FY 2009 WPI Project Progress Report
World Premier International Research Center (WPI) Initiative

Host Institution	Tohoku University	Host Institution Head	Akihisa Inoue
Research Center	Advanced Institute for Materials Research	Center Director	Yoshinori Yamamoto

Summary of center project progress

Our objectives are the following: (1) To promote innovative research on materials science and establish a world top-level research center at Tohoku University; (2) To reform traditional Japanese research systems and management structures to construct a new system appropriate for a world top-level research center; and (3) To reinforce international partnership to establish a "visible center" through cooperative research activities with networks and satellites at home and abroad. Given below is a more specific description:

(1) To aim at a fusion of the five existing fields of physics, chembio, materials science, electronics and information science, and precision and mechanical engineering so as to develop a new domain in the field of materials science. To this end, 32 principal investigators (PIs) have been classified into four groups: Bulk Metallic Glasses (BMG), Nanophysics, NanoChemBio, and Device/System Construction. In addition to the research into hard materials that has so far been conducted, and in order to reinforce the field of soft materials, the following actions have been taken from this fiscal year: 1) The Nanochemistry Group has been renamed the NanoChemBio Group to establish a research system for materials science based on the ChemBio area; 2) Center Director Yamamoto has joined the research in the NanoChemBio area as a PI; 3) Three young PIs from abroad were invited as active PIs who actually manage laboratories and conduct research in Sendai. Two of them belong to the NanoChemBio Group and the other one to the Nanophysics Group; and 4) To further promote fusion research, the Fusion Research Proposal Program was established this fiscal year and startup funds were allocated to promising research.

(2) The center is positioned as a division of Tohoku University and named Tohoku University Advanced Institute for Materials Research (AIMR). PIs are dedicated staff of the Institute. Associate professors, assistant professors and post-doctoral researchers are solicited widely from around the world to secure excellent human resources. The number of researchers (including those who stay in AIMR for more than one month) for this fiscal year is 129 including 70 foreigners, thus exceeding the targets set in the initial plan. PIs are encouraged to use English when exchanging information with each other, and English-speaking staff members are provided for administrative work. Regarding the research environment or, in particular, the space, work on the utilities for the new building (construction work completed last fiscal year) has finished, and research and experiments have started. In addition, design work has been finished for the construction of main institute building based on the supplementary budget for this fiscal year.

(3) Regarding international partnerships and overseas network construction for this fiscal year, a workshop for the BMG-related research areas was held at Grenoble, France led by the European Satellite members. Construction of the network for nanoscience including nanophysics and nanochembio has been promoted mainly with the universities and research institutes to which foreign PIs belong. Researchers whose projects are related to Device/System Construction have things in common with their counterparts in European and American associates and satellites, which enable cooperative efforts. This fiscal year, the GI^3 (Global Intellectual Incubation and Integration Laboratory) Program was started. This aims at positioning AIMR in the global trend of young brains by having research institutions to which PIs abroad belong send young researchers to our center for one to three months, and by having such researchers engage in joint experiments and research as well as exchange with researchers here. This fiscal year, 10 researchers stayed at the center under this program. In addition, the third Annual Workshop was held in March 2010. Researchers who have been deeply involved in WPI through joint research with PIs are appointed as WPI adjunct professors or adjunct associate professors to further expand the network. Thus, a WPI research network is currently being established on a global scale.

As we have stated here, we believe that the center is on the right track.

1. Summary of center project

<Initial plan>

The main objective of the Center is to promote the development of new materials under a world-leading organization for interdisciplinary research in functional materials, by use of an innovative method of atomic and molecular control, departing from the typical approaches and moving towards the next generation. In addition to basic research, the Center will pursue (1) the creation of new compounds and materials with innovative functions which exceed existing ones, (2) the construction of devices based upon a new fundamental paradigm, and (3) the promotion of applied research projects on materials and systems architecture that will generate direct societal impacts. In addition, the Center will establish innovations in understanding diverse material functions through the creation of new basic materials and compounds which brings significant benefits for the future of humanity.

