_3$ thin film on atomically ordered substrate. *ACS Nano* **5**, 7967-7971 (2011).

Physically-doped superconductors

AIMR in collaboration with researchers from the University of Tokyo have succeeded in producing a superconducting state by artificially introducing large amounts of electrical charges into known materials, such as potassium tantalum oxide ($KTaO_3$). They created an electric double layer transistor structure using ionic liquid. By bringing the ionic liquid into contact with the surface of an electrical circuit containing the material, an electric double layer is formed at the material–liquid interface. By applying an electrical voltage to the gate electrode, large amount of carriers are doped into the material due to the large electric field in the electric double layer, compared to general field effect transistors (FETs). Since this method does not face the same limitations as chemical doping, this approach has great potential to discover superconductor systems that have not shown superconductivity by chemical doping.

K. Ueno, S. Nakamura, H. Shimotani, H.T. Yuan, N. Kimura, T. Nojima, H. Aoki, Y. Iwasa and M. Kawasaki, Discovery of superconductivity in $KTaO_3$ by electrostatic carrier doping. *Nature Nanotechnology* **6**, 408–412 (2011).

Graphene oxides for bio-applications

Graphene and its derivatives, such as graphene oxide, have attracted much attention due to their extraordinarily high mobility and wide range of applications. Research into these materials for biological and biomedical applications is also progressing. The interaction between graphene and biological materials such as proteins and cells is the most important factor for bio-applications, and varying reduction change is the most direct way to control this factor. In this study, researchers from AIMR demonstrated a way to optimize cell performance by controlling the reduction state of graphene oxide. Through the thermal reduction method, they controlled the reduction state and

found the optimum conditions for the adsorption of proteins, cell adhesion, cell proliferation and cell differentiation. Moderately reduced graphene oxide showed the highest performance in all cases. This result is fundamentally important for the future bio-applications of graphene materials.

X. Shi, H. Chang, S. Chen, C. Lai, A. Khademhosseini and H. Wu, Regulating cellular behavior on few-layer reduced graphene oxide films with well controlled reduction states. *Advanced Functional Materials* **22**, 751-759 (2012).

(3) create new materials

Nano-"cubes" for emission cleaning

Out of the array of rare earths and precious metals that fill automobile catalytic converters, a compound known as cerium oxide (CeO_2) play a special role in balancing oxygen. Higher efficiencies are expected if we can make nanocrystals. In AIMR, a new synthetic process to produce CeO_2 "nanocubes" that displays almost triple the oxygen storage capacity of typical CeO_2 crystals has been developed. Supercritical hydrothermal synthesis was used to produce these unique box-shaped crystals. The most important point of this technique is to cap the crystal surface by using organic molecules under supercritical hydrothermal conditions in which organic and inorganic materials can be combined. This technique will reduce the amount of precious metals used for catalytic emission cleaning.

J. Zhang, H. Kumagai, K. Yamamura, S. Ohara, S. Takami, A. Morikawa, H. Shinjoh, K. Kaneko, T. Adschiri and A. Suda, Extra-low-temperature oxygen storage capacity of CeO_2 nanocrystals with cubic facets. *Nano Letters* **11**, 361–364 (2011).

Nanoporous supercapacitors

As a technique for energy storage in future society, the importance of double-layer supercapacitors will increase. A team at AIMR has been working on building supercapacitors using transition metal compounds such as manganese dioxide (MnO_2), which can store charges at metal sites through an electron transfer process called 'pseudocapacitance.' The problem is that MnO_2 has low conductivity, and this limits charging and discharging speeds. The researchers solved this problem by making a supercapacitor constructed using an MnO_2-plated gold film. First, they selectively etched a silver–gold alloy into a thin gold sheet permeated with numerous nanopores. They then grew MnO_2 nanocrystals directly into the pore channels using a gas-phase reaction. The supercapacitor device displayed excellent charge storage capacity with an energy density up to 20 times higher than that of other MnO_2 electrodes.

X. Lang, A. Hirata, T. Fujita and M.W. Chen, Nanoporous metal/oxide hybrid electrodes for electrochemical supercapacitors. *Nature Nanotechnonogy* **6**, 232-236 (2011).

(4) create new devices and systems

Tunnel magnetoresistance (TMR) toward magnetic memory

The demand for data storage system, low power, high speed and large storage density, is rapidly increasing. This demand could be satisfied by non-volatile magnetic memory (MRAM). New tunnel magnetoresistance (TMR) materials with both large magnetic anisotropy and low magnetic friction are required to realize high performance MRAM. Using a newly-developed system with an ultrashort laser pulse, a team at AIMR has discovered that an alloy of manganese and gallium is not only a strong magnet but also has switchable magnetization with low loss, a key requirement for fast, low-power non-volatile magnetic memory. This discovery offers unique promise for future magnetic random-access memory devices.

S. Mizukami, F. Wu, A. Sakuma, J. Walowski, D. Watanabe, T. Kubota, X. Zhang, H. Naganuma, M. Oogane, Y. Ando and T. Miyazaki, Long-lived ultrafast spin precession in manganese alloys films with a large perpendicular magnetic anisotropy. *Physical Review Letters* **106**, 117201 (2011).

Another example of an outcome corresponding to this category is described in the next section on "Advancing fusion

of various research fields" – **micro-mirrors using micro electro mechanical systems (MEMS) technology and bulk metallic glass as a material**.

Aside from the above, many high-level results were obtained in FY2011, for example, the surface properties of a polymer film were mapped using atomic force microscopy, the modulation of magnetism with inorganic-organic hybrid structures was achieved, super hybrid materials were created by supercritical hydrothermal synthesis, functionalized fullerenes was produced for lower-cost organic solar cells, and electrochemically-based biosensors were created.

Through the combination of innovative ideas and the state-of-the-art facilities and equipment of AIMR, such as spin- and angle-resolved photoemission spectrometer (spin-ARPES) with the world-best resolution and leading-edge microscopes having atomic resolution, a number of new phenomena have been discovered in the field of materials science. Some discoveries seem to have similar structures or properties and there is the possibility that common principles lie behind various materials. Based on these facts, it became clear that new viewpoints of mathematics are necessary for us to identify common principles. As described in the next section, interdisciplinary fusion research from a mathematical viewpoint will play an important role in creating new materials science. Along this line, we will further investigate the mechanism of functional manifestations from the atom scale to the macroscopic scale and develop a basis for creating new functional materials.

2. Advancing fusion of various research fields

Since FY2009 AIMR has provided the "Fusion Research Proposal Program" to help researchers promote interdisciplinary fusion research. In FY2011, 10 research subjects from 17 proposals were accepted and seed money has been provided. Researchers who were provided the fusion research money in FY2010 were offered an opportunity to make a poster presentation of results from their projects at Tea Time in FY2011 so that the results could be shared with other researchers and inspire more new ideas for fusion research.

In FY2011, the bigger challenge started. In March 2011, AIMR established the Mathematics Unit to accelerate fusion and create a new kind of materials science in AIMR. The Unit joined the existing four research groups for Bulk Metallic Glasses (BMG), Materials Physics, Soft Materials, and Device/System. The researchers of AIMR have frequently organized seminars in order to discuss current topics in materials science, physics, chemistry and the devices area, in order to improve mutual understanding between scientists and initiate fusion research activities. The reward of these efforts has been gradually emerging results. The progress of interdisciplinary research in AIMR is described bellow with examples of such results.

Common structure
(Fusion between BMG and Soft Materials)

One important example of the emerging results was obtained through the fusion research of the BMG Group and the Soft Materials (Polymer) Group. It is becoming clear that in BMG, shear transformation zones (STZs) of several nanometers which generate during plastic deformation have great effects on mechanical characteristics. The latest research by the BMG Group has revealed the existence of cluster structures of several angstroms in BMG (*Nature Materials* **10**, 28-33, 2011). Based on the existence of a short-range order and the lack of a long-range order, it is assumed that BMG contains structural fluctuations and many defective regions, leading to heterogeneity of a similar scale to STZs. The Polymer Laboratory of AIMR has succeeded in mapping the energy dissipation derived from the viscosity in micro-areas using AFM (*Macromolecules* **43**, 9049-9055, 2010) and this

method was applied to investigate heterogeneity in BMG. The analysis revealed that the nonuniform structure of the viscosity measured in BMG had a distinctive scale of 2.5 nm, which matched that of STZs. Therefore, the inhomogeneous distribution of viscosity and STZs are deeply related, which suggests that they dominate the macroscopic characteristics of metallic glasses.

One interesting point is that the measurement and analysis methods developed for polymers could be applied without modification to BMG. This suggests the existence of common principles between BMG and polymers. More specifically, there is a possibility that what is called a "cooperatively rearranging region (CRR)" in polymers is essentially the same as or very similar to a STZ of BMG, despite the different names. There are great expectations that a solution in mathematical framework to this issue will lead to the discovery of common principles and new physical facts that bridge different material systems.

[Ref.] Y.H. Liu, D. Wang, K. Nakajima, W. Zhang, A. Hirata, T. Nishi, A. Inoue and M.W. Chen, Characterization of nanoscale mechanical heterogeneity in a metallic glass by dynamic force microscopy. *Physical Review Letters* **106**, 125504 (2011).

Green catalysts

(Fusion between Soft Materials and BMG)

We learned from fusion research that exchanging a concept between disciplines can produce a new concept for materials. AIMR introduced the concept of “catalyst” (Soft Materials group) into the Bulk Metallic Glasses (BMG) group. Catalysis is an essential concept to control chemical reactions. Palladium is a well-known catalyst for organic synthesis, but unfortunately, palladium catalysts are toxic, expensive and difficult to separate completely from a final product. The synthetic chemist group of AIMR started to collaborate on palladium catalysts with the BMG group, and together they succeeded in developing a solid palladium-based “metallic glass” that can repeatedly catalyze carbon coupling reactions with negligible leaching of the catalyst into the solvent. By using palladium–nickel–phosphorus metallic glass and an electrochemical fabrication techniques, it became possible to create nanoporous palladium having a uniform distribution of pores of about 30 nanometers in diameter. Nanoporous structure provided not only a large specific surface area effective for reactions but also some special effects. Although nanoporous solids have simple relations with nano particles such as being “inside” or “outside,” researchers found further difference between them. The coupling proceeded extremely efficiently even after reusing the nanoporous catalyst four times and the amount of palladium lost into solution during the reaction was less than 0.0005% of the precious metal in each cycle. The results of this fusion research give us hope for more innovation with geometric insight, such as the development of a robust “green” catalyst. The exchange of concepts between disciplines is very important to produce new concepts for materials.

[Ref.] S. Tanaka, T. Kaneko, N. Asao, Y. Yamamoto, M.W. Chen, W. Zhang and A. Inoue, A nanostructured skeleton catalyst: Suzuki-coupling with a reusable and sustainable nanoporous metallic glass Pd-catalyst. *Chemical Communications* **47**, 5985–5987 (2011).

Putting the spotlight on existing materials

(Fusion between Device/System and BMG)

Silicon is traditionally the material of choice in micromechanical innovations. The brittleness of silicon, however, limits the possible range of its applications. The fusion research team for micro electro mechanical systems (MEMS) and bulk metallic glasses of AIMR used metallic glasses as a tougher alternative to silicon in the development of enhanced micro-mirrors. Metallic glasses can bear heavier loads without starting to deform, and are thus ideal for micromechanical devices in which small components are repeatedly subjected to strong forces. They constructed a mirror structure by placing a round plate between two torsion bars that formed the axis for the mirror’s movements. When in resonance with an oscillating external magnetic field, the mirrors followed the field and rotated more than

300 times per second without undergoing any damage. Tilt angles of over 70 degrees were demonstrated in this dynamic mode, and in larger static magnetic fields, the mirrors reached up to 270 degrees. Such unique use was never found in metallic glasses prior to the fusion research in AIMR. The need for MEMS devices has put a spotlight on a mechanical property that has not attracted attention so much thus far.

[Ref.] J.-W. Lee, Y.-C. Lin, N. Kaushik, P. Sharma, A. Makino, A. Inoue, M. Esashi and T. Gessner, Micromirror with large-tilting angle using Fe-based metallic glass. *Optics Letters* **36**, 3464-3466 (2011).

New idea in spintronics

(Fusion among many factors; physics, chemistry, microscopy, and device technology; mathematics in the future)

Integrating ideas and techniques among materials scientists specializing in semiconductors, device physicists skilled in electric double layer transistors, chemists operating liquid electrolytes, and physicists specializing in microscopy have led to a new possibility for the utilization of "spin." The ability to switch the magnetic properties or electron 'spin' of a semiconductor in a similar way to charge in conventional devices opens up new possibilities for fast, low-power data storage and "spintronics" applications. The magnetic semiconductor materials needed for such applications at room temperature, however, have proved elusive as most magnets are either metals or insulators. AIMR has developed a magnetic semiconductor system with controllable ferromagnetism at room temperature. They used titanium dioxide containing a small amount of the magnetic element cobalt as a material and injected high concentration of charge by using a liquid electrolyte. The development of a magnetic semiconductor providing switchable magnetic properties at room temperature offers intriguing possibilities for high-performance devices.

[Ref.] Y. Yamada, K. Ueno, T. Fukumura, H.T. Yuan, H. Shimotani, Y. Iwasa, L. Gu, S. Tsukimoto, Y. Ikuhara and M. Kawasaki, Electrically induced ferromagnetism at room temperature in cobalt-doped titanium dioxide. *Science* **332**, 1065-1067 (2011).

These outcomes would have never been obtained if researchers from various fields had not been gathered at AIMR. It is expected that these results will lead to the creation of Green Materials which contribute to "energy harvesting," "energy saving" and "environmental clean-up," and contribute to green society as shown in Figure 2.

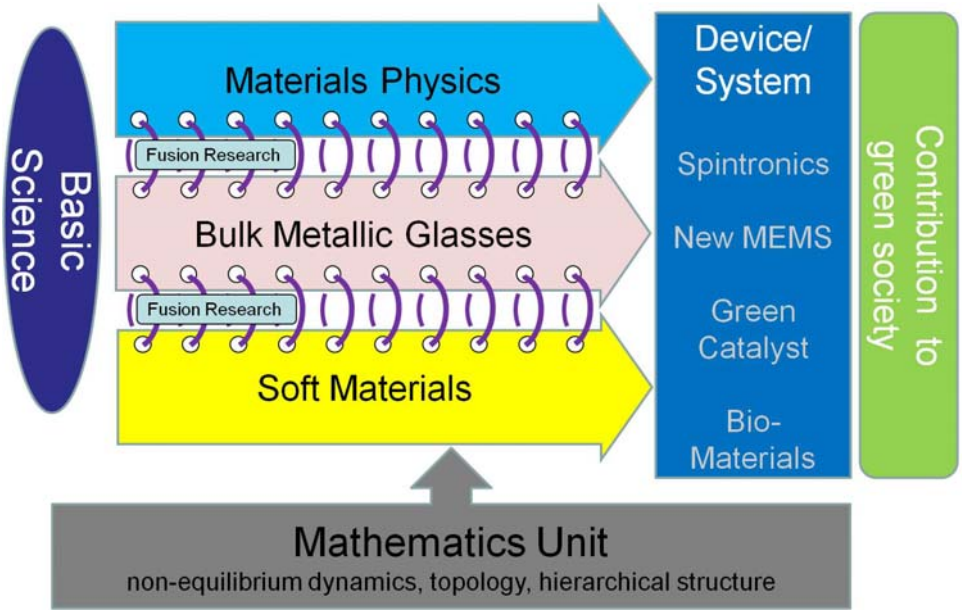


Figure 2 Schematic diagram showing the fusion of various research fields at AIMR.

Through the fusion research, we open the new paradigm of materials science through fusion of different disciplines. They include studies of

a) structures and properties of the non-equilibrium materials, such as metallic glasses and polymers, as well as their formation mechanism and stability. Novel useful functions are expected to emerge based on a common principle inherent to non-equilibrium states
b) functions originating from the "spin" of electrons, and functions related to the "topology of energy bands." The relationship between "topology" and the activity of nanoporous metal catalysts has been also suggested as something to study. The exploration of novel materials and their multi-functions utilizing robust properties of topological features, which need a help from mathematics, is a key challenges.
c) the hierarchical structures from atoms and molecules to macroscopic bulk materials, through short-range ordering (nano-clusters), long-range ordering (nano-crystals), crystals and poly-crystals levels. Importance of a bridge between scales and functional manifestation which derives from multi-scales has been understood. Interface is one of the keys.

We recognized that these items are significant viewpoints in the next-generation materials science and we set them as our target projects to be focused. By probing the three fields carefully and deeply, with the help of advanced mathematics, we will elucidate the mechanisms and common principles. The following three are our target projects and target materials and devices derived from the above categorization.

Three target materials

1) Non-equilibrium Materials based on Mathematical Dynamical Systems

This project targets, for example, metallic glasses, polymer glasses, block copolymers, bio-inspired materials, and super-hybrid multifunctional devices for green society.

2) Topological Functional Materials

This project targets, for example, spintronics materials, superconductors, and MEMS devices for energy-saving, along with nanoporous metal catalysts and new materials for photo-voltaic solar energy conversion and thermoelectric conversion for energy-harvesting.

3) Multi-Scale Hierarchical Materials based on Discrete Geometric Analysis

This project targets the identification of mid-range and long-range order in the atomic / molecular / cluster / domain arrangement and functional manifestation by creating the hierarchical structures. Interfacial processes from the atom/molecule level to macroscopic properties are also targets of this project aiming to understand the mechanism of functional manifestations. For example, grain boundaries for the improvement of electric conduction in devices, solid-liquid interface control for the improvement of friction problems for energy-saving, nanoporous supercapacitors for energy storage, and bio-inspired materials.

The organization for the mathematics – materials science collaboration has been strengthened in order to accomplish these target projects. Two professors (Motoko Kotani, the Deputy Center Director in FY2011, and Yasumasa Nishiura, the Leader of Mathematics Unit from February 2012) were appointed as to PIs of Mathematics Unit. Project Leaders and Project sub-Leaders were appointed in each project. They have organized study groups for each target project. Furthermore, in FY2011, six interface researchers have been assigned from 68 applicants via international recruitment (They will join AIMR in May, June and July in FY2012) – they are theoretical researchers, who will not belong to a specific PI. They will work together with some experimental laboratories, inspiring new experimental

targets, contributing discussions on experimental results and suggesting novel approach of materials control, based on their mathematical and theoretical expertise as shown in Figure 3. AIMR will assign a mentor as their supervisor.

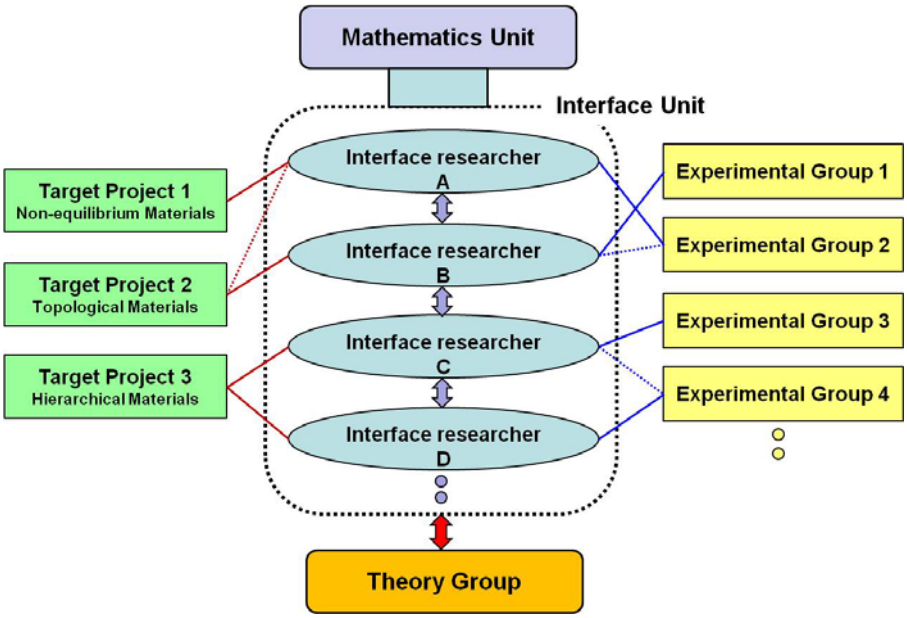


Figure 3 The research organization structure surrounding interface researchers.

3. Globalization of the institution

Describe what's been accomplished or recognized in the efforts to raise the center's international recognition as a genuine top world-level research institute, along with innovative efforts proactively being taken in accordance with the development stage of the center, including the following points, for example:

- Efforts being developed based on the analysis of number and state of world-leading, frontline researchers; number and state of visiting researchers; exchanges with overseas entities
- Proactive efforts to raise the level of the center's international recognition
- Efforts to make the center into one that attracts excellent young researchers from around the world (such as efforts fostering young researchers and contributing to advancing their career paths)

The International Relations Unit was established in the Administrative Division and started to further promote the globalization of AIMR. The unit supports foreign researchers not only in their research activities at AIMR but also with the daily life of their families. As of March 31, 2012, AIMR has 32 principal investigators (PIs) and 44% of them (14 PIs) are foreign researchers. More than 50% of all researchers are foreigners. In order to position AIMR into the flow of global brain circulation, public advertisements for the positions of associate professor, assistant professor and postdoctoral researcher were carried out for international recruitment and AIMR was able to employ talented researchers from around the world. As a concrete plan to enhance international partnership and collaborations, AIMR promoted the GI^3 (Global Intellectual Incubation and Integration) Laboratory Program and sent and accepted young researchers via foreign PIs and 15 partner institutions. After the GI^3 Laboratory Program was institutionalized in FY2009, the number of researchers exchanged between AIMR and overseas partner institutions increased, though it decreased in FY2011 because of the earthquake (15, 18 and 9 researchers in FY2009, 2010, and 2011, respectively). In order to create an environment which can attract foreign researchers, AIMR helped non-Japanese researchers to apply for external research funds, submitting successful applications to KAKENHI and CREST. The winning of a CREST grant by an AIMR foreign researcher (M.W. Chen PI) was a big achievement in FY2011.

In cooperation with three overseas satellites, which are the core of our comprehensive global collaborations, joint workshops were held at the University of Cambridge in June 2011, and at the University of California, Santa Barbara in January 2012, and consequently the name recognition of AIMR was raised. We are preparing to establish joint laboratories at satellite institutions. Global collaboration between AIMR and overseas satellites and partner institutions produced 21 papers in FY2011.

Our 5th Annual Workshop was held in February, 2012 and 246 participants from 10 countries attended it. Since the first workshop held in February 2008, the number of foreign PIs, adjunct professors and adjunct associate professors have increased and the number of participants is increasing year by year as well. In particular, mathematicians joined the workshop this time, allowing us to confirm our mission of seeing mathematics – materials science collaboration through deep discussion. AIMR researchers also attended many international meetings. They gave 117 invited presentations at international meetings in FY2011, with many being plenary lectures and keynote presentations. AIMR researchers introduce WPI and AIMR briefly at the beginning of every presentation to gain publicity.

In order to publicize AIMR further, advertisements for AIMR were printed in *Science* (Vol.333, 2 September 2011) and *Nature Asia-Pacific* (PUBLISHING INDEX 2011), and furthermore, targeting researchers, advertisements for *AIMResearch* was printed in *Nature* (Vol.481, 19 January 2012). Banner advertisements on the websites of those scientific magazines and in their e-mails were also carried out.