A wide range of materials including metals, semiconductors, superconductors, ceramics, and organic and biological compounds will be the subjects of our investigation, aiming at the creation of innovative functions: (1) the creation of new structural materials, electronic materials, nanomolecular materials, materials for surface and interface systems, and materials having molecular assembling properties; (2) the development and elaboration of these materials leading into devices and systems; and (3) the construction of new architectures, using these devices and materials leading to the betterment of society. Synergy between the above three stepwise strategies is anticipated, and the merging of the five research fields (physics, chemistry, materials science, electrical engineering, and mechanical engineering) is strongly thrust to the forefront, and thereby we are convinced that the WPI Research Center for Atom·Molecule·Materials must be established at Tohoku University. “From atom and molecule to social welfare through materials” is the guiding principle for the center as outlined in the detailed items on the research theme and the organization of the center.

<Results/progress/alternations from initial plan>

According to the basic concepts in (1), (2) and (3) on the left, basic and applied researches are being carried out satisfactorily.

In order to ensure “Identification as the WPI research center” and to clarify the differences from the existing Institute for Materials Research pointed out by the follow-up committee this fiscal year, in the orientation of AIMR’s research we have set our goal as becoming top in the world of materials science by encompassing soft materials in addition to hard materials. The orientation has been clearly specified both in and outside the center. To this end, among the four research groups we have changed the Nanochemistry Group to the NanoChemBio Group, recruited capable young PIs in the cutting-edge ChemBio field from Harvard University and Hong Kong University of Science and Technology to carry out research into bio-materials that will make promising future materials. We have also invited a young PI from Texas A&M University to the Nanophysics Group (PhysBio). These three newly-appointed PIs have laboratories in Sendai to promote experiments and research at AIMR. In addition, Center Director Yamamoto, who has devoted himself to the management of the organization, has joined the research in the NanoChemBio group as a PI.

Materials science has been studied based on three fundamental fields (Physics, Chemistry and Bioscience). While researchers tend to carry out their materials science research based on one single fundamental field, we strongly requested PIs to include another basis to their current research to allow fusion with other research and with a view to encouraging this type of research. In other words, we made it clear to them that we would like them to promote PhysChem-Material, ChemBio-Material, and PhysBio-Mateiral fusion research in addition to existing Phys-Material and Chem-Material research. As a practical means of promoting this fusion research, we have launched the Fusion Research Proposal Program and are actively promoting the program by allocating startup funds for promising projects. To provide a place for fusion research to accelerate, we have 1) increased the frequency of the seminars to twice a month (every other Friday) and decided to select the lecturers for the seminars in the planning committee so that we can take the wishes of young researchers into consideration; and 2) started the weekly Friday Tea Time in September.

2. Research fields

<Initial plan>

(Research fields) "From Atom and Molecule to Materials," means the merging of physics, chemistry, materials science, and engineering to generate functional materials.

(Relevant fields) Chemistry, materials sciences, electronics engineering and information sciences, Precision and mechanical engineering, physics.

Our project addresses the inter-disciplinary fields consisting of the above five disciplines.

(Importance) Materials science is one of the most important fields for the future of science and technology in Japan as well as in the world. Materials science is the most important basis for all materials in our present society and should be continued as a core technology in future in order to maintain the current high technology endeavors in our country.

The research activities of materials science at Tohoku University have been world class. Our present research activities and their excellence over those of European and American countries in materials science should be maintained and, in the next 10 years, extended to the discovery of new materials and compounds with innovative functions by the combination of the above five disciplines to produce devices and systems applicable and useful to the benefit of society. Furthermore, it is expected that an entirely new paradigm will be born through the fusion approach.

<Results/progress/alternations from initial plan>

Fusion research is being promoted by the four research groups (Bulk Metallic Glasses, Nanophysics, NanoChemBio, and Device/System Construction) led by a total of 32 PIs, consisting of 19 domestic researchers, 13 from countries in Europe, the United States, and Asia. The difference from the last fiscal year is that the Nanochemistry Group was renamed the NanoChemBio Group and young PIs were invited from Harvard University and Hong Kong University of Science and Technology to serve as the top young researchers in the ChemBio field. All these actions are designed to reinforce the soft materials field. Furthermore, a young PI was invited from Texas A & M University to lead the PhysBio field. They have laboratories in Sendai and promote research as active PIs.

3. Research objectives

<Initial plan>

The main objective of the Center is to promote the development of new materials under a world-leading organization for interdisciplinary research in functional materials, by the use of an innovative method of atomic and molecular control, departing from the typical approaches and moving towards the next generation. In addition to basic research, the Center will pursue (1) creation of new compounds and materials with innovative functions which exceed existing ones, (2) construction of devices based upon a new fundamental paradigm, and (3) promotion of applied research projects on materials and systems architecture that will generate direct societal impacts. In addition, the Center will establish innovations in understanding diverse materials functions through the creation of new basic materials and compounds which brings significant benefits for the future of humanity.

<Results/progress/alternations from initial plan>

The major factors in the research goals we want to achieve have not changed from the initial plan. Given below are the major research achievements for the current fiscal year:

1) The Bulk Metallic Glasses Group has discovered a new bulk metallic glass comprising Pd, Zr, Ni and others, and succeeded in creating metallic glass nano wire (awarded the 2009 James C McGroddy Prize of the American Physical Society). The Group pioneered an experimental characterization of the shear transformation zone in the plastic flow of bulk metallic glass (presented in PNAS) and identified the thermodynamic origin of the yield strength (presented in PRL).

2) The Nanophysics Group has discovered quantum functions including the quantum Hall effect caused by the atomic scale interface control of oxides, which is the first discovery regarding oxides (presented in Science) and the world's first electric-field-induced superconductivity (presented in Nature Materials). The Group succeeded in clarifying the superconductivity mechanism of a ferrous superconductor (presented in PNAS) and of a graphite superconductor (presented in

	Nature Physics) using photoelectric spectroscopy. The Group also clarified the behavior of hydrogen molecules confined in C-60 (presented in PRL). 3) The NanoChemBio Group has developed a synthetic methodology for molecular conversion using gold molecular catalyst, and succeeded in, for example, total synthesis of (+)-ochromycinone, which is an antibiotic substance for helicobacter pylori and has a complicated molecular structure (awarded the 2009 Centenary Prize of the Royal Society of Chemistry, UK). Now, the Group is expanding gold molecular catalyst to a gold nano-structured materials catalyst and developing a green process. In addition, the Group has developed hetero ring synthetic methodology using noble metal catalysts (presented in Chem.Rev. and taken as a featured New Hot Paper in Thomson Science Watch). Invention of the supercritical hydrothermal synthesis technique made it possible to create hybrid materials from polymers and nanoparticles. This has opened the way to creating flexible magnetic materials that had so far been regarded as impossible. 4) The Device/System Construction Group has created a new half metal material (gallium manganate) that is expected to present a giant magnetic resistance effect (linked to the receipt of the Oliver E. Buckley Prize for 2009 from the American Physical Society). The Group succeeded in making piezoelectric thin film (composed of PbZrTi) through organic molecular evaporation and succeeded in applying the film to fluorescence scanners (consequently the Group was selected as a core member of the 2009 Funding Program for World-Leading Innovative R&D on Science and Technology from the Ministry of Education, Culture, Sports, Science and Technology). Innovation is currently progressing according to the new Fusion Research Proposal Program implemented from this fiscal year, including not only the achievements mentioned above but also other excellent ones not given here. The report for fiscal 2010 will summarize the achievements of those fusion research projects. What has changed from the initial plan is the launch of a framework for promoting fusion research. Namely, the incentive was increased by supporting promising fusion research proposals with startup funds. There have been other changes: the Nanochemistry Group has been renamed the NanoChemBio Group, three young foreign PIs were invited to actually manage laboratories and conduct researches in Sendai, and Center Director Yamamoto, who was only engaged in administration and management, has started research in NanoChemBio as a PI.

4. Management

<Initial plan>

1) Composition of administrative staff

Our administrative staff provide logistic support which allows researchers to conduct their studies flawlessly. We also intend to actively invite eligible experts who can handle proactive research development, and together with the researchers, aid in the expansion of research results. Consequently, this formation can significantly contribute to the Center's research goal activities.