The Main Building of AIMR was completed in July 2011, and the "Combination Room" and "Multi-purpose Hall" were constructed in the building for active exchanges and discussion between researchers. Tea Time held on every Friday at such exchange spaces provides further opportunities to make and increase collaboration. These occasions also encourage exchanges between foreign researchers and Japanese researchers. Fusion research is also enhanced in such an atmosphere.

The research environment for researchers from abroad, including short-stay visiting researchers, will be improved by completing the "Research Support Center" which will include the "Common Equipment Unit" and "Computation-Aid Unit," in FY2012. Through the support of this center, researchers will be able to start their research quickly after their arrival at AIMR.

4. Implementing organizational reforms

* If innovated system reforms generated by the center have had a ripple effect on other departments of the host institutions or on other research institutions, clearly describe in what ways.

In order for AIMR to further advance over the next five years, we focus on system reform in particular, centering on the appointment of researchers and reform of research organization toward mathematics – materials science collaboration.

1) AIMR has created new systems for human resources development. We have established a system for evaluation and promotion through international peer reviews. The research outcomes of the researchers over the past four years and the compatibility of their research with the AIMR's new strategy were evaluated based on the judgment of an international referee and an interview by AIMR's Executive Committee. Some PIs were replaced and two IIs were promoted as a result. AIMR has created an environment in which our six young researchers, three Junior PIs and three IIs can pioneer new research areas independently.

We also established a new type of research position, interface researchers. These researchers do not belong to any single laboratory, but form the "Interface Unit" as a whole. Six theoretical researchers have been appointed to the Interface Unit through international recruitment followed by an evaluation of all PIs. They will work together with

partner experimental laboratories to build a bridge between mathematicians and materials scientists. They will promote interdisciplinary fusion under the supervision of a mentor. Moreover, they will construct the basis of the new kind of materials science that we are aiming for in which we can predict new physical properties and functions based on mathematics and theories.

2) In FY2011, AIMR started preparations for and then management of the Research Support Center. The center consists of four parts: a Common Equipment Unit, a Computation-Aid Unit, a Mathematical Collaboration Unit, and a Researcher Support Office. This center will support not only domestic AIMR members but also short-stay visiting researchers including foreign PIs and researchers. Through strong support on the part of this center, even short-stay researchers will be able to promptly start their research in AIMR. This system will enhance exchanges of researchers and contribute to the facilitation of AIMR as the central hub of global brain circulation in the field. Furthermore, in cooperation with our In-house Council consisting of the heads of four departments and institutes at Tohoku University, we have established a research support system using an in-house network. This system makes it possible for us to utilize experimental equipment and computational resources.

3) System reforms at AIMR that have influenced Tohoku University

i) The new salary system at AIMR gave rise to the creation of the "Distinguished Professor System" at the host institution, Tohoku University. Since the "Distinguished Professor System" has been recognized to be effective at strengthening research, the system has been updated for a second term and become a regular system in Tohoku University.

ii) The various rules stipulated by AIMR were used as reference for administrative processing when new organizations at Tohoku University such as the "Tohoku Medical Megabank Organization" and "International Research Institute of Disaster Science" were established.

iii) Manuals have been created for safety in environments where researchers with different backgrounds and cultures gather.

5. Efforts to secure the center's future development over the mid- to long term

* Please address the following items, which are essential to mid- to long-term center development:
- Future Prospects with regard to the research plan, research organization and PI composition; prospects for the fostering and securing of next-generation researchers
- Prospects for securing resources such as permanent positions and revenues; plan and/or implementation for defining the center's role and/or positioning the center within the host institution's institutional structure
- Measures to sustain the center as a world premier international research center after program funding ends (including measures of support by the host institution)

(1) Research plan, Organization, Human resources

In FY2011, AIMR advertised the clear strategy of promoting mathematics – materials science collaboration in order to create new materials science and contribute to society through the creation of new functional materials. Our mid-term goal is to provide a basis for common understanding among the existing four research groups via a mathematical viewpoint, and our long-term goal is to create revolutionary *Green Materials* by contributing to the advancement of the concepts of "energy harvesting," "energy saving" and "environmental clean-up." In terms of AIMR's long-term perspective, we seek to ensure a stable energy supply for future generations and provide a basis for environmental conservation through the use of new materials that can cause an evolutionarily change in our society and show the world what the future should be like.

In order to promote our new approach we have started the following activities.

i) AIMR has set the three target projects described above and strengthened the organization for mathematics – materials science collaboration. Project Leaders and Project sub-Leaders were appointed for each project. Six interface researchers will join AIMR and take up the role of acting as bridges between materials researchers and mathematicians in early FY2012. A mentor will be positioned as their supervisor. Through the whole process for target projects, we will assure direct interaction between mathematicians / theorists and interface researchers / experimentalists so that each stakeholder can mutually benefit from research.

ii) For human resource development, AIMR has created new systems (as described in 4-1). As a result, some PIs were replaced in order to enhance our new research direction, and three Junior PIs and three IIs were given an independent environment in which to pioneer research areas. Six young theoretical researchers have been appointed as interface researchers in order to develop new insights by bridging materials scientists and mathematicians (Figure 3). A Research Support Center (Common Equipment Unit, Computation-Aid Unit, Mathematics Collaboration Unit, and Researcher Support Office, details are in 4-2)) has been started, and it is expected to aid with smooth transitions to life at AIMR. A new framework to foster young researchers, through for example, training on presentations at the Researcher Support Office (in Research Support Center), has been discussed, and this will be organized in FY2012.

(2) Planning and enforcement: the number of researchers, research funds, position within Tohoku University, etc.

The promotion of AIMR and the construction of organizations within it are clearly positioned in the most important items in the Mid-Term Objectives and Plans of our host institution, Tohoku University. The University's new president has stated his organizational policy for Tohoku University as becoming a world leader through "Progress toward becoming a World-class University" and "Leading the Tohoku restoration." In order for Tohoku University, as a research institute, to progress toward becoming world-class, there is a need to promote materials science, which is the strongest research area of the university, and especially AIMR. AIMR is recognized to be the core existence for the promotion of world-leading research and formation of an international environment at Tohoku University. AIMR was established as an organization of Tohoku University from the beginning. As described in the initial application, AIMR will maintain its present scale and continue as a world top level research center for innovative materials science even after the end of the WPI program.

(3) How AIMR will continue to be "world top level research center" after completing the WPI program.

After completing this program, achievements made by the center will serve as a base for the development of the Tohoku University Advanced Institute for Materials Research, which will play a leading role in the promotion and internationalization of advanced research.

In Tohoku University, materials researchers are working in various departments and research centers. We have proposed to the president of Tohoku University the construction of an advanced institute for materials research where all materials research will integrated with AIMR placed as a core. We believe that the establishment of such a center will be necessary for Tohoku University to become a true world leader in materials research.

Towards the realization of this, in FY2012, Tohoku University will establish a Task Force for the establishment of the integrated advanced institute for materials research in Tohoku University. Discussion will be made on the issues among the related departments and a concrete plan for the organization (the number of researchers and their position in the university, etc.). Moreover, the task force will discuss how to introduce and implement the new systems grown

in AIMR over the past five years into the whole university in order to promote system reform and further internationalization.

6. Others

* In addition to the above 1-5 evaluation items, only if there is anything else that deserves mention regarding the center project's progress, please note it.

In July 2011, the main building of AIMR was completed and an environment in which everything is "under one roof" was achieved. This has given the institute a sense of unity greater than ever before and built up strong ties among AIMR members.

The international guest house at Tohoku University – plans for which were based on the requests of AIMR to the University – is now under construction next to the AIMR main building and will be completed in FY2012.

In order to increase chances for personal communication among researchers including foreign PIs, "Tea Time Talk" and mini concerts during Friday Tea Time have been started. Once a month, AIMR members present their specialties, playing instruments, singing, dancing, etc., and such performances have had the effect of creating a good atmosphere at the center. We are planning to extend such events to the families of AIMR members.

7. Center's response to interim evaluation

Transcribe each item from the "Actions Required and Recommendations" section and note how the center has responded to them. However, if you have already provided this information, please indicate where in the report.

1) It is essential for Tohoku University to be sufficiently committed to supporting the new strategy and director.

[Action]

On April 1, 2012, a new directorial structure commenced at the host institution under the leadership of the University President, Susumu Satomi. In March 2012, the new Center Director (Motoko Kotani) and Administrative Director of AIMR met with the University President and confirmed that AIMR would remain at the core of efforts to strengthen research at Tohoku University, that support for AIMR would be prioritized, and that the independence of Center operations would be maintained. Visions were also exchanged on the integrated advanced institute for materials research, which is the University plans to establish after completion of the WPI program. Additionally, a standing task team led by the Executive Vice President in charge of Research will be established to assist the Center Director.

The In-house Council, comprising the heads of departments and research institutes that are deeply related to the Center, will be used to further enhance cooperation with related departments in Tohoku University.

2) AIMR's identity along with its new strategy in materials science should be clearly stated.

[Action]

Since its establishment, AIMR has continuously pursued the creation of new materials science and revolutionary functional materials by gathering researchers from various fields. The main goal is to promote the common understanding of materials based on a knowledge of different size scales from atoms to materials and different

materials such as metals, ceramics, polymers and biomaterials. There is no change in this concept. However, based on the results of discussion and collaborative research carried out during the first five years, we have further crystallized our mission: to discover common elements and universal principles among various materials and create a new kind of materials science which can predict new functions. To accomplish this mission, we have injected mathematical viewpoints into materials science and accelerated fusion research toward our goal. We have established the three target projects of: (1) Non-equilibrium Materials based on Mathematical Dynamical Systems, (2) Topological Functional Materials, and (3) Multi-Scale Hierarchical Materials based on Discrete Geometric Analysis.

In AIMR, material scientists and mathematicians join hands in explaining new phenomena measured by AIMR's top class equipment and elucidate the mechanism lying behind the structure-function relationship. The challenge of elucidating the mechanism of function manifestations and linking it to the creation of new materials is unprecedented in the world. Materials scientists from diverse backgrounds and mathematicians are gathered in a single place at AIMR and challenged to do ambitious investigations to create new materials with revolutionary functions that can contribute to society—that is the identity of AIMR.

3) Firm supporting systems should be provided to the director from material scientists and mathematicians as well as from the host institution.

[Action]

The Center Director frequently exchanges views with the four material group leaders so that AIMR can develop soundly as a center for materials science. Our International Advisory Board consisting of highly reputed personalities including Nobel Prize laureates also gives advice to the Center Director from a global perspective. Moreover, the Center Director's office is placed on the first floor, and an open-door policy will be implemented so that the Center Director will be able to answer the needs of researchers as best as possible, and so that the Center Director can work to carry out necessary system reform and construct a research support system. In February 2012, Professor Yasumasa Nishiura (Research Director of the Mathematics Program of CREST funded by the Japan Science and Technology Agency (JST)), an internationally respected authority on applied mathematics who has spearheaded cooperation between mathematics and the various scientific fields in Japan, joined AIMR as a PI and the leader of the Mathematics Unit. The Unit has commenced activities in a dynamic manner. Partnerships with the Applied Mathematics Forum (AMF), Tohoku University and other mathematical societies in Japan and abroad will be exploited in order to promptly distribute news of mathematics-materials science outcomes at AIMR to the world and to secure the superiority of AIMR.

As described above, the President of Tohoku University has confirmed his strong support for AIMR. As for the Administrative Division of AIMR, the Deputy Administrative Director in charge of research (Doctor of Science) and the Deputy Administrative Director in charge of management were created under the Administrative Director in an effort to strengthen the Division. Moreover, from April 2012, the Administrative Director, who is an experienced and distinguished materials science theorist, has been appointed to provide complete support in order to realize the concepts promoted by the Center Director from a scientific perspective.

4) The performance of the center's science and management will need to be watched carefully over the next two years.

[Action]

AIMR's ultimate objective in science is to discover new principles via collaborative research between materials science and mathematics and to create materials science which can predict new functional manifestations of materials based on discovered principles and then develop those materials. Towards the achievement of this objective, we will

clarify a concrete approach for materials science that incorporates mathematics over the next two years. We have established three target projects based on the PIs' proposals and a mathematical viewpoint and these three projects have been started under the direction of Project Leaders (materials scientists) and sub-Leaders (young materials scientists and mathematicians). These projects will be implemented based on AIMR's mission of creating new materials. In particular, with respect to materials with a high potential to be realized, we have organized study groups, and will concentrate AIMR's research toward these materials to ensure progress, making use of a clearly-defined research management system in the first two years.

The relationship between materials scientists and mathematicians exists on a diverse range of levels. The first stage of our cooperation is daily consultations regarding the operation of mathematics and the introduction of cutting-edge mathematics. The final stage is the development of mathematical models and discovery of new principles. Our objective for the ensuing two years is for experimentalists, theorists, and mathematicians to stimulate each other and experience the fact that such cross-interaction does engender novel ideas. This will allow researchers to understand the true significance of the new strategy. After several different groundbreaking research projects take form, we will provide a policy for the development of new functional materials. In this way, a mathematics atmosphere will permeate AIMR and allow us to explain the mechanisms of functions and discover new principles, as outlined in our mission. By achieving this we will create new materials science which can predict new functions of materials over the ensuing five years and establish a research institute that leads materials science in the world.

8. Center's response to the site-visit report used in the interim evaluation

Transcribe each item from the "7. Actions Required and Recommendations" section and note how the center has responded to them. However, if you have already provided this information, please indicate where in the report.

1. With no doubt, each PIs' activity is at a world-class level. However, it is difficult to judge if the WPI as a whole is presently at a world-class one or not. The overall impression of AIMR is not as high compared with that based on achievements of each individual PI. The main reason seems to be due to the fact that the mission as a whole is not fully confirmed by the members. All the members need to discuss and assess their achievements in terms of the common definition of "materials science" for this center.

[Action]

From March 2011, a monthly PI Meeting (started from December 2010) and Staff Meetings which all researchers above assistant professor level attend have been held regularly. All staff members have made continuous efforts to communicate with each other. In FY2011, the year before the start of the next five years of WPI, we discussed the identity of AIMR deeply and established the three target projects, based on 17 proposals from the PIs. We set the Leaders and sub-Leaders for each project and organized study groups which discussed each subject thoroughly. Each theme is expected to progress faster because of this. Besides the PI Meeting, monthly PI Lunch Meetings have been started and this also stimulates the PIs toward deeper communication and collaboration. Through the active discussion in FY2011, the atmosphere of AIMR has changed incredibly. All AIMR members are ready to accomplish our goal of creating a new type of materials science and establishing AIMR as a firm hub of global brain circulation. The improvement of the research environment through the establishment of the Research Support Center will also accelerate the evolution at AIMR.

2. AIMR is in a period of transition both in leadership and in its technical programs. The fusion efforts have not yet been very productive. Additional time should be granted to AIMR to allow the changes that are in

place to have a chance to mature.

3. After 4 years since its establishment, AIMR now seems to make every effort to establish as a WPI center, sharing the mission of WPI project with all members and carrying out a high level of materials science research. We sincerely hope that AIMR creates a new materials science by collaboration with mathematicians in the next five years.

[Action to items no. 2 and 3]

Mathematics – materials science collaboration and the creation of a new type of materials science through such collaboration is not easy. However, the challenge is ambitious and attractive, and there already exists an atmosphere in AIMR to face it squarely. As described above, AIMR undertook concentrated discussion and reforms in FY2011, creating a completely new atmosphere that is unlike that of any other institute in the world. We are ready to produce real fusion, learning from the struggle of the past five years.

The relationship between materials scientists and mathematicians exists on a diverse range of levels as described in 7-4. Step-by-step progress is important to accomplish our goal. First we will form an environment in which experimentalists, theorists, and mathematicians can understand each other, in order to make the mathematical way of thinking familiar for experimentalists and help mathematicians understand the rich world of materials. Next, through mutual discussion and the exchange of novel ideas, researchers with different expertise will inspire each other to perform unprecedented collaborative works. Since we are already seeing some buds of collaborative work, we will work to grow these and give them form over our next stage. Based on such step-by-step efforts, we will develop a basis for innovative mathematics – materials science collaboration and make a breakthrough that can produce new values for materials science in society.

4. It may collapse anytime if firm and versatile supporting systems are not well provided to the new director. So, this looks somewhat risky. To make it successful, all the PIs need to agree with this scheme sincerely and are committed to support strongly the director. The director in turn should have to learn the global tide and the history of "materials science," since each discipline has its own definition of "materials science."

[Action]

As already noted (see Section 7), AIMR has already started heading in a new direction as a single body. This is the first attempt to do this in the world. All the members of AIMR are enthusiastic about taking up global leadership. The Center Director is willing to make every effort to overcome the difficulties and make AIMR a unique research center that can bring about a paradigm shift in materials science. The director support system, that is, the advice from the International Advisory Board, discussions with group leaders (the Executive Committee of AIMR), and the collecting of opinions from AIMR members of various backgrounds through opportunities such as PI meeting and Staff Meetings, is working effectively.

List of Center's Research Results and Main Awards

A. Published Papers

- List in order of most recent the Center's papers published in refereed journals during FY2011.
- For each, write the paper title; author name(s); journal name, volume, page(s); and publication year. If there are a few authors, underline those affiliated with the Center. (Any order may be used as long as format is the same.)
- If there are many authors, show and underline those affiliated with the Center, cutting out the names of other authors as deemed appropriate.
- For the most important papers, shade in the number block. For papers giving the results of fusion research, underline the number in the block.
- If the list exceeds this form, please add extra pages.

No.	Author names and details
1	T. Kubota, Q. Ma, S. Mizukami, X. Zhang, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, "Dependence of tunnel magnetoresistance effect on Fe thickness of perpendicularly magnetized $L1_0$-$Mn_{62}Ga_{38}$/Fe/MgO/CoFe junctions", Appl. Phys. Express **5**, 043003 (2012)
2	N. Asao, Menggenbateer, Y. Seya, Y. Yamamoto, M.W. Chen, et al., "Nanoporous Gold-Catalyzed [4+2] Benzannulation between ortho-Alkynylbenzaldehydes and Alkynes", Synlett. **1**, 66-69 (2012)
3	H. Miao, P. Richard, Y. Tanaka, K. Nakayama, T. Qian, K. Umezawa, T. Sato, Y.-M. Xu, Y. B. Shi, N. Xu, X.-P. Wang, P. Zhang, H.-B. Yang, Z.-J. Xu, J. S. Wen, G.-D. Gu, X. Dai, J.-P. Hu, T. Takahashi, and H. Ding, "Isotropic superconducting gaps with enhanced pairing on electron Fermi surfaces in $FeTe_{0.55}Se_{0.45}$", Phys. Rev. B, **85**, 094506 (2012)
4	Y. Tanaka, K. Nakayama, S. Souma, T. Sato, N. Xu, P. Zhang, P. Richard, H. Ding, Y. Suzuki, P. Das, K. Kadowaki, and T. Takahashi, "Evolution of electronic structure upon Cu doping in the topological insulator Bi_2Se_3", Phys. Rev. B, **85**, 125111 (2012)
5	S. Souma, K. Eto, M. Nomura, K. Nakayama, T. Sato, T. Takahashi, K. Segwawa, and Y. Ando, "Topological surface states in lead-based ternary telluride $Pb(Bi_{1-x}Sb_x)_2Te_4$", Phys. Rev. Lett., **108,** 116801 (2012)
6	X. Zhang, S. Mizukami, T. Kubota, Q. Ma, M. Oogane, H. Naganuma, Y. Ando, and T. Miyazaki, "Large change of perpendicular magnetic anisotropy in Cobalt ultrathin film induced by varying capping layers", J. Appl. Phys. **111**, 07B320 (2012)
7	I.Hamada, M.Araidai, M.Tsukada, "Origin of nanomechanical motion in a single-C_{60} transistor", Phys.Rev.B, **85**, 121401(R) (2012)
8	L. Suo, W. Han, X. Lu, L. Gu, Y.S. Hu, H. Li, D. Chen, L. Chen, S. Tsukimoto and Y. Ikuhara, "Highly ordered staging structural interface between $LiFePO_4$ and $FePO_4$", Phys. Chem. Chem. Phys., **14**, 5363-5367 (2012)
9	X. Shi, H. Chang, S. Chen, C. Lai, A. Khademhosseini and H. Wu, "Regulating cellular behavior on few-layer reduced graphene oxide films with well controlled reduction states", Advanced Functional Materials **22**, 751-759 (2012)
10	S. Yoshimoto, Y.-G. Kim, K. Sato, J. Inukai, K. Itaya, "Potential-induced phase transition of low-index Au s ingle crystal surfaces in propylene carbonate solution", Phys. Chem. Chem. Phys., **14,** 2286-2291 (2012)

11	M. Hosoda, M. Oogane, M. Kubota, T. Kubota, H. Saruyama, S. Iihama, H. Naganuma, and Y. Ando, "Fabrication of $L1_0$-MnAl perpendicularly magnetized thin films for perpendicular magnetic tunnel junctions", J. Appl. Phys. **111**, 07A324 (2012)
12	G. Ferrara, T. Jin, M. Akhtaruzzaman, A. Islam, L. Han, H. Jiang, Y. Yamamoto, "Cascade cyclization of aryldiynes using iodine: synthesis of iodo-substituted benzo [b] naphtha [2,1-d] thiophene derivatives for dye-sensitized solar cells", Tetrahedron Lett., **53**, 1946 (2012)
13	M.Tsukada, A.Masago, M.Shimizu, "Theoretical Simulation of Kelvin Probe Force Microscopy for Si Surfaces by taking into account of chemical force", J. of Phys., Condensed Matter, **24**, 084002 (2012)
14	D. Ogawa, K. Koike, S. Mizukami, M. Oogane, Y. Ando, T. Miyazaki, and H. Kato, "Evaluation of Exchange Coupling in α-Fe(100)/$Nd_2Fe_{14}B$(001) Interface", J. Mag. Soc. Jpn. **36**, 5-12 (2012)
15	H.Tamura, M.Tsukada, "Role of intermolecular delocalization on electron transport in fullerene aggregates", Phys.Rev.B, **85**, 054301 (2012)
16	M. J. Iqbal, R. A. Khan, S. Mizukami, and T. Miyazaki, "Magnetic and microwave absorption characteristics of substituted W-type hexaferrites nanoparticles", Ceramics International **38,** 4097 (2012)
17	H. Diao, C. Yan, J. M. Bell, M.W. Chen, et al., "Compressive behaviour of nanocrystalline Mg-5Al alloys", Materials Technology **27**, 85-87 (2012)
18	N. Yoshikawa, G. Xie, Z. Cao, D.V. Louzguine, "Microstructure of Selectively Heated (Hot Spot) Region in Fe_3O_4 Powder Compacts by Microwave Irradiation", J Euro Ceram Soc., **32**, 419-424 (2012)
19	N. Asao, N. Hatakeyama, Menggenbateer, T. Minato, E. Ito, M. Hara, Y. Kim, Y. Yamamoto, M.W. Chen, W. Zhang, A. Inoue, "Aerobic oxidation of alcohols in the liquid phase with nanoporous gold catalysts", Chem. Commun., **48**, 4540 (2012)
20	K. Umezawa, Y. Li, H. Miao, K. Nakayama, Z.- H. Liu, P. Richard, T. Sato, J. B. He, D.- M. Wang, G. F. Chen, H. Ding, T. Takahashi, and S.- C. Wang, "Unconventional anisotropic s-wave superconducting gaps of the LiFeAs iron-pnictide superconductor", Phys. Rev. Lett., **108**, 037002 (2012)
21	S. Mizukami, T. Kubota, F. Wu, X. Zhang, H. Naganuma, M. Oogane, A. Sakuma, Y. Ando, and T. Miyazaki, "Composition dependence of magnetic properties in perpendicularly magnetized epitaxial thin films of Mn-Ga alloys", Phys. Rev. B, **85** 014416 (2012)
22	T. Arakane, T. Sato, S. Souma, K. Kosaka, K. Nakayama, M. Komatsu, T. Takahashi, Z. Ren, K. Segawa, and Y. Ando, "Tunable Dirac cone in the topological insulator $Bi_{2-x}Sb_xTe_{3-y}Se_y$", Nat. Commun., **3**, 636 (2012)
23	D. V. Louzguine-Luzgin, "Aluminum-Base Amorphous and Nanocrystalline Materials", Metal Science and Heat Treatment., **53**, 472-477 (2012)
24	I. Hamada, S. Meng, "Water wetting on representative metal surfaces: Improved description from van der Waals density functionals", Chem. Phys. Lett., **521**, 161 (2012)
25	Q. H. Zhang, L. J. Wang, X. K. Wei, A. Hirata, M.W. Chen, et al., "Direct observation of interlocked domain walls in hexagonal RMnO(3) (R = Tm, Lu)", Phys. Rev. B, **85**, 2 (2012)