Specifically, daily routines such as in accounting, human resources and research support are managed by highly experienced staff who can accomplish their duties without difficulty. They will be selected mainly from intramural administrative staff. To satisfy the requirements for the Center's official language, which is English, staff who have supportive abilities in English language will be preferentially assigned, and external staff with a good command of English are also planned to be recruited. Besides the duties above, a Program Officer, Project Manager, and other senior positions will be occupied by excellent and experienced personnel from various fields including researcher evaluation, international research coordination, activating expansion of and public relations for research results, and planning and support of research workshops. We will proactively hire diverse professionals; not only experienced at the University, but also from the private sector and non-Japanese with international experience, former researchers etc., utilizing an annual salary system.

2) Decision-making system

In the bid for a rapid and flexible decision making process, we will not specifically launch a decision making organization, but set up a top-down command system governed by our Center Director.

Aimed at support for a Center Director's top-down decision making system, an International Advisory Board, which includes Nobel Laureate board members, is to be established directly under the Center Director position. We will also develop a proper environment utilizing Internet technology, so that the Center Director and board members can effectively exchange and share their views together on implementation of system reform and other issues for creation of a world premier international research center.

Also, the university will implement a taskforce team in the Administration Bureau, led by the Office of the President, which will activate environmental improvements for Center Director top-down management to bring flexible approaches, and revisions and betterment of the university's system at the Center Director's request.

3) Allocation of authority between center director and host institution

<Results/progress/alternations from initial plan>

1) Composition of administrative staff

This fiscal year, no changes were made to the administrative staff after the major expansion of the last fiscal year. The administrative staff is composed of an Administrative Director under whom there is a Deputy Administrative Director. Under the Deputy Administrative Director are a total of 29 administrative staff members for four types of services: General Affairs section, International Academic/Research Cooperation section, Accounting section and Property Management section. In addition, those in charge of facilities, networks, and safety control are assigned as research assistants. The Management Office for Safety and Health has been separated to ensure the health of researchers and safety management of the laboratories. Eleven associated personnel who have the ability to work in English are assigned as administrative staff.

The Administrative Director who had been concurrently serving both as manager and professor is assigned as administrative director, and Administrative Director Iwamoto who has experience at an international organization was recruited on October 1, 2009 from outside with a view to inspiring the administrative staff to be more international. At the same time, the administrative structure was improved to allow the Center Director to fully exercise his leadership.

2) Decision-making system

Continuing on from the last fiscal year and following our initial plan, we have not established a decision-making organization based on a council system, but make decisions more flexibly and rapidly through a top-down administrative style with both the Center Director and the Administrative Director making decisions.

However, in order to fully make public the intentions of the Center Director and promote specific administrative measures, an Executive Committee has been established concurrently with the new Administrative Director taking office. The committee consists of the Center Director, the Administrative Director and the leaders of the four research groups (Bulk Metallic Glasses: PI Chen; Nanophysics: PI Tanigaki; NanoChemBio: PI Yamamoto; and Device/System Construction: PI Miyazaki).

Also, liaison meetings for PIs are held as required.

3) Allocation of authority between center director and host institution

To secure the independence of the center administration, the host institution will limit its authority to extremely important items such as the appointment and dismissal of the Center Director, and leave all other personnel, budget execution and other items effectively under the discretion of the Center Director. For personnel matters, the host institution will only retain authority over the appointment and dismissal of the Center Director, and have all other personnel items within the center including the employment of lead researchers determined by the Center Director. The budget allotted to the center (personnel expenses and non-personnel expenses) will be turned over in its entirety for free execution at the judgment of the Center Director, and it will be possible to carry over funds allocated for budget items that are not implemented by the end of the fiscal year to the subsequent fiscal year.	Continuing from last fiscal year and following our initial plan, administration of the center is entirely at the judgment of the Center Director and the Administrative Director to ensure independent administration of the center. On the other hand, the host institution retains authority over very limited matters of importance including appointment and dismissal of the Center Director. Researchers are always recruited based on the final decision of the Center Director, and implementation of the budget is also at the discretion of the Center Director.