26	S. Lu, T. Jin, M. Bao, A. M. Asiri, Y. Yamamoto, "Palladium-catalyzed bisfunctionalization of active alkenes by β-acetonitrile-α-allyl addition: application to the synthesis of unsymmetric 1,4-di(organo)fullerene derivatives", Tetrahedron Lett., **53**, 1210 (2012)
27	Y. Matsubara, T. Makino, H. Hiraga, C. Chen, S. Tsukimoto, K. Ueno, Y. Kozuka, Y. Ikuhara and M. Kawasaki, "High crystallinity $CuScO_2$ delafossite films exhibiting ultraviolet photoluminescence grown by vapor-liquid-solid tri-phase epitaxy", Appl. Phys. Express, **5**, 011201 (2012)
28	M. Aljerf, K. Georgarakis, D.V. Louzguine-Luzgin, A. Le Moulec, A. Inoue, A. R. Yavari, "Strong and Light Metal Matrix Composites with Metallic Glass Particulate Reinforcement", Mater. Sci. Eng. A, **532**, 325-330 (2012)
29	D.V. Louzguine-Luzgin, G.Q. Xie, S. Gonzales, J.Q. Wang, K. Nakayama, J.H. Perepezko, A. Inoue, "Nano-Crystallization Behavior of Zr-Cu-Al Bulk Glass-Forming Alloy", J. Non-Cryst Solid, **358**, 145-149 (2012)
30	D.V. Louzguine-Luzgin, K. Georgarakis, V. Zadorozhnyy, N. Chen, K. Nakayama, G. Vaughan, A.R. Yavari, A. Inoue, "Atomic Structure Changes and Phase Transformation Behavior in Pd-Si Bulk Glass-Forming Alloy, Intermetallics, **20**, 135-140 (2012)
31	G.Q. Xie, H.M. Kimura, D.V. Louzguine-Luzgin, H. Men, A. Inoue, "SiC Dispersed Fe-Based Glassy Composite Cores Produced by Spark Plasma Sintering and Their High Frequency Magnetic Properties", Intermetallics, **20**, 76-81 (2012)
32	T. Jin, M. Yan, Menggenbateer, T. Minato, M. Bao, Y. Yamamoto," Nanoporous Copper Metal Catalyst in Click Chemistry: Nanoporosity-Dependent Activity without Supports and Bases", Adv. Synth. Catal., **353**, 3095 (2011)
33	X. Zhu, K. Ino, Z. Y. Lin, H. Shiku, G. Chen, T. Matsue, "Label-free amperometric detection of DNA hybridization using multi-point, addressable electrochemical devices". Sens. Actuat. B, **160**, 923-928 (2011)
34	Y. Date, S. Takano, H. Shiku, K. Ino, T. Ito-Sakaki, M. Yokoo, H. Abe, T. Matsue, "Monitoring oxygen consumption of single mouse embryos using an integrated electrochemical microdevice", Biosens. Bioelectron., **30**, 100-106 (2011)
35	M. C. Wang, C. Yan, L. Ma, M.W. Chen, et al., "Effect of defects on fracture strength of graphene sheets", Computational Materials Science, **54,** 236-239 (2011)
36	M. Tokuyama, "Universality in Self-Diffusion of Atoms among Distinctly Different Glass-Forming Liquids", Journal of Phys. Chem. B, **115**, 14030 (2011)
37	S. Lu, T. Jin, M. Bao, E. Kwon, Y. Yamamoto, "Highly Efficient $Cu(OAc)_2$-Catalyzed Dimerization of Monofunctionalized Hydrofullerenes Leading to Single-Bonded [60]Fullerene Dimers, Angew". Chem. Int. Ed., **51**, 802 (2011)
38	A. Caron, R. Wunderlich, D.V. Louzguine, T. Egami, H.-J. Fecht, "On the Glass Transition Temperature and the Elastic Properties in Zr-Based Bulk Metallic Glasses", Phil. Mag. Lett, **91**, 751–756 (2011)
39	K. C. Rahnejat, C. A. Howard, N. E. Shuttleworth, S. R. Schofield, K. Iwaya, C. F. Hirjibehedin, Ch. Renner,G. Aeppli, M. Ellerby, "Charge density waves in the grapheme sheets of the superconductor CaC_6", Nature Communications **2**, 558 (2011)

40	S. Chakraverty, M. Saito, S. Tsukimoto, Y. Ikuhara, A. Ohtomo, and M. Kawasaki, "Magnetic properties of Sr_2FeTaO_6 double perovskite epitaxially grown by pulsed-laser deposition", Appl. Phys. Lett., **99**, 223101 (2011)
41	M. Araidai, M. Tsukada, "Nonadiabatic electromigration along a one-dimensional gold chain", Phys. Rev.B, **84**, 195461 (2011)
42	T. Kumagai, A. Shiotari, H. Okuyama, S. Hatta, T. Aruga, I. Hamada, T. Frederiksen, H. Ueba, "H-atom relay reactions in real space", Nature Mater. **11**, 167 (2011)
43	P. Richard, T. Sato, K. Nakayama, T. Takahashi, and H. Ding**, "**Fe-based superconductors: an angle-resolved photoemission spectroscopy perspective", Rep. on Prog. in Phys., **74**, 124512 (2011)
44	G.Q. Xie, L. Shao, D.V. Louzguine-Luzgin, A. Inoue, "He Ion Irradiation Induced Nanocrystallization in $Cu_{50}Zr_{45}Ti_5$ Glassy Alloy", Surf. Coat. Tech., **206**, 829-833 (2011)
45	HS. Lee, T. Mizoguchi, T. Yamamoto, SJ. L. Kang, and Y. Ikuhara, "Characterization and atomic modeling of an asymmetric grain boundary", Phys. Rev. B, **84**, 195319 (2011)
46	Z. Wang, M. Saito, K. P. McKenna, L. Gu, S. Tsukimoto, A. L. Shluger, and Y. Ikuhara, "Atom-Resolved Imaging of Ordered Defect Superstructures at Individual Grain Boundaries", Nature, **479**, 380-383 (2011)
47	N. Asao, Menggenbateer, Y. Seya, Y. Yamamoto, M.W. Chen, W. Zhang, A. Inoue, "Nanoporous gold-catalyzed [4 + 2] benzannulation between *ortho*-alkynylbenzaldehydes and alkynes", Synlett, **23**, 66 (2011)
48	T.Kubota, M.Araidai, S.Mizukami, X.Zhang, Q.Ma, H.Naganuma, M.Oogane, Y.Ando, M.Tsukada, T.Miyazaki, "Composition dependence of magnetoresistance effect and its annealing endurance in tunnel junctions having Mn-Ga electrode with high perpendicular magnetic anisotropy", Appl. Phys. Lett., **99**, 192509 (2011)
49	D. Wang, X.B. Liang, Y.H. Liu, S. Fujinami, T. Nishi, K. Nakajima, "Characterization of Surface Viscoelasticity and Energy Dissipation in a Polymer Film by Atomic Force Microscopy" , Macromolecules, **44**, 8693–8697 (2011)
50	T. Kubota, M. Araidai, S. Mizukami, X. Zhang, Q. Ma, H. Naganuma, M. Oogane, Y. Ando, M. Tsukada, and T. Miyazaki, "Composition dependence of magnetoresistance effect and its annealing endurance in tunnel junctions using Mn-Ga high perpendicular magnetic anisotropy electrode", Appl. Phys. Lett. **99**, 192509 (2011)
51	T. Kaneko, S. Tanaka, N. Asao, Y. Yamamoto, M.W. Chen, W. Zhang, A. Inoue, "Reusable and Sustainable Nanostructured Skeleton Catalyst: Heck Reaction with Nanoporous Metallic Glass Pd (PdNPore) as a Support, Stabilizer and Ligand-Free Catalyst", Adv. Synth. Catal., **353**, 2927 (2011)
52	Y. H. Liu, T. Fujita, A. Hirata, H.W. Liu, M.W. Chen, et al., "Deposition of multicomponent metallic glass films by single-target magnetron sputtering", Intermetallics, **21**, 1, 105-114 (2011)
53	H.Okuyama, I.Hamada, "Hydrogen-bond imaging and engineering with a scanning tunneling microscope", J.Phys.D: Appl.Phys., **44**, 464004 (2011)

54	K.Yamauchi, I.Hamada, H.Huang, T.Oguchi, "Role of van der Waals interaction in ammonia borane", Appl.Phys.Lett., **99**, 181904 (2011)
55	T. Nakanishi, Y. Hirai, H. Yabu, M. Shimomura, "Flexible, Optically Transparent, and Conductive Line-and-Space-Patterned Films Prepared by Using a Simple Dewetting Process of Gold Nanoparticle Dispersions", Appl. Phys. Express, **41**, 17301 (2011)
56	Z. Wang, M. Saito, S. Tsukimoto, and Y. Ikuhara, "Heterointerfaces: Atomic Structures, Electronic States, and Related Properties, J. Ceramics Soc. of Jap., **119**, 783-793 (2011)
57	Y. Kezuka, E. Tochigi, N. Shibata, C. Moon, S. Kanehira, K. Hirao, and Y. Ikuhara, "Formation of a Cr^{3+}-rich luminescent thin phase along a grain boundary of alpha-Al_2O_3", J. Ceram. Soc. Jap., **119**, 620-622 (2011)
58	Y. Kezuka, E. Tochigi, N. Shibata, and Y. Ikuhara, "TEM analysis of dislocation structures formed in the Cr-doped grain boundary of alumina", J. Ceram. Soc. Japan, **119**, 817-821 (2011)
59	JP. Buban, T. Mizoguchi, N. Shibata, E. Abe, T. Yamamoto, and Y. Ikuhara, "Zr segregation and associated Al vacancies in alumina grain boundaries", J. Ceram. Soc. Jap., **119**, 840-844 (2011)
60	HS. Lee, SD. Findlay, T. Mizoguchi, and Y. Ikuhara, "The effect of vacancies on the annular dark field image contrast of grain boundaries: A $SrTiO_3$ case study", Ultramicroscopy, **111**, 1531-1539 (2011)
61	M. J. Iqbal, R. A. Khana, S. Mizukami, and T. Miyazaki, "Mossbauer and magnetic study of Mn, Zr and Cd substituted W-type hexaferrites prepared by co-precipitation method", Materials Res. Bull. **46**, 1980 (2011)
62	G. Ferrara, T. Jin, K. Oniwa, J. Zhao, A. M. Asiri, Y. Yamamoto, "Synthesis of new donor-acceptor-donor materials via Au-catalyzed double cascade cyclization", Tetrahedron Lett., **53**, 914 (2011)
63	G. Eda, H. Yamaguchi, D. Voiry, T. Fujita, M.W. Chen, et al., "Photoluminescence from Chemically Exfoliated MoS(2)", Nano Lett., **11**, 5111-5116 (2011)
64	Y. Sato, T. Hirayama, and Y. Ikuhara, "Real-Time Direct Observations of Polarization Reversal in a Piezoelectric Crystal: $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ Studied via In Situ Electrical Biasing Transmission Electron Microscopy", Appl. Phys. Lett., **107**(18), 187601 (2011).
65	I.Hamada, A.Uozumi, Y.Morikawa, A.Yanase, H.Katayama-Yoshida, "Density-Functional Theory Study of Self-regenerating Catalyst $LaFe_{1-x}MxO_3$ (M=Pd, Rh, and Pt)", J.Am.Chem.Soc., **133**, 18506 (2011).
66	R. Shimizu, K. Iwaya, T. Ohsawa, S. Shiraki, T. Hasegawa, T. Hashizume, T. Hitosugi, "Atomic-scale visualization of initial growth of homoepitaxial $SrTiO_3$ thin film on an atomically ordered substrate", ACS Nano **5**, 7967 –7971 (2011)
67	A. Caron, A. Kawashima, H.J. Fecht, D.V. Louzguine-Luzgin, A. Inoue, "On the Anelasticity and Strain Induced Structural Changes in a Zr-Based Bulk Metallic Glass", Appl. Phys. Lett., **99**, 171907 (2011)
68	A. Hirata, T. Fujita, Y. R. Wen, M.W. Chen, et al., "Atomic structure of nanoclusters in oxide-disp ersion-strengthened steels", Nature Materials, **10**, 922-926 (2011)

69	M. Akhtaruzzaman, A. Islam, F. Yang, N. Asao, E. Kwon, S. P. Singh, L. Han, Y. Yamamoto, "A novel metal-free panchromatic TiO_2 sensitizer based on a phenylenevinylene-conjugated unit and an indoline derivative for highly efficient dye-sensitized solar cells", Chem. Commun., **47**, 12400 (2011)
70	H.Miyashita, E.Tomono, Y.Kawai, M.Esashi and T.Ono, "Fabrication of Einzel Lens Array with One-Mask Reactive Ion Etching Process for Electron Micro-Optics", Jap. J. Appl. Phys, **50,** 106503-1-5 (2011)
71	I.Hamada, S.Yanagisawa, "Pseudopotential approximation in van der Waals density functional calculations", Phys.Rev.B, **84**, 153104 (2011)
72	X. Zhang, S. Mizukami, T. Kubota, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, "Interface effects on perpendicular magnetic anisotropy for molecular-capped cobalt ultrathin films", Appl. Phys. Lett., **99**, 162509 (2011)
73	A. Chutia and M. Tokuyama, "Orbital interaction and local stability of Ni substituted Pd nanoalloys", Chem. Phys. Lett., **515**, 96-101 (2011)
74	V. Kumar, T. Fujita, K. Konno, M.W. Chen, et al., "Atomic and electronic structure of Pd(40)Ni(40)P(20) bulk metallic glass from ab initio simulations", Phys. Rev. B, **84**, 134204 (2011)
75	T.Ikeshoji, M.Otani, I.Hamada, Y.Okamoto, "Reversible redox reaction and water configuration on a positively charged platinum surface: first principles molecular dynamics simulation", Phys.Chem., **13**, 20223 (2011)
76	H. Liu, L. Zhang, X. Lang, Q-k. Xue, M.W. Chen, et al., "Single molecule detection from a large-scale SERS-active Au(79)Ag(21) substrate", Scientific Reports, **1**, Article number 112 (2011)
77	M. Takeda, H. Shiku, K. Ino, T. Matsue, "Electrochemical Chip Integrating Scalable Ring-Ring Electrode Array to Detect Secreted Alkaline Phosphatase". Analyst , **136**, 4491-4496 (2011)
78	Y. Takahashi, A. I. Shevchuk, P.l Novak, Y. Zhang, N. Ebejer, J. V. Macpherson, P. R. Unwin, A. J. Pollard, D. Roy, C. A. Clifford, H. Shiku, T. Matsue, D. Klenerman, Y. E. Korchev, "Multifunctional Nanoprobes for Nanoscale Chemical Imaging and Localized Chemical Delivery at Surfaces and Interfaces". Angew. Chem. Int. Ed., **50**, 9638-9642, (2011)
79	T.Tsukamoto, M.Esashi and S.Tanaka, "A Micro Thermal Switch with a Stiffness-enhanced Thermal Isolation Structure", J. of Micromech. Microeng., **21**, 104008 (2011)
80	T.Yabe, Y.Mimura, H.Takahashi, A.Onoe, S.Muroga, M.Yamaguchi, T.Ono and M.Esashi, "Three-Dimentional Micro-Coil Oscillator Fabricated with Monolithic Process on LSI", IEEJ Trans. on Sensors and Micromachines, **131,** 363-367 (2011)
81	A. Takeuchi, A. Inoue, "$Pd_{20}Pt_{20}Cu_{20}Ni_{20}P_{20}$ High-Entropy Alloy as a Bulk Metallic Glass in the Centimeter", Intermetallics, **19**, 1546-1554 (2011)
82	S.V. Madge, P. Sharma, D.V. Louzguine-Luzgin, A.L. Greer, A. Inoue, "Mechanical Behaviour of Zr-La-Cu-Ni-Al Glass-Based Composites", Intermetallics, **19**, 1474-1478 (2011)

83	S. Mizukami, T. Kubota, X. Zhang, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, "Influence of Pt doping on Gilbert damping in permalloy films and comparison with the perpendicularly magnetized alloys films", Jpn. J. Appl. Phys. **50**, 103003 (2011)
84	S. Mizukami, D. Watanabe, T. Kubota, X. Zhang, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, "Time-resolved Kerr effect for very thin films of CoCrPt Alloy", IEEE Trans. Magn. **47**, 3897 (2011)
85	X. Zhang, S. Mizukami, T. Kubota, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, "Spin transport in Co/Al2O3/Alq3/Co organic spin valve", IEEE Trans. Magn. **47**, 2649 (2011)
86	Y. Tanabe, K. K. Huynh, S. Heguri, G. Mu, T. Urata, J. Xu, R. Nouchi, N. Mitoma, and K. Tanigaki, "Coexistence of Dirac-cone states and superconductivity in iron pnictide Ba(Fe(1-x)Ru(x)As)(2)", Phys. Rev. B, **84**, 100508 (2011)
87	J. Tang, J. T. Xu, S. Heguri, K. Akai and K. Tanigaki, "Valence Band Studies of p- and n-Type Ba(8)Ga(16)Ge(30) Using High-Resolution Photoelectron Spectroscopy", J. of Elect. Materials **40**, 769-772 (2011)
88	K.Akagi, "Towards the microscopic understanding of solid/liquid interfaces", IOP Conf.Ser.: Mater.Sci.Eng., **24**, 012001 (2011)
89	T. Mizuno, Y. Nagao, A. Yoshikawa, K. Koumoto, T. Kato, Y. Ikuhara, and H. Ohta,"Electric field thermopower modulation analysis of an interfacial conducting layer formed between Y_2O_3 and rutile TiO_2", J. Appl. Phys., **110**, 063719 (2011)
90	X. Lang, L. Zhang, T. Fujita, M.W. Chen, et al., "Three-dimensional bicontinuous nanoporous Au/polyaniline hybrid films for high-performance electrochemical supercapacitors", J. of Power Sources, **197**, 325-329 (2011)
91	L. Chen, H. Guo, T. Fujita, A. Hirata, M.W .Chen, et al., "Nanoporous PdNi Bimetallic Catalyst with Enhanced Electrocatalytic Performances for Electro-oxidation and Oxygen Reduction Reactions", Adv. Functional Materials, **21**, 4364-4370 (2011)
92	B.Cai, O.Sugihara, H.I.Elim, T.Adschiri, T.Kaino, "A Novel Preparation of High-Refractive-Index and Highly Transparent Polymer Nanohybrid Composites", Appl. Phys. Exp., **4**, 092601 (2011)
93	H.Asakawa, K.Ikegami, M.Setou, N.Watanabe, M.Tsukada, "Submolecular-scale Imaging of α-Helices and C-Terminal Domains of Tublins by Frequency Modulation Atomic Force Microscopy in Liquids", Biophysical J., **101**, 1270 (2011)
94	S. C. George, S. Thulasi, S. Anas, K. V. Radhakrishnan, Y. Yamamoto, "Palladium Catalyzed 1,8-Conjugate Addition to Heptafulvene via Bis-π-allyl Palladium Complexes", Org. Lett., **13**, 4984 (2011)
95	F. Yang, T. Jin, M. Bao, Y. Yamamoto, "Facile synthesis of dihaloheterocycles via electrophilic iodocyclization", Tetrahedron, **67**, 10147 (2011)
96	T. Nakagawa, H. Nishimura, I. Sakaguchi, N. Shibata, K. Matsunaga, T. Yamamoto, and Y. Ikuhara, "Grain boundary character dependence of oxygen grain boundary diffusion in alpha-Al_2O_3 bicrystals", Scripta Materialia, **65**, 544-547 (2011)
97	L. Zhang, L. Chen, H. Liu, A. Hirata, T. Fujita, M.W. Chen, et al., "Effect of Residual Silver on Surface-Enhanced Raman Scattering of Dealloyed Nanoporous Gold", Journal of Physical Chemistry C, **115**, 19583-19587 (2011)

98	J.-W.Lee, Y.-C.Lin, N.Kaushik, P.Sharma, A.Makino, A.Inoue, M.Esashi and T.Gessner, "Micromirror with Large-tilting Angle Using Fe-based Metallic Glass", Optics Letters, **36**, 3464-3466 (2011)
99	N. Chen, R. Frank, N. Asao, D.V. Louzguine-Luzgin, P. Sharma, J.Q. Wang, G.Q. Xie, Y. Ishikawa, N. Hatakeyama, Y.C. Lin, M. Esashi, Y. Yamamoto, A. Inoue, "Formation and Properties of Au-Based Nanograined Metallic Glasses", Acta. Mater., **59**, 6433-6440 (2011)
100	A. I. Oreshkin, N. S. Maslova, V. N. Mantsevich, S. I. Oreshkin, S. V. Savinov, V. I. Panov, D. V. Louzguine-Luzgin, "Metallic Glass Electronic Structure Peculiarities Revealed by UHV STM/STS", JETP. Lett., **94**, 58-62 (2011)
101	S. Chakraverty, A. Ohtomo, D. Okuyama, M. Saito, M. Okude, R. Kumai, T. Arima, Y. Tokura, S. Tsukimoto, Y. Ikuhara, and M. Kawasaki, "Ferrimagnetism and spontaneous ordering of transition metals in double perovskite La_2CrFeO_6 films", Phys. Rev. B, **84**, 064436 (2011)
102	T. Ohsawa, J. Okubo, T. Suzuki, H. Kumigashira, M. Oshima, and T. Hitosugi, "An n-type Transparent Conducting Oxide: $Nb_{12}O_{29}$", J. Phys. Chem. C, **115**, 16625 (2011)
103	H. Yabu, T. Nakanishi, Y. Hirai and M. Shimomura, "Black thin layers generate strong structural colors: a biomimetic approach for creating one-dimensional (1D) photonic crystals", J. Mater. Chem., **21**, 15154-15156 (2011)
104	Z.-H. Liu, P. Richard, K. Nakayama, G.-F. Chen, S. Dong, J.-B. He, D.-M. Wang, T.-L. Xia, K. Umezawa, T. Kawahara, S. Souma, T. Sato, T. Takahashi, T. Qian, Yaobo Huang, Nan Xu, Yingbo Shi, H. Ding and S.-C. Wang, "Unconventional superconducting gap in $NaFe_{0.95}Co_{0.05}As$ observed by angle-resolved photoemission spectroscopy", Phys. Rev. B, **84**, 064519 (2011)
105	J.-W.Lee, Y.-C.Lin, N.Chen, D.V.Louzquine, M.Esashi and T.Gessner, "Development of the Large Scanning Mirror Using Fe-Based Metallic Glass Ribbon", Jap. J. of Appl. Phys., **50** 087301 (2011)
106	K. Nakamura, T. Mizoguchi, N. Shibata, K. Matsunaga, T. Yamamoto, and Y. Ikuhara, "First-principles study of grain boundary sliding in alpha-Al_2O_3", Phys. Rev. B, **84**, 059903 (2011)
107	K. Yamamoto, H. Sugiura, R. Amemiya, H. Aikawa, Z. An, M. Yamaguchi, M. Mizukami, K. Kurihara, "Formation of double helix self-assembled monolayers of ethynylhelicene oligomer disulfides on gold surfaces", Tetrahedron, **67**, 5972-5978 (2011)
108	S.Yoshida, T.Ono and M.Esashi, "Local Electrical Modification of a Conductivity-switching Polyimide film Formed by Molecular Layer Deposition", Nanotechnology, **22,** 3353302 (2011)
109	K. Yamamoto, H. Sugiuchi, R. Amemiya, H. Aikawa, Z. An, M. Yamaguchi, M.Mizukami, K.Kurihara, "Formation of Double Helix Self-assembled Monolayers of Ethynyhelicene Oligomer Disulfides on Gold Surfaces", Tetrahedron, **67,** 5972-5978 (2011)
110	T. Narumi and M. Tokuyama, "Comparison of mode-coupling theory with molecular dynamics simulations from a unified point of view", Phys. Rev. E, **84**, 022501 (2011)
111	Y. Takahashi, T. Miyamoto, H. Shiku, K. Ino, T. Yasukawa, R. Asano, I. Kumagai, T. Matsue, "Electrochemical Detection of Receptor-mediated Endocytosis by Scanning Electrochemical Microscopy", Phys. Chem. Chem. Phys., **13**, 16569-16573 (2011)
112	T. Sato, K. Segawa, K. Kosaka, S. Souma, K. Nakayama, K. Eto, T. Minami, Y. Ando and T. Takahashi, "Unexpected mass acquisition of Dirac fermions at the quantum phase transition of a topological insulator", Nature Phys., **7**, 840 (2011)

113	M. Oogane and S. Mizukami, "Tunnel magnetoresistance effect and magnetic damping in half-metallic Heusler alloys", Phil. Trans. R. Soc. A., **369**, 3037 (2011).
114	Y. Uraki, Y. Tamai, T. Hirai, K. Koda, H. Yabu, M. Shimomura, "Fabrication of honeycomb-patterned cellulose material that mimics wood cell wall formation processes", Materials Science and Engineering C, **31**, 1201–1208 (2011)
115	K. Iwaya, R. Shimizu, T. Hashizume, and T. Hitosugi, "Systematic analyses of vibration noise of a vibration isolation system for high-resolution scanning tunneling microscopes", Rev. Sci. Instrum., **82**, 083702 (2011)
116	G. Mu, J. Tang, Y. Tanabe, J. Xu, S. Heguri, and K. Tanigaki, "Evidence for line nodes in the energy gap of the overdoped Ba(Fe(1-x)Co(x))(2)As(2) from low-temperature specific heat measurements", Phys. Rev. B, **84**, 054505 (2011)
117	Y. Ikuhara, "Grain boundary atomic structures and light-element visualization in ceramics: combination of Cs-corrected scanning transmission electron microscopy and first-principles calculations", J. Electron. Microsc., **60**, S173-S188 (2011)
118	H. Ogino, Y. Shimizu, N. Kawaguchi, K. Kishio, J. Shimoyama, T. Tohei, and Y. Ikuhara, "A new iron pnictide oxide $(Fe_2As_2)(Ca_5(Mg, Ti)_4O_y)$ and a new phase in the Fe-As-Ca-Mg-Ti-O system", Supercond. Sci. Tech., **24**, 085020 (2011)
119	M.Makihata, S.Tanaka, M.Muroyama, S.Matsuzaki, H.Yamada, N.Nakayama, U.Yamaguchi, Y.Nonomura, M.Fujiyoshi and M.Esashi, "Adhesive Wafer Bonding Using a Molded Thick Benzocyclobutene Layer for Wafer-level Integration of MEMS and LSI", J. of Micromech. Microeng., **21**, 085002 (2011)
120	M.Muroyama, M.Makihata, Y.Nakano, S.Tanaka, S.Matsuzaki, H.Yamada, U.Yamaguchi, N.Nakayama, Y.Nonomura, M.Fujiyoshi, S.Tanaka and M.Esashi, "Development of an LSI Tactile Sensors Systems on Whole-Body of Robots", IEEJ Trans. on Sensors and Micromachines, **131**, 302-309 (2011)
121	D.V. Louzguine-Luzgin, R. Belosludov, A.R. Yavari, K. Georgarakis, G. Vaughan, Y. Kawazoe, T. Egami, A. Inoue, "Structural Basis for Supercooled Liquid Fragility Established by Synchrotron-Radiation Method and Computer Simulation", J. Appl. Phys., **110**, 043519 (2011)
122	W. Ichinose, M. Miyagawa, J. Ito, M. Shigeno, R. Amemiya, M. Yamaguchi, "Synthesis and Duplex Formation of the Reverse Amidohelicene Tetramer", Tetrahedron**, 67,** 5477-5486 (2011)
123	Z. W. Zhang, C. T. Liu, Y. R. Wen, A. Hirata, M.W. Chen, et al., "Influence of Aging and Thermomechanical Treatments on the Mechanical Properties of a Nanocluster-Strengthened Ferritic Steel", Metall. Trans. A, Phys. Metall. Mater. Sci., **43A**, 351-359 (2011)
124	X. He, Z. Wang, A. Hirata, L. Gu, M.W. Chen, et al., "Modulated Na(2)Ti(4)O(9): Zr Nanobelt via Site-Specific Zr Doping", Appl. Phys. Express, **4**, 085003 (2011)
125	R. Nouchi, K. Tanigaki, "Empirical Modeling of Metal-Contact Effects on Graphene Field-Effect Transistors", Jap. J. Appl. Phys., **50,** 070109 (2011)
126	Y. Tokuda, S. Kobayashi, T. Ohnishi, T. Mizoguchi, N. Shibata, Y. Ikuhara, and T. Yamamoto, "Strontium vacancy clustering in Ti-excess $SrTiO_3$ thin film", Appl. Phys. Lett., **99**, 033110 (2011)

127	Y. Hirai, H. Yabu, Y. Matsuo, K. Ijiro, M. Shimomura, "Fabrication and Wettability Patterning of Nano-structured Silicon Surface by using Self-organized Polymer Structures", J. of the Surface Sci. Soci. of Jap., **32**, 416-421 (2011)
128	M. J. Iqbal, R. A. Khan, S. Takeda, S. Mizukami, and T. Miyazaki, "W-type hexaferrite nanoparticles: A Consideration for microwave attenuation at wide frequency band of 0.5 to 10 GHz", J. Alloys Compd. **509**, 7618 (2011).
129	Y.-M. Xu, P. Richard, K. Nakayama, T. Kawahara, Y. Sekiba, T. Qian, M. Neupane, S. Souma, T. Sato, T. Takahashi, H.-Q. Luo, H.-H. Wen, G.-F. Chen, N.-L. Wang, Z. Wang, Z. Fang, X. Dai and H. Ding, "Fermi surface dichotomy of the superconducting gap and pseudogap in underdoped pnictides", Nat. Commun., **2**, 392 (2011)
130	S. Lu, T. Jin, M. Bao, Y. Yamamoto, "Cobalt-Catalyzed Hydroalkylation of [60]Fullerene with Active Alkyl Bromides: Selective Synthesis of Monoalkylated Fullerenes", J. Am. Chem. Soc., **133**, 12842 (2011)
131	X. Fan, R. Nouchi, and K. Tanigaki, "Effect of Charge Puddles and Ripples on the Chemical Reactivity of Single Layer Graphene Supported by SiO(2)/Si Substrate", J.Phys. Chem. C **115**, 12960-12964 (2011)
132	J. Zhang, T. Naka, S. Ohara, K. Kaneko, T. Trevethan, A. Shluger, T. Adschiri, "Surface ligand assisted valence change in ceria nanocrystals", Phys. Rev. B, **84**, 045411 (2011)
133	T. Kamijo, M. Kasuya, M. Mizukami, K. Kurihara, "Direct Observation of Double Layer Interactions between the Potential Controlled Gold Electrode Surfaces Using the Electrochemical Surface Forces Apparatus", Chem. Lett., **40**, 674-675 (2011)
134	D. Fukushi, M.Kasuya, H.Sakuma, K.Kurihara, "Fluorescent Dye Probe for Monitoring Local Viscosity of Confined Liquids", Chem. Lett. **40**, 776-778 (2011)
135	T. Kubota, S. Mizukami, D. Watanabe, F. Wu, X. Zhang, H. Naganuma, M. Oogane, Y.Ando, and, T. Miyazaki, "Effect of metallic Mg insertion on the magnetoresistance effect in MgO-based tunnel junctions using $D0_{22}$-$Mn_{3-\delta}Ga$ perpendicularly magnetized spin polarizer", J. Appl. Phys. **110**, 013915 (2011)
136	B.Wen, S.Takami, Y.Kawazoe, T.Adschiri, "Pressure-dependent mechanical stability of simple cubic carbon", PHYSICA B-CONDENSED MATTER.,**406**, 2654 (2011)
137	SD. Findlay, NR. Lugg, N. Shibata, LJ. Allen, and Y. Ikuhara, "Prospects for lithium imaging using annular bright field scanning transmission electron microscopy: A theoretical study", Ultramicroscopy, **111**, 1144-1154 (2011)
138	NR. Lugg, SD. Findlay, N. Shibata, T. Mizoguchi, AJ. D'Alfonso, LJ. Allen, and Y. IKuhara, "Scanning transmission electron microscopy imaging dynamics at low accelerating voltages", Ultramicroscopy, **111**, 999-1013 (2011)
139	Y.Jiang, M.Esashi and T.Ono, "Design Issues for Piezoresistive Nanocantilever Sensors with Non-uniform Nanoscale Doping Profiles", IEEJ Trans. on Sensors and Micromachines, **131**, 270-271 (2011)
140	I.Hamada and M.Tsukada, "Adsorption of C_{60} on Au(111) revisited: a van der Waals density functional study", Phys.Rev.B **83**, 245437 (2011)

141	S. Gonzalez, D.V. Louzguine-Luzgin, J.H. Perepezko, A. Inoue, "Large Plasticity of a $Mg_{42}Li_{23}Cu_{25}Y_{10}$ Multiphase Composite", Mater Sci Eng A **528**, 5576-5584 (2011)
142	K. Nakayama, T. Sato, Y.-M. Xu, Z.-H. Pan, P. Richard, H. Ding, H.-H. Wen, K. Kudo, T. Sasaki, N. Kobayashi, and T. Takahashi, "Two pseudogaps with different energy scales at the antinode of the high-remperature $Bi_2Sr_2CuO_6$ superconductor using angle-resolved photoemission spectroscopy", Phys. Rev. B, **83**, 224509 (2011)
143	M. Mizukami, O. Sugihara, H. Yamabe, I. Andoh, S. Kurokawa, K. Kurihara, "Surface Forces Study on Metal-Polymer Adhesion 2", J. Jpn. Soc. of Colour Mater., **84**, 87-91 (2011)
144	H. Yuan, H. Liu, H. Shimotani, M.W. Chen, Q-K. Xue, et al., "Liquid-Gated Ambipolar Transport in Ultrathin Films of a Topological Insulator Bi(2)Te(3)", Nano Lett., **11**, 2601-2605 (2011)
145	Matsuura, M.; Fukuhara, M.; Konno, K.; Fujita, T.; Chen, M.W.; et al., "Distorted icosahedral Ni(5)Nb(3)Zr(5) clusters in the as-quenched and hydrogenated amorphous (Ni(0.6)Nb(0.4))(0.65)Zr(0.35) alloys", J. of Non-Crystalline Solids, **357**, 3357-3360 (2011)
146	T. Mizoguchi, H. Ohta, HS. Lee, N. Takahashi, and Y. Ikuhara, "Controlling Interface Intermixing and Properties of $SrTiO_3$-Based Superlattices", Adv. Funct. Mater., **21**, 2258-2263 (2011)
147	N. Saito, R. Terakawa. M. Shigeno, R. Amemiya, M.Yamaguchi, "Side Chain Effect on the Double Helix Formation of Ethynylhelicene Oligomers", J. Org. Chem. **76**, 4841-4858 (2011)
148	S. Fujinami, K. Nakajima, T. Nishi, "Novel Viscoelasticity Measurement Method Based on AFM Force Mapping and JKR Analysis", J. of Soc. of Rubber Industry, Jap., **84**, 171-175 (2011)
149	S.Asahina, S.Takami, T. Otsuka, T. Adschiri, O.Terasaki, "Exploitation of Surface-Sensitive Electrons in Scanning Electron Microscopy Reveals the Formation Mechanism of New Cubic and Truncated Octahedral CeO_2 Nanoparticles", Chem Cat Chem, **3**, 1038 (2011)
150	S. Asahina, S.Uno, M.Suga, S.M. Stevens, M. Klingstedt,Y.Okano, M. Kudo, F. S., Michael W.Anderson, T. Adschiri, O.Terasaki, "A new HRSEM approach to observe fine structures of novel nanostructured materials", MICROPOROUS AND MESOPOROUS MATER. , **146**,11 (2011)
151	S.Yanagisawa, I.Hamada, K.Lee, D.C.Langreth, Y.Morikawa, "Adsorption of Alq_3 on Mg(001) surface: Role of chemical bonding, molecular distortion, and van der Waals interaction", Phys. Rev.B, **83**, 235412 (2011)
152	S.-I. Kobayashi, Y.-G. Kim, R. Wen, K. Yasuda, H. Fukidome, T. Suwa, R. Kuroda, X. Li, A. Teramoto, T. Ohmi, K. Itaya, "Visualization of single atomic steps on an ultra-flat Si(100) surface by advanced differential interference contrast microscopy", Electrochemical and Solid-State Letters, **14**, H351-H353 (2011)
153	T.Arita H.Hitaka, K.Minami, T. Naka, T.Adschiri, "Synthesis and Characterization of Surface-modified FePt Nanocrystals by Supercritical Hydrothermal Method", Chem. Lett., **40**, 588 (2011)
154	G.M.Seong, S. Takami, T.Arita, K.Minami, D.Hojo, A.R. Yavari, T. Adschiri, "Supercritical hydrothermal synthesis of metallic cobalt nanoparticles and its thermodynamic analysis", J. Supercrit. Fluids, **60**, 113 (2011)

155	T. Mitsuma, T. Tohei, N. Shibata, T. Mizoguchi, T. Yamamoto, and Y. Ikuhara, "Structures of a Sigma 9, [110]/{221} symmetrical tilt grain boundary in $SrTiO_3$", J. Mater. Sci., **46**, 4162-4168 (2011)
156	S. Kobayashi, Y. Tokuda, T. Ohnishi, T. Mizoguchi, N. Shibata, Y. Sato, Y. Ikuhara, and T. Yamamoto, "Cation off-stoichiometric SrMnO(3-delta) thin film grown by pulsed laser deposition", J. Mater. Sci., **46**, 4354-4360 (2011)
157	C. M. Montesa, N. Shibata, T. Tohei, and Y. Ikuhara, "TEM observation of liquid-phase bonded aluminum-silicon/aluminum nitride hetero interface", J. Mater. Sci., **46**, 4392-4396 (2011)
158	T. Matsudaira, S. Kitaoka, N. Shibata, T. Nakagawa, and Y. Ikuhara, Mass transfer through a single grain boundary in alumina bicrystals under oxygen potential gradients, J. Mater. Sci., **46**, 4407-4412 (2011)
159	I. Sugiyama, M. Goto, T. Taniuchi, F. Shirase, T. Tanase, K. Okada, Y. Ikuhara, and T. Yamamoto, "Blunt corners of WC grains induced by lowering carbon content in WC-12mass%Co cemented carbides", J. Mater. Sci., **46**, 4413-4419 (2011)
160	E. Tochigi, N. Shibata, A. Nakamura, T. Yamamoto, and Y. Ikuhara, "Dislocation structures in a {-1104}/< 11-20 > low-angle tilt grain boundary of alumina (alpha-Al_2O_3)", J. Mater. Sci., **46**, 4428-4433 (2011)
161	Y. Ikuhara and M. Kohyama, "Preface to the special issue on intergranular and interphase boundaries in materials", J. Mater. Sci., **46**, 4093-4094 (2011)
162	Y.-M.Lee, M.Toda, M.Esashi and T.Ono, "Micro Wishbone Interferometer for Fourier Transform Infrared Spectroscopy", J. of Micromech. Microeng., **21,** 065039 (2011)
163	G.Q. Xie, D.V. Louzguine-Luzgin, A. Inoue, "Formation and Properties of Two-Phase Bulk Metallic Glasses by Spark Plasma Sintering", J. Alloys Comp., **509**, S214-S218 (2011)
164	S. Li, G.Q. Xie, D.V. Louzguine-Luzgin, M. Sato, A. Inoue, "Microwave-Induced Sintering of Cu-Based Metallic Glass Matrix Composites in a Single-Mode 915-MHz Applicator", Metall. Mater. Trans. A-Phys. Metall. Mater. Sci., **42**, 1463-1467 (2011)
165	D.V. Louzguine-Luzgin, A. Vinogradov, S. Li, A. Kawashima, G. Xie, A.R. Yavari, A. Inoue, "Deformation and Fracture Behavior of Metallic Glassy Alloys and Glassy-Crystal Composites", Metall. Mater. Trans. A-Phys. Metall. Mater. Sci., **42**, 1504-1510 (2011)
166	H. Guo, K. Sugawara, A. Takayama, S. Souma, T. Sato, N. Satoh, A. Ohnishi, M. Kitaura, M. Sasaki, Q.-K. Xue, and T. Takahashi, "Evolution of surface states in $Bi_{1-x}Sb_x$ alloys across the topological phase transition", Phys. Rev. B, **83**, 201104R (2011)
167	L. Zhang, XY. Lang, A. Hirata, M.W. Chen, et al., "Wrinkled Nanoporous Gold Films with Ultrahigh Surface-Enhanced Raman Scattering Enhancement", Acs Nano, **5**, 4407-4413 (2011)
168	Y. Yamada, K. Ueno, T. Fukumura, HT. Yuan, H. Shimotani, Y. Iwasa, L. Gu, S. Tsukimoto, Y. Ikuhara, and K. Kawasaki, "Electrically Induced Ferromagnetism at Room Temperature in Cobalt-Doped Titanium Dioxide", Science, **332**, 1065-1067 (2011)
169	H. Yamaguchi, K. Murakami, G. Eda, T. Fujita, P.G. Guan, M.W. Chen, et al., "Field Emission from Atomically Thin Edges of Reduced Graphene Oxide", Acs. Nano, **5**, 4945-4952 (2011)

170	S. Ohara, Y.Hatakeyama, M. Umetsu, Z. Tan, T. Adschiri, "Fabrication of Pd-DNA and Pd-CNT hybrid nanostructures for hydrogen sensors", Adv.Powder Tech., **22**, 559 (2011)
171	S. Souma, K. Kosaka, T. Sato, M. Komatsu, A. Takayama, T. Takahashi, M. Kriener, K. Segawa, and Y. Ando, "Direct Measurement of the Out-of-Plane Spin Texture in the Dirac Cone Surface State of a Topological Insulator", Phys. Rev. Lett., **106**, 216803 (2011)
172	K. Huynh Khuong, Y. Tanabe, K. Tanigaki, "Both Electron and Hole Dirac Cone States in Ba(FeAs)(2) Confirmed by Magnetoresistance", Phys. Rev. Lett. **106**, 217004 (2011)
173	H. Aikawa, T. Kaneko, N. Asao, Y. Yamamoto, "Gold-catalyzed alkylation of silyl enol ethers with *ortho*-alkynylbenzoic acid esters", Beilstein J. Org. Chem., **7**, 648 (2011)
174	M. Tokuyama, T. Moriki, and Y. Kimura, "Self-diffusion of biomolecules in solution", Phys. Rev. E **83**, 051402 (2011)
175	H. Yabu, Y. Nakamichi, Y. Hirai, and M. Shimomura, "A Biomimetic Approach for Creating Thermally Stable Polyimide-coated Honeycomb Films", Chem. Lett., **40**, 597-599 (2011)
176	K. Nagamine, Y. Takahashi, K. Ino, H.Shiku, T. Matsue, "Influence of tip size on single yeast cell imaging using scanning electrochemical microscopy", Electroanalysis, **23**, 1168-1174 (2011)
177	H. Okazaki, T. Arakane, K. Sugawara, T. Sato, T. Takahashi, T. Wakita, M. Hirai, Y. Muraoka, Y. Takano, S. Ishii, S. Iriyama, H. Kawarada, and T. Yokoya, "Photoemission study of electronic structure evolution across the metal-insulator transition of heavily B-doped diamond", J. Phys. Chem. Solids, **72**, 582-584 (2011)
178	Y.Jiang, M.Esashi and T.Ono, "Modeling and Experimental Analysis on the Nonlinearity of Single Crystal Silicon Cantilevered Microstructures", IEEJ Trans. on Sensors and Micromachines, **131**, 195-196 (2011)
179	T.Arita, H.Hitaka, K.Minami, T.Naka, T. Adschiri, "Synthesis of iron nanoparticle: Challenge to determine the limit of hydrogen reduction in supercritical water", J.Supercrit.Fluids, **57**,183 (2011)
180	T. Qian, N. Xu, Y.-B. Shi, K. Nakayama, P. Richard, T. Kawahara, T. Sato, T. Takahashi, M. Neupane, Y.-M. Xu, X.-P. Wang, G. Xu, X. Dai, Z. Fang, P. Cheng, H.-H. Wen, and H. Ding, "Quasi-nested Fe orbitals versus Mott-insulating V orbitals in superconducting Sr_2VO_3FeAs as seen from angle-resolved photoemission", Phys. Rev. B, **83**, 140513R (2011)
181	H.Tamura, I.Burghardt, M.Tsukada, "Exciton Dissociations at Thiophene/Fullerene Interfaces: The Electronic Structures and Quantum Dynamics", J.Phys.Chem., **115**, 10205 (2011)
182	A. Chowdhury, A. Kudo, T. Fujita, M.W. Chen, T. Adschiri, "Nano-twinned structure and photocatalytic properties under visible light for undoped nano-titania synthesised by hydrothermal reaction in water-ethanol mixture", J. of Supercritical Fluids, **58**, 136-141 (2011)
183	M.Taguchi, S.Takami, T.Adschiri, T.Nakane, K.Sato, T. Naka, "Supercritical hydrothermal synthesis of hydrophilic polymer-modified water-dispersible CeO_2 nanoparticles", Cryst. Eng. Comm.,**13**, 2841 (2011)

184	B. Wen, S.Takami, Y.Kawazoe, T.Adschiri, "Carbon-doped K_4 nitrogen: A novel high energy density material", Chem. Phys. Lett. ,**506**, 175 (2011)
185	H. W. Sheng, M. J. Kramer, A. Cadien, T. Fujita, M.W. Chen, "Highly optimized embedded-atom-method potentials for fourteen fcc metals", Phys. Rev. B, **83**, 134118 (2011)
186	K. Ino, A. Ishida, K. Y. Inoue, M. Suzuki, M. Koide, T. Yasukawa, H. Shiku, T. Matsue, "Electrorotation chip consisting of three-dimensional interdigitated array electrodes", Sens. Actuat. B, **153**, 468-473 (2011)
187	M. Koide, T. Yasukawa, K. Nagamine, H. Shiku, T. Itayama, T. Matsue, "An electrochemical device with microwells for determining the photosynthetic activity of a single cyanobacterium", Sens. Actuat. B, **153**, 474-478 (2011)
188	S. Tanaka, T. Kaneko, N. Asao, Y. Yamamoto, M.W. Chen, W. Zhang, A. Inoue, "A nanostructured skeleton catalyst: Suzuki-coupling with a reusable and sustainable nanoporous metallic glass Pd-catalyst", Chem. Commun., **47**, 5985 (2011)
189	A. Takayama, T. Sato, S. Souma, and T. Takahashi, "Giant out-of-plane spin component and the asymmetry of spin-polarization in surface Rashba states of bismuth thin film", Phys. Rev. Lett., **106**, 166401 (2011)
190	T. Arakane, T. Sato, T. Takahashi, T. Fujii, and A. Asamitsu, "Angle-resolved photoemission study of doping evolution of three-dimensional Fermi surface in Na_xCoO_2", New J. Phys., **13**, 043021 (2011)
191	A. Caron, P. Sharma, A. Shluger, H.J. Fecht, D.V. Louzguine-Luzguin, A. Inoue, "Effect of Surface Oxidation on the nm-Scale Wear Behavior of a Metallic Glass", J Appl Phys, **109**, 083515 (2011)
192	S. Gonzalez, G.Q. Xie, D.V. Louzguine-Luzgin, J.H. Perepezko, A. Inoue, "Deformation and Strain Rate Sensitivity of a Zr-Cu-Fe-Al Metallic Glass", Mater Sci Eng A, **528**, 3506-3512 (2011)
193	I.Hamada, Y.Morikawa, "A density-functional theory study of water on clean and hydrogen preadsorbed Rh(111) surfaces", J. Chem. Phys., **134**, 154701 (2011)
194	K. Sugawara, K. Kanetani, T. Sato, and T. Takahashi, "Fabrication of Li-intercalated bilayer grapheme", AIP Advances, **1**, 022103 (2011)
195	Y. Yu, L. Gu, XY. Lang, T. Fujita, M.W. Chen, et al., "Li Storage in 3D Nanoporous Au-Supported Nanocrystalline Tin," Advanced Materials, **23**, 2443 (2011)
196	H. Liu, S. Fujinami, D. Wang, K. Nakajima, T. Nishi, "Nanomechanical Mapping on the Deformed Poly(ε-caprolactone)", Macromolecules, **44**, 1779-1782 (2011)
197	H. Hojo, E. Tochigi, T. Mizoguchi, H. Ohta, N. Shibata, B. Feng, and Y. Ikuhara, "Atomic structure and strain field of threading dislocations in CeO(2) thin films on yttria-stabilized ZrO_2", Appl. Phys. Lett., **98**, 153104 (2011)
198	L. Gu, C. Zhu, H. Li, Y. Yu, C. Li, S. Tsukimoto, J. Maier, and Y. Ikuhara, "Direct Observation of Lithium Staging in Partially Delithiated $LiFePO_4$ at Atomic Resolution", J. Am. Chem. Soc., **133**, 4661-4663 (2011)

199	K. Iwaya, R. Shimizu, H. Aida, T. Hashizume, and T. Hitosugi, "Atomically resolved silicon donor states of β-Ga_2O_3", Appl. Phys. Lett. **98**, 142116 (2011)
200	N. Yamada, T. Shibata, K. Taira, Y. Hirose, S. Nakao, Ngoc Lam Huong Hoang, Taro Hitosugi, Toshihiro Shimada, Takayoshi Sasaki, and Tetsuya Hasegawa, "Enhanced carrier transport in uniaxially (001)-oriented anatase $Ti_{0.94}Nb_{0.06}O_2$ films grown on nanosheet seed layers", Appl. Phys. Express **4,** 045801 (2011)
201	N.Chen, H.A.Yang, A.Caron, P.C.Chen, Y.C.Lin, D.V.Louzguine-Luzgin, K.F.Yao, M.Esashi and A.Inoue, "Glass-forming Ability and Thermoplastic Formability of a $Pd_{40}Ni_{40}Si_4P_{16}$ Glassy Alloy", J. of Materials Sci., **46**, 2091-2096 (2011)
202	J.M. Pelletier, D.V. Louzguine-Luzgin, S. Li, A. Inoue, "Elastic and Viscoelastic Properties of Glassy, Quasicrystalline and Crystalline Phases in $Zr_{65}Cu_5Ni_{10}Al_{7.5}Pd_{12.5}$ Alloys", Acta Mater, **59**, 2797-2806 (2011)
203	A. Inoue, A. Takeuchi, "Recent Development and Application Products of Bulk Glassy Alloys", Acta. Mater., **59**, 2243-2267 (2011)
204	S. Gonzalez, N. Chen, Q.S. Zhang, D.V. Louzguine-Luzgin, J.H. Perepezko, A. Inoue, "Effect of Shear Bands Initiated in the Pre-Yield Region on the Deformation Behaviour of Zr-Based Metallic Glasses", Scripta. Mater., **64**, 713-716 (2011)
205	N. Chen, H.A. Yang, A. Caron, P.C. Chen, Y.C. Lin, D.V. Louzguine-Luzgin, K.F. Yao, M. Esashi, A. Inoue, "Glass-Forming Ability and Thermoplastic Formability of a $Pd_{40}Ni_{40}Si_4P_{16}$ Glassy Alloy", J. Mater. Sci., **46**, 2091-2096 (2011)
206	K. Ueno, S. Nakamura, H. Shimotani, H.T. Yuan, N. Kimura, T. Nojima, H. Aoki, Y. Iwasa and M. Kawasaki, "Discovery of superconductivity in $KTaO_3$ by electrostatic carrier doping", Nature Nanotechnology **6**, 408–412 (2011)
207	J. Zhang, H. Kumagai, K. Yamamura, S. Ohara, S. Takami, A. Morikawa, H. Shinjoh, K. Kaneko, T. Adschiri and A. Suda, "Extra-low-temperature oxygen storage capacity of CeO_2 nanocrystals with cubic facets", Nano Letters **11**, 361–364 (2011)
208	X. Lang, A. Hirata, T. Fujita and M.W. Chen, "Nanoporous metal/oxide hybrid electrodes for electrochemical supercapacitors", Nature Nanotechnonogy **6**, 232-236 (2011)
209	S. Mizukami, F. Wu, A. Sakuma, J. Walowski, D. Watanabe, T. Kubota, X. Zhang, H. Naganuma, M. Oogane, Y. Ando and T. Miyazaki, "Long-lived ultrafast spin precession in manganese alloys films with a large perpendicular magnetic anisotropy". Phys. Rev. Lett., **106**, 117201 (2011)

B. Invited Lectures, Plenary Addresses (etc.) at International Conferences and International Research Meetings
- List up to 10 main presentations during FY2011 in order from most recent.
- For each, write the lecturer/presenter's name, presentation title, conference name and date(s)

No.	Lecturer/presenter names and details
1	**Shigemi Mizukami** and T. Miyazaki (Invited talk), "Tetragonal Heusler-like alloy films with perpendicular magnetic anisotropy for spin torque applications", Spring Meeting in German Physical Society (DPG spring meeting), Berlin, Germany, March 29, 2012.
2	**Ken Nakajima** (Invited Talk), "Measurement Procedure of Elastic Modulus for Soft Materials by AFM", The 3rd International Symposium on SPM Standardization (SPM2012), Tsukuba, Japan, March 1-2, 2012.
3	**Masatsugu Shimomura** (Keynote presentation), "New trends in next generation biomimetics: Innovative paradigm shift based on biodiversity", 2012 International Symposium on Nature-Inspired Technology, Kangwon, Korea, January 9-11, 2012.
4	**Mingwei Chen** (Invited talk), "Metal/oxide hybrids with hierarchical nanoporosity for high-performance supercapacitors", 2011 MRS Fall Meeting, Boston, USA, November 28 - December 1, 2011.
5	**Tomokazu Matsue** (Keynote presentation),"Highly-Sensitive Electrochemical Imaging for Biosensing", US-Japan Workshop on Bio-Inspired Engineering of Next-Generation Sensors and Actuators, San Francisco, USA, November 12-13, 2011.
6	**Yuichi Ikuhara** (Plenary lecture), "HAADF and ABF STEM Characterization of Ceramic Interfaces", TEM Workshop Electron Microscopy, Exploring Materials on the Atomic Scale, TU Darmstadt, October 10, 2011.
7	**Dmitry V. Louzguine-Luzgin**, K. Georgarakis, J. Antonowicz, G. Vaughan, A.R. Yavari, T. Egami, A. Inoue (Keynote presentation), "Changes in Atomic Structure of Supercooled Pd-Ni-Cu-P Glassforming Liquid during in-situ Vitrification on Cooling Established by Synchrotronradiation X-ray Diffraction", Euromat 2011, Montpellier, France, September 12-15, 2011.
8	**Masayoshi Esashi** (Invited talk), "MEMS for Practical Applications by Open Collaboration", JCK MEMS/NEMS 2011, Jeju Island, Korea, September 5, 2011.
9	**Yoshinori Yamamoto** (Plenary lecture), "From Molecular Catalysts to Nano-structured Materials Skeleton Catalysts", 16th IUPAC International Symposium on Organometallic Chemistry Directed Towards Organic Synthesis (16th OMCOS) 2011, Shanghai, China, July 24, 2011.
10	**Tadafumi Adschiri** (Keynote presentation) "Supercritical Route for Super Hybrid Nanomaterials" , International Conference on Materials for Advanced Technologies (ICMAT 2011), Singapore, June 27 - July1, 2011.

C. Major Awards
- List up to 10 main awards received during FY2011 in order from the most recent.
- For each, write the recipient's name, name of award, and year issued.
- In case of multiple recipients, underline those affiliated with the center.

No.	Recipient names and details
1	**Seigo Souma**, Award for the Encouragement of Young Physicists, The Physical Society of Japan, 2012.
2	**Ali Khademhosseini**, AIMBE's College of Fellows, 2012
3	**Ali Khademhosseini**, the 2012 Biotechnology and Bioengineering Daniel I.C. Wang Award recipient, 2011.
4	**Yuichi Ikuhara**, Fellow, The American Ceramic Society, 2011.
5	**Ali Khademhosseini**, Presidential Early Career Award for Scientists and Engineers (PECASE), 2011.
6	**Ali Khademhosseini**, Early Career Award in Nanotechnology, The IEEE Nanotechnology Council (NTC), 2011.
7	**Alain Reza Yavari**, Award for Scientific Excellence, French National Center for Scientific Research (CNRS), 2011.
8	**Kingo Itaya**, The Prix Jacques Tacussel Award of the International Society of Electrochemistry, 2011.
9	**Masayoshi Esashi**, Outstanding Paper Award, Transducers'11, 2011.
10	**Mingwei Chen**, The 2011 Distinguished Award, The 8th International Workshop on Intermetallic and Advanced Materials, China, 2011.

FY 2011 List of Principal Investigators

NOTE:
・Underline names of investigators who belong to an overseas research institution. Place an asterisk (*) by names of investigators considered to be ranked among world's top researchers.
・In case of researchers not listed in initial plan or the latest report, attach "Biographical Sketch of a New Principal Investigator".

<Results at the end of FY2011>

Principal Investigators Total: 32

Name (Age)	Affiliation (Position title, department, organization)	Academic degree, specialty	Working hours (Total working hours: 100%)				Starting date of project participation	Status of project participation (Describe in concrete terms)	Contributions by PIs from overseas research institutions
			Work on center project		Others				
			Research activities	Other activities	Research activities	Other activities			
Center Director Yoshinori Yamamoto*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Chemistry Organic Chemistry, Organic Synthesis, Catalytic Reactions	40%	50%	10%	0%	Director: From start PI: From 2009	Usually stays at the center	
Deputy Director Motoko Kotani*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Mathematics (Geometry)	60%	20%	0%	20%	Deputy Director: From May 2011 PI: From March 2011	Usually stays at the center	
Tadafumi Adschiri*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Hybrid materials, Super-critical Fluid Technology	80%	0%	0%	20%	From start	Usually stays at the center	

Kingo Itaya*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Electro-chemistry of Nano-Materials, Solid: Liquid Interface with atomic resolution	80%	0%	0%	20%	From start	Usually stays at the center	
Masayoshi Esashi*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Sensors, Micro Electro Mechanical Systems	80%	0%	0%	20%	From start	Usually stays at the center	
Kazue Kurihara *	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Physical Chemistry Colloid and Interface Science	80%	0%	0%	20%	From Apr. 2010	Usually stays at the center	
Masatsugu Shimomura*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Polymer Science	80%	0%	0%	20%	From start	Usually stays at the center	
Takashi Takahashi*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Solid-State Physics	80%	0%	0%	20%	From start	Usually stays at the center	
Katsumi Tanigaki*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Nano Materials Science	80%	0%	0%	20%	From start	Usually stays at the center	

Mingwei Chen*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Materials Science	100%	0%	0%	0%	From start	Usually stays at the center	
Michio Tokuyama*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Statistical Physics	80%	0%	0%	20%	From start	Usually stays at the center	
Tomokazu Matsue*	Professor, WPI-AIMR Tohoku University	Dr. of Pharmacy/ Biosensing Engineering	80%	0%	0%	20%	From Nov. 2010	Usually stays at the center	
Terunobu Miyazaki*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Magnetic Properties	100%	0%	0%	0%	From start	Usually stays at the center	
Masahiko Yamaguchi *	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Organic Chemistry	80%	0%	0%	20%	From start	Usually stays at the center	
Kazuyoshi Yamada*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Solid-State Physics	80%	0%	0%	20%	From start	Usually stays at the center	
Dmitri V. Louzguine*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Materials Science	100%	0%	0%	0%	Professor: From Dec. 2007 PI: From 2009	Usually stays at the center	

Masaru Tsukada*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Theory of Surface and Nano-Structures	100%	0%	0%	0%	From start	Usually stays at the center	
Toshio Nishi*	Professor, WPI-AIMR Tohoku University	Dr. of Engineering/ Materials Science	100%	0%	0%	0%	From start	Usually stays at the center	
Yasumasa Nishiura*	Professor, WPI-AIMR Tohoku University	Dr. of Science/ Applied Mathematics (Nonliner Dynamics)	100%	0%	0%	0%	From Feb. 2012	Usually stays at the center	
Yuichi Ikuhara*	Professor, School of Engineering, University of Tokyo	Dr. of Engineering/ Physical Metallurgy	40%	0%	40%	20%	From start	Stays at the center every two weeks	
Alain Reza Yavari*	Professor, Grenoble Institute of Technology	PhD/ Physical Metallurgry	30%	0%	45%	25%	From start	Stays at the center several times Attends the conference Sends some young scientists to the center	send young scientists to the WPI center (1/3months) (2/2months each)
Thomas P. Russell*	Professor Department of Polymer Science and Technology, University of Masachu-Setts Amharst	PhD/ Nano-Science Technology	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	send young scientist to the WPI center (1/1month)
Thomas Gessner*	Professor, Center for Micro-technologies, Chemnitz University of Technology	PhD/ Device Science/ Technology	30%	0%	50%	20%	From start	Stays at the center twice a year Attends the conference Sends some young scientists to the center Presentation of his research in AIMResearch 2011	send young scientists to the WPI center (1/2years) (1/8months) (2/6months each)

									(2/3months each) (1/1month)
Alexander Shluger*	Professor, Department of Physics and Astronomy, University College London	PhD/ Compu-tational Materials Science, Condensed Matter Physics	35%	0%	40%	25%	From start	Stays at the center several times (one month in total) a year Attends the conference Sends some young scientists to the center	send young scientists to the WPI center (1/8months) (1/5months) (1/2months)
Alain Lindsay Greer*	Professor, Department of Materials Science & Metallurgy, University of Cambridge	PhD/ Metallurgy & Materials Science	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	send young scientist to the WPI center (1/9months)
Li-Jun Wan*	Professor, Institute of Chemistry, Chinese Academy of Science	PhD/ SPM, Physical Chemistry, Nano-science and technology	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	send young scientist to the WPI center (1/9months)
Paul S. Weiss*	Professor, Department of Chemistry and Biochemistry, University of California, Los Angeles	PhD/ Surface Science	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	plan to send young scientist to the WPI center
Kevin J. Hemker*	Professor, Department of Mechanical Engineering, Johns Hopkins University	PhD/ Physical Metallurgy	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	plan to send young scientist to the WPI center
Qi Kun Xue*	Professor, Department of Physics, Tsinghua University	PhD/ Surface Science	20%	0%	45%	35%	From start	Attends the conference Sends the young scientist to the center	send young scientist to the WPI center (1/8months)

Winfried Teizer*	Associate Professor, Department of Physics, Texas A&M University	PhD/ Physics	35%	0%	40%	25%	From Nov. 2009	Stays at the center several times (over four months in total) a year Joins a videoconference from the home institution (Texas A&M Univ) once a week Presentation of his research in WPI-AIMR NEWS	send young scientists to the WPI center (3/1year each)
Hongkai Wu*	Assistant Professor, Department of Chemistry, Hong Kong University of Science and Technology	PhD/ Chemistry	35%	0%	45%	20%	From Nov. 2009	Stays at the center several times Joins a videoconference from the home institution (Hong Kong Univ) once a week Presentation of his research in WPI-AIMR NEWS	send young scientists to the WPI center (3/1year each) (1/6months)
Ali Khademhosseini *	Associate Professor, Medical School, Harvard University	PhD/ Bio-engineering	35%	0%	45%	20%	From Nov. 2009	Stays at the center several times Joins a videoconference from the home institution (Harvard Univ) once a week Presentation of his research in WPI-AIMR NEWS	send young scientists to the WPI center (2/1year each) (1/10months) (1/7months)

Researchers unable to participate in project in FY 2011

Name	Affiliation (Position title, department, organization)	Starting date of project participation	Reasons	Measures taken
Tadahiro Ohmi	Researcher, New Industry Creation Hatchery Center, Tohoku University	From start	To concentrate on the research at NICHe, Tohoku University	
Masahi Kawasaki	Professor, School of Engineering, the University of Tokyo	From start	To concentrate on the research at the University of Tokyo	

Records of FY2011 Center Activities

1. Researchers and center staffs, satellites, partner institutions

1-1. Number of researchers in the "core" established within the host institution

- Enter the total number of people in the columns below. In the "Researchers" column, put the number and percentage of overseas researchers in the < > brackets and the number and percentage of female researchers in the [ ] brackets.
- In the "Administrative staffs" column, put the number and percentage of bilingual staffs in the ( ) brackets.
- In the "Final Goal" column, enter the currently projected goal and the estimated date for achieving it [OO month, OO year].

	Goal set in the "Post-interim evaluation revised center project"	Results at end of FY 2011	Final goal (March, 2017)
Researchers	146 < 73, 50%> [22, 15%]	131 < 63, 48%> [11, 8%]	146 < 73, 50%> [22, 15%]
Principal investigators	33 < 12, 36%> [2, 6%]	32 < 14, 44%> [2, 6%]	33 < 12, 36%> [2, 6%]
Other researchers	113 < 59, 52%> [20, 18%]	99 < 49, 49%> [9, 9%]	113 < 59, 52%> [20, 18%]
Research support staffs	50	43	50
Administrative staffs	24	24 (22, 92%)	24 (22, 92%)
Total	220	198	220

Other matters of special mention

- Enter matters warranting special mention, such as concrete plans for achieving the Center's goals, established schedules for employing main researchers, particularly principal investigators.
- As background to how the Center is working to mobilize/circulate the world's best brains, give good examples, if any, of how career paths are being established for the Center's researchers; that is, from which top-world research institutions do researchers come to the Center and to which research institutions do the Center's researchers go, and how long are their stays at those institutions.

"GI^3 (Global Intellectual Incubation and Integration) Laboratory" was inaugurated in FY2009 to motivate prominent researchers (including graduate students) to converge on AIMR from all over the world. The laboratory is designed to become a center of the brain circulation where researchers specializing in materials science can undertake internationally collaborative and fusion research activities. The GI^3 system has led to active exchange with researchers from countries all over the world.

The number of researchers who visited AIMR in FY2011 within the framework of GI^3 was 3 senior researchers (professors and associate professors) and 6 young researchers (assistant professors, post-docs, and graduate students).

The following are examples of prominent researchers studying on a full-time basis who are part of the global brain circulation of researchers.

No	Position at AIMR	Length at AIMR	Former affiliation	Affiliation after AIMR
1	Postdoc	1 year	Postdoc, Univ. of Hyogo (JPN)	(remain at AIMR)
2	Assist. Prof.	1 year	Assist. Prof., Kyoto Univ. (JPN)	(remain at AIMR)
3	Postdoc	1 year	Postdoc, WPI-MANA (JPN)	(remain at AIMR)
4	Postdoc	1 year	Postdoc, Osaka Univ. (JPN)	(remain at AIMR)
5	Postdoc	6 months	Postdoctoral Fellowship for Research Abroad, JSPS (JPN)	(remain at AIMR)
6	Postdoc	5 months	Senior Researcher, Moscow State Inst. of Steel and Alloys (RUS)	(remain at AIMR)
7	Assist. Prof.	3.5 months	Research Fellow, Kyoto Univ. (JPN)	(remain at AIMR)
8	Prof. (PI)	2 months	Professor, Hokkaido Univ. (JPN)	(remain at AIMR)
9	Assist. Prof.	2 months	PhD. Student, Kyoto Univ. (JPN)	(remain at AIMR)
10	Postdoc	2 months	Postdoctoral Research Fellow, McMaster Univ., (CAN)	(remain at AIMR)
11	Assist. Prof.	1 year and 7 months	Postdoc, Univ. of California, Santa Barbara (USA)	Professor, Leader of Junior Research Group, Asia Pacific Center for Theoretical Physics (KOR)
12	Assist. Prof.	1 year and 8 months	JSPS Postdoctoral Fellowship for Foreign Researchers (JPN)	Professor, Jilin Univ. (CHN)
13	Assist. Prof.	2 years and 9.5 months	Postdoc, The Univ. of Utah (USA)	Principle Investigator, Assoc. Professor, Peking Univ. (CHN)
14	Assist. Prof.	2 years and 8 months	Researcher, University College London (GBR)	Lecturer, The Univ. of York (GBR)
15	Assist. Prof.	2 years and 10 months	Researcher, University College London (GBR)	Senior Research Fellow, The Univ. of Sussex (GBR)
16	Postdoc	2 years and 2 months	Postdoc, Tohoku Univ. (JPN)	Research Scientist, Inst. of Microelectronics (SGP)
17	Assist. Prof.	3 years and 8 months	Specially Appointed Assist. Prof., Osaka Univ. (JPN)	Associate Professor, Inst. of Physics, Chinese Academy of Sciences (CHN)

18	Postdoc	3 years and 5 months	Researcher, Intl. Advanced Research Center for Power Metallurgy and New Materials (IND)	Scientist, Natl. Metallurgical Lab. (IND)
19	Assist. Prof.	1 year and 4 months	Assist. Prof., Temple Univ. (USA)	Assist. Professor, Univ. of Georgia (USA)
20	Assist. Prof.	2 year and 2 months	Researcher, RIKEN (JPN)	Specially Appointed Assist. Professor, Nagoya Institute of Technology (JPN)
21	Assist. Prof.	4 years	Specially Appointed Assist. Prof., Osaka Univ. (JPN)	Specially Appointed Lecturer, Osaka Prefecture Univ. (JPN)
22	Postdoc	2 years and 2.5 months	Researcher, Tohoku Univ. (JPN)	JSPS Postdoctoral Fellowship for Foreign Researchers (JPN)
23	Postdoc	2 years and 2.5 months	Researcher, Kyushu Univ. (JPN)	Specially Appointed Assist. Prof., Kyushu Univ. (JPN)
24	Assist. Prof.	1 year	Researcher, Tohoku Univ. (JPN)	Assoc. Research Scientist, Yale Univ. (USA)
25	Postdoc	1 year	PhD. Student, The Univ. of Tokyo (JPN)	Research Fellowships for Young Scientists, JSPS (JPN)
26	Postdoc	6 months	PhD. Student, Hong Kong Univ. of Sci. & Tech.	Assoc. Professor, Sun Yat-sen Univ. (CHN)

1-2. Satellites and partner institutions

- List the satellite and partner institutions in the table below.
- Indicate newly added and deleted institutions in the "Notes" column.
- If satellite institutions have been established, describe by satellite the Center's achievements in coauthored papers and researcher exchanges in Appendix 4.

<Satellite institutions>

Institution name	Principal Investigator(s), if any	Notes
University of Cambridge	Alan Lindsay Greer Bill Jones	Principal Investigator Adjunct professor
Institute of Chemistry, Chinese Academy of Sciences	Li-Jun Wan	Principal Investigator
University of California, Santa Barbara	Fred Wudl	Adjunct professor

< Partner institutions>

Institution name	Principal Investigator(s), if any	Notes
University of Wisconsin-Madison	John H. Perepezko	Adjunct professor
Grenoble Institute of Technology	Alain Reza Yavari	Principal Investigator
University of Massachusetts Amherst	Thomas P. Russell	Principal Investigator
Chemnitz University of Technology	Thomas Gessner	Principal Investigator
University College London	Alexander Shluger Peter Sushko	Principal Investigator Adjunct professor
University of California, Los Angeles	Paul S. Weiss	Principal Investigator
Johns Hopkins University	Kevin J. Hemker	Principal Investigator
Tsinghua University	Qi-Kun Xue	Principal Investigator
Texas A&M University	Winfried Teizer	Principal Investigator
Harvard Medical School	Ali Khademhosseini	Principal Investigator
Hong Kong University of Science & Technology	Hongkai Wu	Principal Investigator
The University of Tokyo	Yuichi Ikuhara	Principal Investigator

2. Securing competitive research funding

- Competitive and other research funding secured in FY2011:

Total: 2,810,000,000 yen

- Describe external funding warranting special mention. Include the name and total amount of each grant.

Name of Project	Chief Researcher	Total Amount (JPY)	Project Period
Creation of Innovation Center for Advanced Interdisciplinary Research Areas (JST)	Prof. Masayoshi Esashi (PI)	576,403,307	April 1, 2007 ~ March 31, 2016
Fund for World-Leading Innovative R&D on Science and Technology (FIRST Program) (JSPS)	Prof. Masayoshi Esashi (PI)	432,529,405	March 10, 2010 ~ March 31, 2014
Technological Development of Ultra-hybrid Materials (Technological Development of Contradictory Functional Materials by Nano-scale Structure Control) (NEDO)	Prof. Tadafumi Adschiri (PI)	202,255,000	April 10, 2008 ~ February 29, 2012
Green Tribology Innovation Network (MEXT)	Prof. Kazue Kurihara (PI)	191,818,673	December 6, 2011 ~ March 31, 2012
Center for Fusion Research of Nano Interface Devices (MEXT)	Prof. Kazue Kurihara (PI)	153,961,500	June 14, 2010 ~ May 31, 2011
Core Research for Evolutional Science and Technology (CREST) (JST)	Prof. Kazue Kurihara (PI)	78,378,862	April 1, 2008 ~ March 31, 2012
Grant-in-Aid for Scientific Research: Specially Promoted Research (JSPS)	Prof. Takashi Takahashi (PI)	72,410,000	April 1, 2011 ~ March 31, 2015
Core Research for Evolutional Science and Technology (CREST) (JST)	Prof. Motoko Kotani (PI)	44,956,709	October 1, 2008 ~ March 31, 2014

3. International research conferences or symposiums held to bring world's leading researchers together

- Indicate the number of international research conferences or symposiums held in FY2011 and give up to three examples of the most representative ones using the table below.

FY 2011: 3 meetings

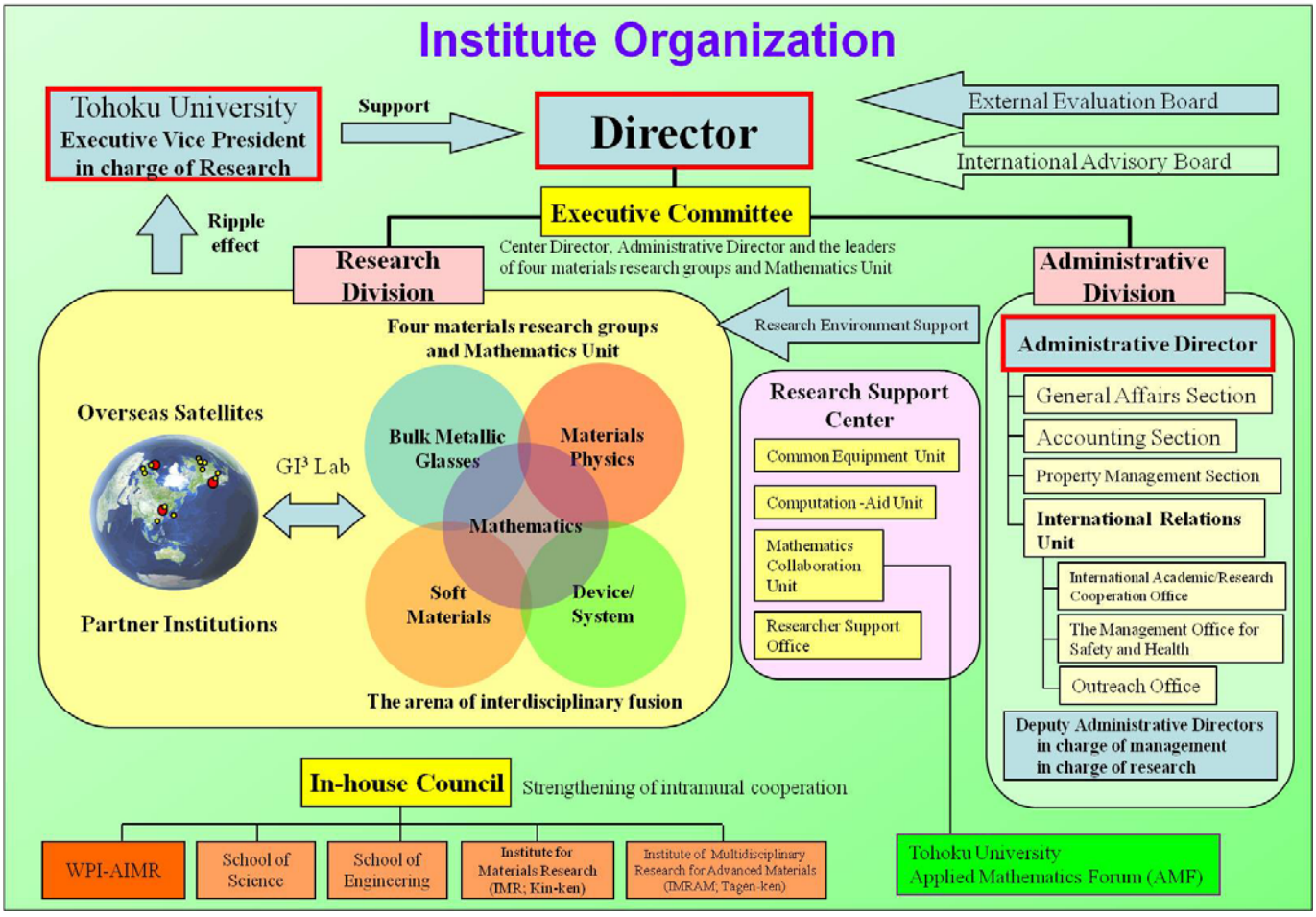
Major examples (meeting title and place held)	Number of participants
The 2012 WPI-AIMR Annual Workshop (Sendai, Miyagi, Japan)	From domestic institutions: 225 From overseas institutions: 42
UCSB ICMR/CNSI and Tohoku University WPI-AIMR Joint Workshop on Materials Research (Santa Barbara, California, U.S.A)	From domestic institutions: 14 From overseas institutions: 20
WPI-AIMR Cambridge Symposium (Cambridge, UK)	From domestic institutions: 9 From overseas institutions: 7

4. Center's management system

- Please diagram management system in an easily understood manner.
- If any changes have been made in the management system from that in the"Post-interim evaluation revised center project," please describe them. Please describe any changes made in the administrative director, head of host institution, and officer(s) in charge at the host institution (e.g., executive vice president for research)

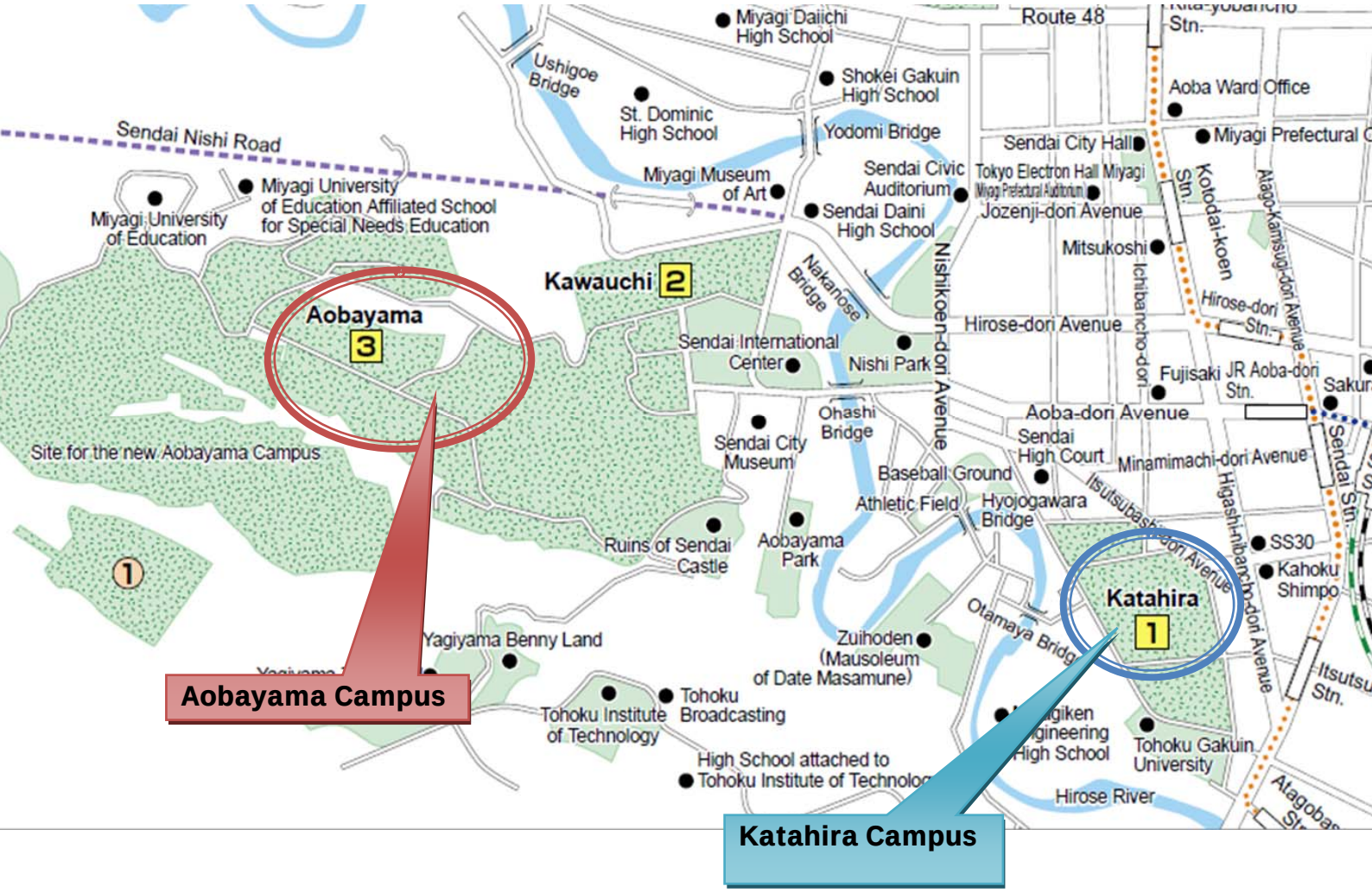
There are some changes in the management system from that in the "Post-interim evaluation revised center project" as follows:

Position	Name	Predecessor
Head of host institution	Prof. Susumu Satomi	Dr. Akihisa Inoue
Executive Vice President in charge of Research	Prof. Sadayoshi Ito	Prof. Toshio Iijima
Director of AIMR	Prof. Motoko Kotani	Prof. Yoshinori Yamamoto
Administrative Director of AIMR	Dr. Masaru Tsukada	Mr. Wataru Iwamoto



5. Campus Map

- Please draw a simple map of the campus showing where the main office and principle investigator(s) are located.

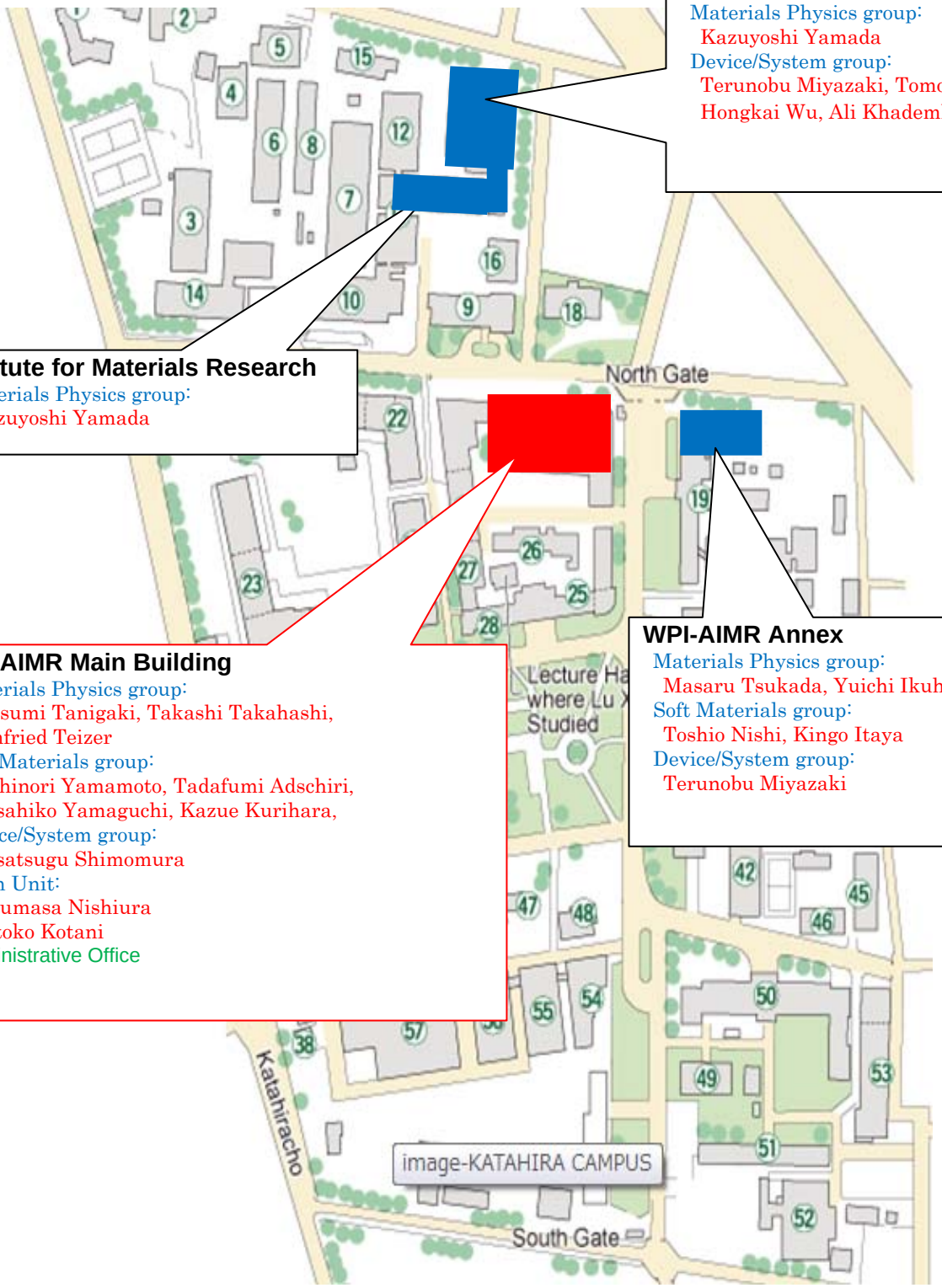


Note: It takes about 15 minutes from Katahira to Aobayama by car.

【Katahira Campus】

WPI-AIMR Laboratory Building
Bulk Metallic Glasses group:
Mingwei Chen, Michio Tokuyama,
Dmitri Louzguine
Materials Physics group:
Kazuyoshi Yamada
Device/System group:
Terunobu Miyazaki, Tomokazu Matsue
Hongkai Wu, Ali Khademhosseini,

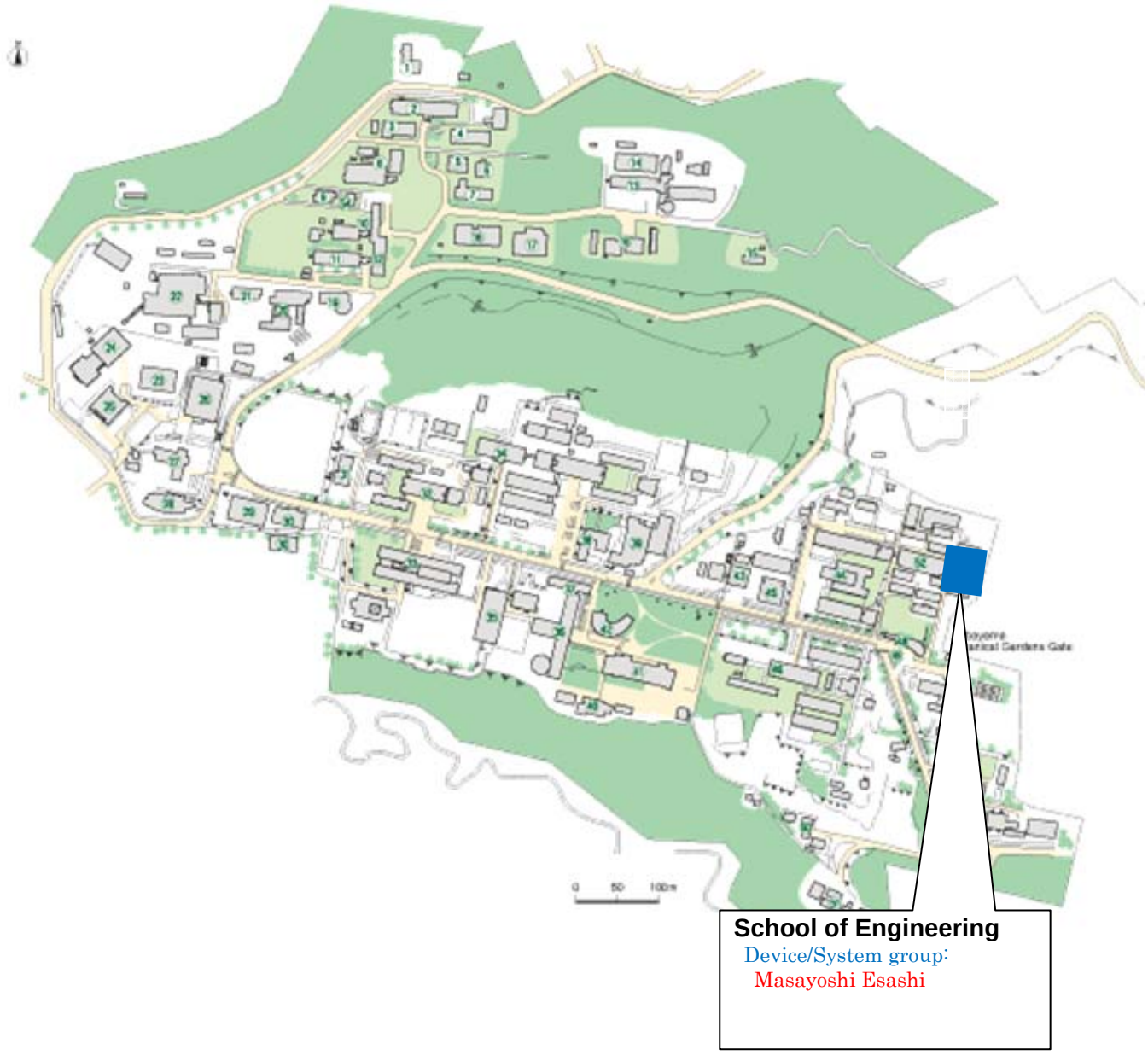
Institute for Materials Research
Materials Physics group:
Kazuyoshi Yamada



WPI-AIMR Annex
Materials Physics group:
Masaru Tsukada, Yuichi Ikuhara
Soft Materials group:
Toshio Nishi, Kingo Itaya
Device/System group:
Terunobu Miyazaki

WPI-AIMR Main Building
Materials Physics group:
Katsumi Tanigaki, Takashi Takahashi,
Winfried Teizer
Soft Materials group:
Yoshinori Yamamoto, Tadafumi Adschiri,
Masahiko Yamaguchi, Kazue Kurihara,
Device/System group:
Masatsugu Shimomura
Math Unit:
Yasumasa Nishiura
Motoko Kotani
Administrative Office

【Aobayama Campus】



6. FY2011 Project Expenditures (the exchange rate used: 1USD= 80 JPY)

i) Overall project funding

Cost Items	Details	Costs (10,000 dollars)
Personnel	Center director and Administrative director	33
	Principal investigators (no. of persons):19	247
	Other researchers (no. of persons):83	560
	Research support staffs (no. of persons):17	58
	Administrative staffs (no. of persons):25	122
	Total	1,020
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):10	17
	Cost of dispatching scientists (no. of persons):0	0
	Research startup cost (no. of persons):29	93
	Cost of satellite organizations (no. of satellite organizations):0	0
	Cost of international symposiums (no. of symposiums):1	22
	Rental fees for facilities	0
	Cost of consumables	22
	Cost of utilities	47
	Other costs	436
	Total	637
Travel	Domestic travel costs	3
	Overseas travel costs	8
	Travel and accommodations cost for invited scientists (no. of domestic scientists):42 (no. of overseas scientists):19	8
	Travel cost for scientists on secondment (no. of domestic scientists):4 (no. of overseas scientists):0	1
	Total	20
Equipment	Depreciation of buildings	188
	Depreciation of equipment	1,152
	Total	1,340
Other research projects	Projects supported by other government subsidies, etc.	0
	Commissioned research projects, etc.	1,751
	Grants-in-Aid for Scientific Research, etc.	392
	Total	2,143
Total		5,160

Ten thousand dollars

WPI grant	1,630
Costs of establishing and maintaining facilities	2,350
Establishing new facilities (Number of facilities: , 9,000 m²) Costs paid:	2,350
Repairing facilities (Number of facilities: , m²) Costs paid:	
Others	
Cost of equipment procured	1,563
Sum-Frequency Generation Vibrational Spectrometer Number of units: 1 Costs paid:	101
Nano-particles Production Apparatus Number of units: 1 Costs paid:	100
Scanning Near-field Raman Spectrometer Number of units: 1 Costs paid:	74
Neutral Beam Etching Apparatus Number of units: 1 Costs paid:	74
DLC Neutral Beam CVD Apparatus Number of units: 1 Costs paid:	60
High-frequency Leser Measurement System Number of units: 1 Costs paid:	32
Microfocus X-ray CT Number of units: 1 Costs paid:	33
Scannning Electron Microscope for 6 inch wefer Number of units: 1 Costs paid:	31
Atomic Layer Deposition Apparatus Number of units: 1 Costs paid:	29
Electrostatic Patterning Apparatus Number of units: 1 Costs paid:	18
Others	1,011

ii) Costs of Satellites and Partner institutions

Cost Items	Details	Costs (10,000 dollars)
Personnel	Principal investigators (no. of persons):1	
	Other researchers (no. of persons):19	
	Research support staffs (no. of persons):0	
	Administrative staffs (no. of persons):0	
	Total	98
Project activities		15
Travel		15
Equipment		0
Other research projects		0
Total		128

Status of Collaboration with Overseas Satellites

1. Coauthored Papers

- List the refereed papers published in FY2011 that were coauthored between the center's researcher(s) in domestic institution(s) and overseas satellite institution(s). List them by overseas satellite institution in the below blocks.
- Transcribe data in same format as in Appendix 1. Italicize the names of authors affiliated with overseas satellite institutions.
- For reference write the Appendix 1 item number in parentheses after the item number in the blocks below.

Overseas Satellite 1: University of Cambridge (Total: 2 papers)

No.	Author names and details
1-1 (78)	Y. Takahashi, A. I. Shevchuk, P.l Novak, Y. Zhang, N. Ebejer, J. V. Macpherson, P. R. Unwin, A. J. Pollard, D. Roy, C. A. Clifford, H. Shiku, T. Matsue, *D. Klenerman*, Y. E. Korchev, "Multifunctional Nanoprobes for Nanoscale Chemical Imaging and Localized Chemical Delivery at Surfaces and Interfaces", Angew. Chem. Int. Ed., **50**, 9638-9642 (2011)
1-2 (82)	S.V. Madge, P. Sharma, D.V. Louzguine-Luzgin, *A.L. Greer*, A. Inoue, "Mechanical Behaviour of Zr-La-Cu-Ni-Al Glass-Based Composites", Intermetallics, **19**, 1474-1478 (2011)

Overseas Satellite 2: Institute of Chemistry, Chinese Academy of Sciences (Total: 1 paper)

No.	Author names and details
2-1 (152)	S.-I. Kobayashi, Y.-G. Kim, *R. Wen,* K. Yasuda, H. Fukidome, T. Suwa, R. Kuroda, X. Li, A. Teramoto, T. Ohmi, K. Itaya, "Visualization of single atom ic steps on an ultra -flat Si(100) surface by advanced differential interference contrast microscopy", Electrochemical and Solid-State Lett., **14**, H351-H353 (2011)

2. Status of Researcher Exchanges

- Using the below tables, indicate the number and length of researcher exchanges in FY2011. Enter by institution and length of exchange.
- Write the number of principal investigator visits in the top of each space and the number of other researchers in the bottom.

Overseas Satellite 1: University of Cambridge

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011	5				5
	4				4
Total	5				5
	4				4

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011	1				1
	3		1	1	5
Total	1				1
	3		1	1	5

Overseas Satellite 2: Institute of Chemistry, Chinese Academy of Sciences

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011	2				2
	1				1
Total	2				2
	1				1

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011	1				1
	2			1	3
Total	1				1
	2			1	3

Overseas Satellite 3: University of California, Santa Barbara

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011	6				6
	8				8
Total	6				6
	8				8

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2011					0
	2				2
Total					0
	2				2

FY 2011 Visit Records of World Top-caliber Researchers from Abroad

Researchers Total: 87

Name	Current affiliation (Position title, department, organization)	Academic degree, specialty	Record of research activities (Awards record, etc.)	Time, duration	Summary of activities during stay at center (e.g., participation as principal investigator; short-term stay for joint research; participation in symposium)
Alexander Shluger	University College London (Professor)	PhD Computational Materials Science		May21, 2011 -May 28, 2011 Oct 11, 2011 -Oct 23, 2011 Mar 25, 2012 -Apr 4, 2012	Participation as Principle Investigator
Winfried Teizer	Texas A&M University (Associate Professor)	PhD Physics Biophysics	Diploma ("Abitur")-Prize of the German Chemical Industry (1989) Exchange Fellowship: Massachusetts, USA−Baden-Württemberg, Germany (1992-1993) Montague/Center for Teaching Excellence Scholar, Texas A&M University (2004)	May 26, 2011 -Sep 1, 2011 Oct 6, 2011 -Oct 19, 2011 Nov 9, 2011 -Nov 21, 2011 Jan 5, 2012 -Jan15, 2012,	Participation as Principle Investigator
Alain Reza Yavari	Institut Polytechnique de Grenoble (Professor)	PhD Materials Science	CNRS（Centre national de la recherche scientifique）top ranked researcher Ph.D. in Applied Physics, Harvard University, USA (1980) Habilitation Diploma, INP de Grenoble, France (1987)	Jun 5, 2011 -Jun 14, 2011 Oct 14, 2011 -Nov 8, 2011 Feb 19, 2012 -Mar 19, 2012	Participation as Principle Investigator Participation in the 2012 WPI-AIMR Annual Workshop as PI

Albert Pisano	University of California, Berkley (Professor)	PhD Mechanical Engineering		Jul 1, 2011 -Dec 10, 2011	Stay for joint research
Xiaojuan Liu	Changchun institute of applied chemistry, Chinese Academy of Sciences (Assoc. Prof.)			Aug 6, 2011 -Aug 30, 2011	Stay for joint research Supported by JSPS
Hongkai Wu	Hong Kong University of Science and Technology (Assistant Professor)	PhD Chemistry	Tsinghua University "Hundred Talents" award (2005) Li Foundation Heritage Prize (2006-2007) DuPont Young Professor Award (2007-2010)	Aug 9, 2011 -Aug 12, 2011 Feb 17, 2012 -Feb 24, 2012	Participation as Principle Investigator Participation in the 2012 WPI-AIMR Annual Workshop and giving a talk as PI
Richmond Sarpong	UC Berkeley (Assoc. Professor, Department of Chemistry)	PhD Organic Chemistry	SSOCJ Lectureship award	Aug 2011	Short-term stay for participation in a symposium
F. Dean Toste	UC Berkeley(Professor, Department of Chemistry)	PhD Organic Chemistry	Mukaiyama award	Aug 2011	Short-term stay for participation in a symposium
Frank Uwe Renner	Max-Planck-Institute for Iron Research (Research Group Leader)			Sep 18, 2011 -Sep 20, 2011	Short-term stay for giving a talk at a group seminar and exchange research information
Calum J. Drummond	The Commonwealth Scientific and Industrial Research Organization (CSIRO) Materials Science and Engineering Chief	PhD	Physical Chemistry Division Medal, Royal Australian Chemical Institute	Sep 5, 2011 -Sep 6, 2011	Short-term stay for participation in Lecture Series on Surface Forces 11 and discussion

Denis Acron	Institute of Jozef Stefan, Slovenia, Professor	PhD	Japan-Slovenia International Collaborations (MEXT 2012-2014)	Nov 22, 2011 -Nov27, 2011	Short-term stay for discussion for joint research, Collaboration of Phonon PDOS and participation in a symposium
Taner Yildrimu	University of Pennsylvania (Professor)	PhD		Nov 22, 2011 -Nov27, 2011	Short-term stay for discussion for joint research, Collaboration of Phonon PDOS and participation in a symposium
Jone S. Tse	University of Saskatchewan (Professor)	PhD		Nov 22, 2011 -Nov27, 2011	Short-term stay for discussion for joint research, Collaboration of Phonon PDOS and participation in a symposium
Bo Iversen	Aarhus University (Professor)	PhD		Nov 23, 2011 -Nov 25, 2011	Short-term stay for participation in a symposium
Palobo Esquinazi	University of Leipzig(Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Richar M. Laine	University of Michigan (Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Masssimo Capone	University of Sapienza (Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Herald Hillebrecht	Albert-Ludwigs-University (Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Naurang L. Saini	University of Rome (Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Zi Kang Tang	Hong Kong University (Professor)	PhD		Nov 23, 2011 -Nov 26, 2011	Short-term stay for participation in a symposium
Burkard Hillebrands	Technische Universitaet Kaiserslautern (Professor, Vice President of Univ.)	PhD Spin dynamics	IEEE Magnetic Society Distinguished Lecturer Award 2005, and so on.	Nov 24, 2011 -Nov 25, 2011	Short-term stay for participation in a workshop as a research collaborator

Claudia Felser	Max Plank Institute, Dresden and Johannes Gutenberg University Mainz (Proffer)	PhD Electric structure calculation	IEEE Magnetics Society, Distinguished Lecturerr Award 2010, and so on.	Nov 24, 2011 -Nov 25, 2011	Short-term stay for participation in a workshop as a research collaborator
David Chen	Seoul National University (Professor, Department of Chemistry)	PhD Organic Chemistry		Nov 2011	Short-term stay for participation in a symposium
Zhaobin Qiu	Beijing University of Chemical Technology (Professor)			Dec 13, 2011 -Dec 14, 2011	Short-term stay for a discussion for joint research
Bill Jones	University of Cambridge (Professor)	Ph.D		Jan 16, 2012 -Jan 18, 2012	Short-term stay for discussion about the future research plan for a satellite at the University of Cambridge
Xinghua Xue	Hainan University (Professor)	Doctor		Jan 17, 2012 -Feb 29, 2012	Stay for joint research
Xu Bingshe	Taiyuan University of Technology (Vice President)			Jan 27, 2012- Jan 29, 2012	Short-term stay for BMG joint research
Zhang Di	Shanghai Jiao Tong University (Professor)			Feb 2, 2012 - Mar 3, 2012	stay for joint research
Andrew Copestake	Swedish Biomimetics 3000 (Chief Executive Officer)			Feb 3, 2012 -Feb 9, 2012	Short-term stay for join a workshop and speech at Biomimetics
Michel Laguerre	IECB-CBMN (Project reader)			Feb 4, 2012 -Feb 12, 2012	Short-term stay for join a workshop and speech at Biomimetics

Mac Dinh Hung	University of Science, VNU (Lecturer)	PhD Organic synthesis		Feb 4, 2012 -May 1, 2012	stay for joint research
Nicholas D. Spencer	Swiss Federal Institute of Technology	PhD, tribology, biointerfaces, surface modification, surface forces	President of the ETH Research Committee	Feb 5, 2012 -Feb 7, 2012	Short-term stay for participation in Lecture Series on Surface Forces 11 and discussion
Daniel Miracle	Materials and Manufacturing Directorate	Dr. Materials Science	1999 Fellow, American Society for Metals, International	Feb 9, 2012 -Mar 9, 2012	Stay for joint research
Chun Liu	Penn State University Department of Mathematics Professor			Feb 17, 2012 -Feb 22, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Pavel Exner	Czech Academy of Sciences	CSc. (a PhD equivalent)		Feb 17, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Carlos Garcia -Cervera	University of California, Santa Barbara (Professor)	PhD, Mathematics	•Faculty Early Career Development Award (CAREER) from the National Science Foundation, 2007-2012.•Alfred P. Sloan Dissertation Fellowship, 1997.•Harold Grad Memorial Prize, Courant Institute, 1996.•Fellowship given by The Bank of Spain, 1995-1997.•'La Caixa' Fellowship, Spain, 1994-1995.	Feb 17, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Giuseppe Nittis	Universite de Cergy-Pontoise			Feb 17, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Keith Promislow	Michigan State University (Professor)			Feb 17, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop

Alan Greer	University of Cambridge (Professor)	PhD (Metallurgy & Materials Science)	Lee Hsun Lecture Award, Chinese Academy of Sciences (2008) Griffith Medal and Prize, Institute of Materials, Minerals & Mining (UK) (2009)	Feb 18, 2012 -Feb 23, 2012	Participation in the 2012 WPI-AIMR Annual Workshop as PI
Frank Ernst	Case Western Reserve University (Professor, Dept. Materials Science)	PhD, Crystal defect	Case School of Engineering Teaching Leader (2005) Nomination for the Carl F. Wittke Award for Excellence in Undergraduate Teaching (2005) Case School of Engineering Outstanding Teacher (2006)	Feb 18, 2012 -Feb 25, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Murugan Ramalingam	Strasbourg University (Associate Professor)	PhD Biomaterials		Feb 18, 2012 -Mar 4, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop as Adjunct Assoc. Prof.
Jean Aime	CNRS Research (Senior Chair of the network nanoscienes-nanotechnologies Cnano GSO)	PhD of Physics	IAAM Medal (2011)	Feb 19, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
John Perepezko	The University of Wisconsin (Professor)	PhD Metallurgical and Materials Science	•Who's Who in Engineering •William Hume-Rothery Award, TMS (2009)	Feb 19, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop as Adjunct Prof.

Li-Jun Wan	ICCAS (Professor)	PhD Applied Chemistry	Fellow of Royal Society of Chemistry Vice President of Chinese Chemical Society President Elected of Chinese Society of Electrochemistry Chemistry Award of TWAS 2nd class Award of National Natural Science of China	Feb 19, 2012 -Feb 23, 2012	Participation in the 2012 WPI-AIMR Annual Workshop as PI
Todd Hufnagel	Johns Hopkins University (Professor)	PhD Materials Science and Engineering	Visiting Fellow, Sidney Sussex College, University of Cambridge (2010) Capers and Marion McDonald Award for Excellence in Mentoring and Advising (2005)	Feb 19, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Michelle Khine	University of California, Irvine (Associate Professor)	PhD of Bioengineering	Lab Automation SLAS Innovation Finalist: 1 of 10 finalists (2010) Fast Company Magazine: 100 Most Creative People in Business (2011) Marie Claire Magazine 'Women on Top' Award, recognized as 'Top Scientist' (2011)	Feb 19, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Yuri Korchev	Imperial College London (Professor)	PhD, Biophysics		Feb 19, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk

Fred Wudl	UCSB (Research Professor, Chemistry and Materials, Co-Director CPOS)	PhD	Tolman Medal of the SCALACS (2007) Professional Achievement Award, University of California, Los Angeles (2008) Stephanie Kwolek Award for Polymer Science from the Royal Society of Chemistry (2010)	Feb 19, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk as Adjunct Prof.
Youn-Woo Lee	Seoul National University (Professor)	PhD of Chemical Engineering	Numerous Awards for achievement of commercialization by Supercritical Fluid Tech.(1) Supercritical Fluid Extraction of Sesame oil(2) Nano-Particles of Ceria by Hydrothermal Synthesis in Supercritical water(3) Waste-Refinery from TPA Process by Supercritical Water Oxidation(4) Process for Producing Low-Toxic Pharmaceuticals by Supercritical CO2	Feb 19, 2012 -Feb 26, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Thomas Russell	University of Massachusetts Amherst (Professor)	PhD, Polymer Science and Engineering	■Editorial Board Member, Current Opinion in Chemical Engineering, April, 2011-present ■Award for Outstanding Accomplishment in Research and Creative Activity, UMass Amherst, 2011 ■Honorary Distinguished Professor, Chinese Academy of Science, Changchun Institute of Applied Chemistry, 2011-present ■International	Feb 20, 2012 -Feb 22, 2012	Participation in the 2012 WPI-AIMR Annual Workshop as PI

			Advisory Board, Chinese Journal of Polymer Science, 2011-present ■Electorate Nominating Committee, American Association for the Advancement of Science, 2012-2015 ■Provost Lecturer, University of Pennsylvania, March 12, 2012 ■Fred Kavli Distinguished Lecturer, Material Research Society, April 2012 ■John B. Derienx Lecture, North Carolina State University, April 30, 2012		
Tingbing Cao	Renmin University of China (Professor and Dean)	PhD of Chemistry		Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Derek Chan	University of Melbourne, Australia, Professorial Fellow and Deputy Director	PhD Applied Mathematics	Queen Elizabeth II Fellowship (1977) Personal Chair in Mathematics (1995)	Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Thomas Gessner	Fraunhofer ENAS in Chemnitz Chemnitz University of Technology (Professor, Center for Microtechnologies)	Dr.-Ing. habil. in Microelectronics Technologies	Member of the Academy of Science in Saxony, Germany (1996-present) Member of Scientific Council of Germany (1998-2004) Member of acatech (2003-present)	Feb 20, 2012 -Feb 23, 2012	Participation in the 2012 WPI-AIMR Annual Workshop as PI

Chain Liu	University of Hong Kong (University Distinguished Professor)	PhD in Materials Science and Engineering	R&D 100 Award, sponsored by R&D Magazine, USA. (2009) Honorary Member of Japan Institute for Metals (2007) Foreign Member of Chinese Academy of Engineering (CAE) (2005)	Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
David Srolovitz	A*STAR, Institute of High Performance Computing, Singapore (Scientific Director)	PhD of Materials Science	Commencement Speaker, National University of Singapore (2010) Fellow, Institute of Physics (Great Britain) (1999) Fellow, ASM International (1998) Outstanding Paper Award, American Institute of Chemical Engineers (1997)	Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Samuel Stupp	Northwestern University (Board of Trustees Professor of Materials Science, Chemistry and Medicine, Director, Institute for BioNanotechnology in Medicine)	PhD of Materials Science & Engineering	Honorary Doctorate from Eindhoven University of Technology for Revolutionary Research in Complex Molecular Systems, The Netherlands (2009) Thomson Reuters Top 100 Chemists for 2000-2010 (2011) Honorary Doctorate, National University of Costa Rica (2011)	Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk

Matthew Rosseinsky	University of Liverpool (Professor)	First Class Honours degree in Chemistry with Quantum Chemistry, D. Phil "Physical Properties of Superconducting Oxides and Radical Cation Salts" (1990)	Zernike Lecturer, Rijksuniversitat Groningen (2009) De Gennes Prize for Materials Chemistry, Royal Society of Chemistry (Inaugural winner of lifetime achievement award in this discipline) (2009) C.N.R. Rao Award, Chemical Research Society of India (2010) Royal Society Hughes Medal (2011)	Feb 20, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Yuri Korchev	Imperial College, London (Professor, Division of Medicine)	PhD Biophysics	Pioneer of bioimaging. Many publications in top-level journals such as Nature.	Feb 20, 2012 -Feb 24, 2012	Short-term stay fir joint research, participation in symposium
Komas Prassides	Durham University (Professor)	DPhil Chemistry	Leverhulme Trust Senior Research Fellowship, The Royal Society, UK (2009) Tilden Prize, Royal Society of Chemistry, UK (2010)	Feb 20, 2012 -Feb 24, 2012	Short-term stay for discussion for joint research, Collaboration of Phonon PDOS and participation in a symposium
Herbert Gleiter	KIT - Campus Nord	PhD in physics	Member of National Academy of Engineering Gottfried Wilhelm Leibniz Prize in 1988 for contributions to the field of nanotechnology	Feb 20, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop
Hongwen Liu	Chinese Academy of Sciences (Specially Appointed Associate Professor)	PhD of Electronics Physics		Feb 20, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk

Tanguy Rouxel	University of Rennes 1 (Professor)	PhD	Professor Brahm Prakash Visiting Chair, Indian Institute of Science, Bangalore, India (2009) Adjunct Professor of the Chinese Academy of Science, SICCAS, Shanghai, China (2009) Otto Schott Research Award (2009)	Feb 20, 2012 -Feb 24, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Buxing Han	Chinese Academy of Sciences (Professor) Royal Society of Chemistry (Fellow)	PhD degree		Feb 22, 2012 -Feb 23, 2012	Short-term stay for participation in the 2012 WPI-AIMR Annual Workshop and giving a talk
Stephane Sarrade	French Atomic Energy Commission/ Head of Physical Chemistry Department	PhD Biotechnology and Chemical Engineer	Head of Supercritical Fluids and Membranes Laboratory (SFML) Head of the Decontamination and Conditioning Processes Service.	Feb22, 2012 –Feb 24, 2012	Short-term stay for joint research
Ali Khademhosseini	Harvard Medical School (Associate Professor)			Aug 7, 2011 -Aug 14, 2011 Feb 22, 2012 - Feb 27, 2012	Participation as Principle Investigator Participation in the 2012 WPI-AIMR Annual Workshop as PI
Anand Yethiraj	Memorial University of Newfoundland (Associate Professor, Faculty of Science)	PhD, Experiment of condensed matters		Feb 24, 2012 -Mar 1, 2012	Stay for participation in international workshop and joint research
Limei Xu	Peking University (Associate Professor, International Center for Quantum Materials)	PhD, Theory of condensed matters		Feb 25, 2012 -Feb 28, 2012	Short-term stay for participation in international workshop

Kia Ngai	Università di Pisa (Professor, Dipartimento di Fisica)	PhD, Theory of condensed matters		Feb 25, 2012 -Mar 2, 2012	Short-term stay for participation in international workshop
Frederic Affouard	University LILLE1 (Professor, Unité Matériaux Et Transformations)	PhD, Experiment of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Yong Seok Cho	Asia Pacific Center for Theoretical Physics (Professor, Junior Research Groups)	PhD, Theory of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Xiujun Han	Shanghai Jiao Tong University (Professor, Advanced Materials Research Center)	PhD, Theory of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Peter Harrowell	The University of Sydney (Professor, Chemistry and Director of Postgraduate Studies)	PhD, Theory of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Yoon Hwae Hwang	Pusan National University (Professor, Department of Nanomaterials)	PhD, Experiment of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in workshop
Sangmin Jeon	POSTECH (Associate Professor, Department of Chemical Engineering)	PhD, Experiment of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop

Francesco Mallamace	Universit di Messina (Professor, Dipartimento di Fisica)	PhD, Experiment of condensed matters	2006 Cozzarelli Prize of National Academy of Sciences USA Class III (Engineering and Applied Sciences)	Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Andreas Meyer	Institute of Materials Physics in Space German Aerospace Center (Professor)	PhD, Experiment of condensed matters	Award of a Heisenberg fellowship of the German Science Foundation (DFG), 2004	Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Marian Paluch	Silesian University (Professor, Institute of Physics)	PhD, Experiment of condensed matters	Prizewinner of the1st edition of TEAM competition announced by the Foundation for Polish Science (FNP) in 2008	Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Josep Lluís Tamarit	Universitat Politècnica de Catalunya (Professor, Dept. de Física i Enginyeria Nuclear)	PhD, Experiment of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Gilles Tarjus	UPMC/CNRS, LPTMC (Professor)	PhD, Theory of condensed matters		Feb 26, 2012 -Mar 1, 2012	Short-term stay for participation in international workshop
Christiane Alba-Simionesco	CEA-CNRS, Laboratoire Léon Brillouin (Professor)	PhD, Experiment of condensed matters		Feb 26, 2012 -Mar 2, 2012	Short-term stay for participation in international workshop
Thomas Voigtmann	University of Konstanz, Fachbereich Physik (Professor)	PhD, Theory of condensed matters		Feb 27, 2012 -Mar 2, 2012	Short-term stay for participation in international workshop and joint research
Jian Meng	Chinese Academy of Sciences (Professor, Changchun Institute of Applied Chemistry, State key Lab	PhD, Rare earth material		Mar 1, 2012 -Mar 30, 2012	Short-term stay for joint research supported by JSPS

	of Rare Earth Resource Applications)				
Richard Tilley	Victoria University of Wellington and MacDiarmid Institute of Advanced Materials and Nanotechnology (Associate Professor)	PhD Supercritical reaction	Principal Investigator, MacDiarmid Institute for Advanced Materials and Nanotechnology	Mar 15, 2012 -Apr 16, 2012	Stay for joint research
Lin Gu	The Chinese Academy of Sciences (Professor)			Mar 28, 2012 -Apr 6, 2012	Short-term stay for BMG joint research
Radu Barna	Ecole des Mines Albi, RAPSODEE, CNRS・ (Professor)	PhD supercritical reaction	H2 by supercritical water gasification of biomass	Mar 29, 2012 -May 26, 2012	JSPS Invitation Fellowship Program for Research in Japan (Short Term)
Shueh-Lin Yau	National Central University (Professor, Department of Chemistry)	PhD, Chemistry	Research scientist at Tohoku University (Japan) from 1994 to 1997	1 week	Short-term stay for joint research
Andrzej Wieckowski	University of Illinois (Professor)	PhD	North American Editor of Electrochimica Acta	3 days	Short-term stay for joint research

State of Outreach Activities

- Using the table below, show the achievements of the Center's outreach activities in FY2011 (number of activities, times held).
- Describe those activities that have yielded novel results or that warrant special mention in the "Special Achievements" space below.
- In appendix 7, list and describe media coverage (e.g., articles published, programs aired) in FY2011 resulting from press releases and reporting.

Activities	FY2011 (number of activities, times held)
PR brochure, pamphlet	13
Lectures, seminars for general public	22
Teaching, experiments, training for elementary and secondary school students	5
Science cafe	0
Open houses	5
Participating, exhibiting in events	13
Press releases	28

Special Achievements

- Activities of Outreach Office –

In FY2011, the system of the **Outreach Office** of AIMR was strengthened. In April 2010, Dr. Susumu Ikeda was assigned as Outreach Manager of AIMR to further promote outreach activities. However, the system was not enough to fully accomplish our aim to facilitate communication and mutual understanding between AIMR and the public. In FY2011, therefore, the Outreach Office was placed under the International Relations Unit which was established in FY2011. Due to this change, it has become easy to get support from the parent organization, for example for human resources at events. Placing the Outreach Office under the International Relations Unit is also useful for strengthening international public affairs.

Although the start of outreach activities in FY2011 was delayed because of the Great East Japan Earthquake, the Outreach Office was able to issue volume 4 of the outreach magazine *Tohoku WPI Tsu-Shin* within the year. In the same way as the previous issues, all articles are written in Japanese for public distribution. Volume 4 mainly introduced metallic glasses and outcomes of the metallic glass research in AIMR. This volume also contained a report of public events. The issue was mailed to all elementary schools and junior high schools in Sendai City and all high schools in Miyagi Prefecture. The magazine was placed at Sendai City Information Centers, Sendai Science Museum, and Sendai Astronomical Observatory. It was distributed to participants in scientific events and sent to all researchers of Tohoku University.

The fourth volume of TOHOKU WPI Tsu-Shin

Tohoku WPI Tsu-Shin. All articles can be downloaded from the following website:
http://www.wpi-aimr.tohoku.ac.jp/jp/modules/kenkyu/index.php%3Fcat_id=3.html

Moreover, the Outreach Office joined in the following events in FY2011.

"The Academic Consortium of Sendai – Satellite Campus" (June 11, 2011)

AIMR participated in the Satellite Campus Project of the Academic Consortium of Sendai. The Academic Consortium of Sendai was established for higher education organizations such as universities and for citizens, companies, and administrative organs to improve each other, to bring about the sustainable development of the academic city, Sendai, and to manage projects such as the satellite campus. Outreach Manager S. Ikeda

Satellite Campus

gave a lecture at the satellite campus entitled “Introduction to materials science – from rocks to state-of-the-art materials” on June 11, 2011 at Ichiban-cho Lobby of the Tohoku Institute of Technology, Aoba-ku, Sendai. We had 25 participants in attendance. In the first half of the course, a basic lecture was given on materials and materials science, for example the relationship between stones, and the silicon wafers supporting modern computer society was shown. In the latter half, the participants enjoyed experiments using polarizing plates and learned how we can distinguish crystalline materials and amorphous materials using the polarizing plates.

“The City of Academia *Sendai-Miyagi* Science Day 2011” (July 10, 2011)

AIMR opened a booth at the “City of Academia *Sendai-Miyagi* Science Day 2011” held at Kawauchi North Campus in Tohoku University on July 10, 2011. Participants enjoyed investigating the properties of light and materials with polarizing plates. Materials can be divided into two groups. One is crystalline materials in which atoms or molecules are regularly arranged. The other is amorphous materials in which atoms or molecules are arranged randomly, glasses being the typical instances. Using the polarizing plates, we can distinguish between crystals and amorphous materials. First, we studied the properties of the polarizing plates and properties of light. In the next step, we inserted the various thin samples between the two polarizing plates and observed the difference among them. Participants also learned that there are many kinds of materials, for example metallic glass as one of the promising amorphous materials.

The “Science Day AWARD” program was created this year to praise exhibitors at Science Day. On this occasion, Prof. Yoshinori Yamamoto, Director of AIMR, established the “WPI-AIMR AWARD” to praise the exhibitors from AIMR’s perspective.

Science Day

“Tohoku University Open Campus 2011” (July 27-28, 2011)

Tohoku University Open Campus was held on July 27 and 28, and AIMR opened a booth in the Physics-A Building, Aobayama Campus, to show Tohoku University’s activities to high school students. About 200 participants, mainly high school students, visited the AIMR booth during the two days. At the booth, an introduction of AIMR was offered using posters and magazines, following which participants enjoyed small experiments. In AIMR, not only crystalline materials but also amorphous materials such as metallic glasses are important targets for our investigation. At our booth, participants learned how to distinguish crystalline materials and amorphous materials using polarizing plates. They also learned the properties of light and polarizing plates.

Open Campus

“Katahira Festival 2011” & “WPI-AIMR Open House” (October 8-9, 2011)

Katahira Festival (Katahira Matsuri in Japanese) was held at Katahira Campus of Tohoku University on October 8 and 9. Since 1998, Katahira Festival has been held every two years and organized by Tohoku University’s six research institutes and research center (Institute for Materials Research, Institute of Development, Aging and Cancer, Institute of Fluid Science, Research Institute of Electrical Communication, Institute of Multidisciplinary Research for Advanced Materials, and Center for Northeast Asian Studies). It is for the first time that AIMR joined Katahira Festival. This Festival is held to promote public understanding for the research outcomes of Tohoku University in the scientific field. Besides this, Tohoku University Archives introduces Tohoku University’s history and traditional buildings. AIMR opened 9 booths under the theme “Nano Expo” at the AIMR main building completed at the end of July. These events are managed by AIMR young and foreign researchers. About 2,500 participants enjoyed events together with staff members and listened attentively to their explanations, and they also asked several questions concerning the mechanism. As one of the official events of Katahira Festival, the Special Lecture by Prof. Toshio Nishi (AIMR) was held on October 8. In his lecture entitled “Science of Rubber Bearings for Seismic Isolation”, Prof. Nishi talked about the fundamentals and applications of rubber bearings and showed many examples of how the rubber bearings work at the moment earthquakes strike. About 60 people attended this lecture, and they asked many questions after the talk.

Katahira Festival

“2011 Tohoku University Festival” (November 3, 2011)

AIMR opened a booth at the “2011 Tohoku University Festival” held at Kawauchi North Campus in Tohoku University. At the booth, an introduction of AIMR was offered using posters and magazines, following which participants enjoyed small experiments. Through the experiments, they learned about the properties of light and materials using polarizing plates. Participants could also see actual bulk metal glass samples and have fun with a machine for high repulsion of metallic glass (golf-club heads) and a miniature golf course for testing golf clubs made from metallic glass. This event was supported by BMG group of AIMR.

University Festival

“WPI 6 Institutes – Joint Symposium ‘Cutting-Edge Sciences and Your Future’” (November 12, 2011)

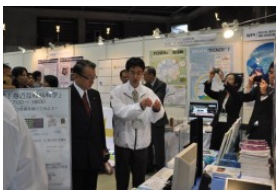
The WPI 6 Institutes Joint Symposium “Cutting-Edge Science and Your Future” was held under the auspices of the International Institute for Carbon-Neutral Energy Research (I^2CNER) of Kyushu University at the Fukuoka Bank Hall in Fukuoka City. The symposium was attended by more than 600 participants, high school students, and the general public, mostly from the Kyushu/Yamaguchi areas. The day officially began with opening remarks from Dr. Setsuo Arikawa, President of Kyushu University, and a keynote lecture presented by Dr. Toshio Kuroki, WPI Program Director, sending an encouraging message to the young audience. Then, Prof. Petsos Sofronis, Director of I^2CNER, gave a lecture, followed by lectures of the representatives from the six WPI research centers (I^2CNER, AIMR, IPMU, iCeMS, IFReC, MANA). In the presentations, Prof. Motoko Kotani, a deputy director of AMIR, in her lecture entitled “Giving Shape to Your Dreams”, presented in an easy-to-understand manner how human beings have invented new materials and made use of them for society, taking an example of the space shuttle. The panel discussion was held after six WPI research center presentations, coordinated by Ms. Junko Edahiro, an environmental journalist, and there were active questions and answers between the 12 panelists, high school students, junior high school students, and lecturers. In the area of the booths, the posters of research activities of the WPI 6 institutes were put up, and lecturers and the staff provided explanations and demonstrated to young people. Many young people asked lead scientists many questions and communicated with them. MANA and AIMR set up a joint booth with materials science under the theme “Let’s Experience with Pleasure! – Familiar Materials Science”, and Outreach Manager S. Ikeda demonstrated the experimentation on “Investigation of Materials’ Properties Using Polarizing Plates” to many young people. Some high school students who were interested in the lecture by Prof. Kotani eagerly asked her about mathematics. The advertising campaign for “Idea Contest – Challenger to the Future” was also conducted in the course of the event.

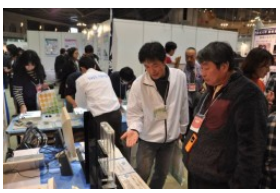
Joint Symposium (Fukuoka)

“Science and Technology Festa in Kyoto” (December 17-18, 2011)

For two days on December 17 and 18, 2011, “Science and Technology Festa in Kyoto 2011” was held at Kyoto International Conference Center. The Science and Technology Festa aims at giving opportunities of presenting and exhibiting various outcomes of Japan’s cutting-edge science and technology to the public so that they will become more familiar with science and technology through direct conversation with scientists or persons involved in science and technology. Following last year’s Festa, WPI centers ran a joint booth involving the cooperation of all the centers. As far as AIMR was concerned, we manned a booth that introduced our institute profile and activities displaying posters and videos, and also provided an area where visitors could try experiments. After enjoying the experiments with polarizing plates that identify the difference between crystals and glasses, visitors listened to explanations on the structure of metallic glasses and composites to familiarize themselves with the “Science” of Materials. More than 600 people enjoyed the AIMR booth and had a chance to look closely at real metallic glasses. On the 17th, Minister of State for Science and Technology Policy Motohisa Furukawa and Minister of Education, Culture, Sports, Science and Technology Masaharu Nakagawa visited the event hall. They came over to the AIMR booth and asked many questions ranging from general to technical topics to the staff. Throughout the two-day period, the Festa had over 5,000 participants and ended with great success.

S & T Festa Kyoto





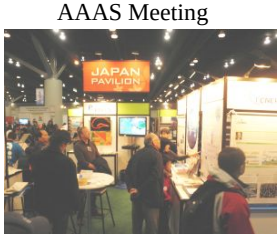
“Idea Contest – Challenger to the Future”

Idea Contest

MANA and AIMR co-organized “Idea Contest – Challenger to the Future” under the theme of materials science. The history of human beings has so largely depended on the development of materials, such as earthenware, bronze ware, and ironware that the inventive ideas of a new materials science are an important key to the sustainable future of the earth. With this in mind, the aim of this contest is to provide young people, who will lead the future of our society, with the opportunities to reflect on the materials and to develop the capacity of future scientists through educational activities. A total of 320 works were submitted and ten winners were chosen through a rigorous screening process. A commendation ceremony for this contest was held at the National Museum of Nature and Science, Tokyo, on March 24, 2012, attended by the recipients of the Award for Excellent Challenger, as well as their families and guests. The ceremony started with an opening address by MANA Director General Masakazu Aono, who afterward with AIMR Center Director Yoshinori Yamamoto presented the award certificates, medals, and extra prizes to each winner and honored their achievements. Furthermore, the Special Recognition Awards were presented to two works filled with dreams, and two other works containing technically feasible options that could contribute to society. The members of the screening committee individually made comments and sent messages with expectations to the young people who will build a future. At the end of the ceremony, AIMR Center Director Yamamoto delivered a closing address. After the ceremony, the attendants moved to the exhibition space on the first floor of the Global Gallery in the National Museum of Nature and Science and watched the award-winning works. The works were displayed for one month after the ceremony.

“2012 AAAS Annual Meeting”

AAAS Meeting



Japan’s science ministry and the six WPI centers presented their activities at the 2012 American Association for the Advancement of Science (AAAS) Annual Meeting held at the Vancouver Convention Center in Vancouver, BC, Canada, from February 16 to 20. The WPI booth was open from February 17 to 19 in the Japan Pavilion (organized by JST) constructed at the exhibition hall, and about 2,700 audience members visited the Japan Pavilion. This was the first outreach event to which outreach members from the six WPI centers went to attend an overseas meeting. Under the leadership of main manager (Kyoto Univ. iCeMS) and co-manager (Osaka Univ. IFReC), we prepared materials for exhibition such as posters, videos, and FAQs. Fortunately, thanks to the large effort by the main manager, many outreach members could obtain press badges, enabling them to enter all events and symposiums and even attend the press meetings. Our outreach team gained a fruitful experience which will be useful in our future outreach activities.

For details of these events, please visit the “Public Events” page of our website.
http://www.wpi-aimr.tohoku.ac.jp/en/modules/newsinfo/index.php%3Fcat_id=3.html

- Outreach activities performed by researchers of AIMR

Individual researchers were encouraged to make a great effort to disseminate their research activities to the public. Typical examples are shown as follows.

Lectures and seminars for the general public

1) Public lecture, “Draw a map of the Universe -mathematical knowledge to measure unmeasurable things-” at the 65th “Enjoy Science Class”, Tokyo, Oct. 15, 2011

2) Public lecture, “World of atoms” at The Japanese Society of Microscopy, Fukuoka, May 15, 2011

3) Public lecture of IYC2011 (international year of chemistry 2011) at The International Society of Electrochemistry, Niigata, Sep. 15 2011

4) Public lecture, “History of technologies” at Micro-Nanomachining Seminar, Sendai, Aug. 2-4, 2011

5) Public lecture, “Science and technology for future” at World of Photo-Catalyst and Mechatronics, Sendai, Aug. 8, 2011

Lectures and seminars for researchers in general

1) Technical guidance to Japanese Fine Ceramics Center, April 2011 - March 2012

2) Tutorial about Spintronics at the 72th Fall Meeting 2011 of the Japan Society of Applied Physics, Yamagata, Aug. 29, 2012

3) Tutorial about Spintronics at the 59th Spring Meeting 2012 of the Japan Society of Applied Physics, Tokyo, Mar. 15, 2012

4) Four lectures about spin and magnetism, Summer School in ASPIMATT meeting, Villa Denis, Diemerstein / Kaiserslautern, Germany, Wednesday, Aug. 24-26, 2011

5) Lecture, “Tetragonal Manganese Alloys for Magnetoresistive Memory Application,” Seminar in Institute of Physics, University of Goettingen, Goettingen, Aug. 19, 2011

6) Tohoku Univ. Micro System Integration Center Symposium 2011, Sendai, Nov. 9, 2011

7) MEMS intensive course in Kyoto, Aug. 9-11, 2011

8) 4th Workshop on microsystem fusion, Sendai, Sep. 8, 2011

9) 10th meeting on promotion of industry-academia-government collaboration, Tokyo, Sep. 22, 2011

10) Tohoku University Symposium on international industry-academia collaboration, Tokyo, Oct. 27, 2011

11) Japan-Germany symposium on micro-nano application technologies “7th Fraunhofer symposium in Sendai”, Sendai, Nov. 8, 2011

12) Micro system integration R&D center (μSIC) symposium, Sendai, Nov. 9, 2011

13) 2nd International Symposium on Integrated Microsystems (ISIM2012), Tsukuba, Feb. 13, 2012

14) 5th Workshop on microsystem fusion, Sendai, Mar. 8, 2012

Lectures for university students

1) Lecture of learning of applied physics for master course students in the Department of Applied Physics in Tohoku University, subsequently joined by about 30 students for the lab-tour in Miyazaki-Mizukami Lab and Prof. Dr. Chen’s lab.

2) Tohoku University Day: Dalian University of Technology-Tohoku University Joint Symposium Nov. 23-25, 2011, Dalian, China. Speakers: Naoki Asao + 7 Researchers. Lecture Title: “Nanoporous Gold as an Effective and Reusable Catalyst for Molecular Transformations”

Teaching, experiments, training for elementary and secondary school students

1) Demonstration of a machine for high repulsion of metallic glass (golf-club heads) and miniature golf course, and display of actual bulk metallic glass samples at 2011 Tohoku University Festival, Kawauchi North Campus, Sendai, Nov. 3, 2011

2) Faculty of Science 100 years anniversary event

3) 2nd International Contest on Application of Nano-Micro technologies (iCAN'11), Beijing, Jun. 5-8, 2011

4) FIRST Science Forum 2 “Young people. Talk with top scientists on future of science and on Japan”, Sendai, Feb. 5, 2012

5) Fukui Science Festa ”Focusing to fusion of technologies for value added integrated circuit”, Fukui, Feb. 19, 2012

Participating, exhibiting in events

1) Demonstration of machine for high repulsion of metallic glass (golf-club heads) and display of actual bulk metallic glass samples at the WPI 6 Institutes - Joint Symposium, Fukuoka Bank Hall in Fukuoka, Nov. 12, 2011

2) Demonstration of a machine for high repulsion of metallic glass (golf-club heads) and display of actual bulk metallic glass samples at Science and Technology Festa in Kyoto 2011, Kyoto International Conference Center, Dec. 17-18, 2011

3) Booth exhibition at Tohoku University Innovation Fair 2012 TOKYO, Tokyo, Mar. 15, 2012

FY 2011 List of Project's Media Coverage

- Select main items of coverage, and list them within these 2 pages.

No.	Date	Type media (e.g., newspaper, television)	Description
1	March 30, 2012	Nikkan Kogyo Shimbun	Formation of consortium for supercritical fluid technology on nanomaterials (Tohoku University, JCII).
2	February 9, 2012	Nikkan Kogyo Shimbun	Tohoku University develops apparatus for mass production of nanoparticles.
3	February 9, 2012	Kagaku Kogyo Nipou	Capable of Mass production of hybrid nanoparticles (10 metric ton/year).
4	January 16, 2012	Kagaku Kogyo Nipou	(Editorial article) Gaining expectation of support for supercritical fluid technology.
5	December 6, 2011	Nikkan Kogyo Shimbun	ITEC corp. distributes nanoparticulate materials.
6	December 4, 2011	Yomiuri Shimbun	"Impurities Super-Structure formed in Ceramics"
7	November 25, 2011	The Science News (Kagaku Shimbun)	Success in giving mass to the massless Dirac fermions
8	November 18, 2011	Kagaku Kogyo Nipou	Development of application of cubic-shaped cerium oxide.
9	November 17, 2011	Nihon Keizai Shinbun	"Discover of Super Planar Structure which dominates Mechanical Strength of Ceramics"
10	November 17, 2011	Chuniti Shimbun	"Super Ceramics reinforced by Impurities Array?"
11	November 17, 2011	Nikkan kogyo Shimbun	"Impurities Array affects Ceramics Properties"

12	November 17, 2011	Tokyo Shimbun	“No Brittle Ceramics? Reinforcement by Impurities Array”
13	November 9, 2011	Kahoku Shinpoh	Tohoku University makes a contract with German research institute and promotes to exchange activities in high technology.
14	November 9, 2011	Nikkei Sangyo Shimbun	“Atomic-Scale Observation of Piezoelectric Materials by using Special Microscope”
15	November 5, 2011	Nihon Keizai Shinbun	Tohoku University, New facility for Micro Electro Mechanical Systems collaborating with German research institute.
16	October 28, 2012	Nikkan Kogyo Shimbun	The structural feature of the nano oxide which exists in "oxide-dispersion-strengthened (ODS) steels" which is a composite material with high intensity and can be used for nuclear reactors under high temperatures was clarified.
17	October 21, 2012	Kagaku Kogyo Nipou	Formation of consortium for nanomaterials with contrariety functions by using supercritical fluid technology.
18	September 13, 2011	Fuji-Sankei Business-eye	Tohoku University is high in favor with prototyping facility and promotes local activities with MEMS.
19	August 22, 2011	Nikkei Sangyo Shimbun	Success in giving mass to the massless Dirac fermions
20	August 11, 2011	Kagaku Kogyo Nipou	R&D hub for super hybrid materials in Tohoku University; Fusing supercritical fluid technology to conventional technology and creating new industry in area of distress.
21	July 22, 2011	The Science News (Kagaku Shimbun)	Direct observation of pseudo-gap in iron-based superconductors
22	July 19, 2011	Nikkei Sangyo Shimbun	Very fast observation of surface condition of semiconductors in one second by new microscope. Contributions to micro-fabrication technique.
23	July 14, 2011	Nikkei Sangyo Shimbun	Direct observation of pseudo-gap in iron-based superconductors
24	July 4, 2011	Tech-On (Nikkei electronics)	Toshiba Company has developed fundamental technology of MRAM, which was strongly assisted by Miyazaki Gr. in Tohoku Univ., AIST, Oosaka Univ. and Electro-Communication Univ. in the framework of NEDO spintronics nonvolatile devices project.
25	May 18, 2011	Nikkan Kogyo Shimbun	Direct observation of electron spin in topological insulators