5. Researchers and center staffs

i) “Core” to be established within host institution

Principal investigators

	At beginning	Planned for end of FY 2007	Final goal (Date: Oct, 2008)	Results at end of FY 2008	Results at end of FY 2009
Researchers from within host institution	15	15	15	15	15
Foreign researchers invited from abroad	11	11	11	10	13
Researchers invited from other Japanese institutions	4	4	4	4	4
Total principal investigators	30	30	30	29	32

All members

	At beginning	Planned for end of FY 2007	Final goal (Date: Oct, 2008)	Results at end of FY 2008	Results at end of FY 2009
Researchers <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	60 < 19, 31%>	90 < 28, 31%>	120 < 38, 31%>	83 < 33, 40%> [5, 6%]	129 < 70, 54%> [10, 8%]
Principal investigators <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	30 < 12, 40%>	30 < 12, 40%>	30 < 12, 40%>	29 < 11, 38%> [0, 0%]	32 < 15, 47%> [0, 0%]
Other researchers <Number of foreign researchers among them and their percentage> [Number of female researchers among them and their percentage]	30 < 7, 23%>	60 < 16, 26%>	90 < 26, 27%>	54 < 22, 41%> [5, 9%]	97 < 55, 57%> [10, 10%]
Research support staffs	44	44	53	13	33
Administrative staffs	35	35	40	26	29
Total	139	169	213	122	191

ii) Satellites <Initial plan> Institution (1) -Role -Personnel composition and structure -Collaborative framework Institution (2)	<Results/progress/alternations from initial plan> Last fiscal year, a European Satellite was launched at University of Cambridge in order to intensively promote joint research with the European BMG Group. This fiscal year, the European Satellite played a central role in holding an international conference on metallic glasses at Grenoble, France. Institution (1) University of Cambridge -Role Wide and detailed joint research in the creation of bulk metallic glasses, characterization, functional assessment, and construction of theoretic, etc. -Personnel composition and structure Alan Lindsay Greer (PI), Shantanu Madge (postdoctoral researcher) -Collaborative framework Expanding the network jointly with another European BMG Group (Alain Reza Yavari) based at University of Cambridge
iii) Partner institutions <Initial plan> Institution (1) University of Wisconsin-Madison -Role Joint research in nanophysics -Personnel composition and structure Max G. Lagally (PI) -Collaborative framework Promotes joint research in nanophysics. Arranges postdoctoral researcher and assistant professors, etc. Institution (2) Grenoble Institute of Technology -Role Joint research into bulk metallic glasses -Personnel composition and structure Alain Reza Yavari (PI) -Collaborative framework Promotes joint research into bulk metallic glasses. Arranges postdoctoral researchers and assistant professors, etc. Institution (3) IBM Thomas J. Watson Research Center -Role Joint research in nanophysics -Personnel composition and structure	<Results/progress/alternations from initial plan> Institution (1) University of Wisconsin-Madison -Role Joint research in nanophysics -Personnel composition and structure Max G. Lagally (PI) -Collaborative framework Promoting joint research in nanophysics. Institution (2) Grenoble Institute of Technology -Role Joint research into bulk metallic glasses -Personnel composition and structure Alain Reza Yavari (PI), Konstantinos Geogarakis (assistant professor) -Collaborative framework Promoting joint research into bulk metallic glasses. Yavari has visited WPI several times to actively promote the joint research of the BMG Group. A joint research structure is being established with Geogarakis placed as assistant professor. Within the framework of the joint research, accepted a Ph. D. student from the Yavari Laboratory at the university as a visiting scientist.

Rudolf M. Tromp (PI)
-Collaborative framework
Promotes joint research in nanophysics. Specifically, arranges postdoctoral researchers and assistant professors, etc., whose main work centers on research into surface physics and surface chemistry.

Institution (4) University of Massachusetts Amherst
-Role
Joint research into high polymer chemistry and soft materials
-Personnel composition and structure
Thomas P. Russell (PI)
-Collaborative framework
Promotes joint research into high polymer chemistry and soft materials. The partners in Japan should be PIs Nishi and Shimomura. Arranges postdoctoral researchers and assistant professors, etc.

Institution (5) Chemnitz University of Technology
-Role
Joint research into MEMS
-Personnel composition and structure
Thomas Gessner (PI)
-Collaborative framework
Promotes joint research into MEMS. The main partner in Japan is PI Esashi, and other engineering system researchers will participate. Arranges postdoctoral researchers and assistant professors, etc.

Institution (6) University College London
-Role
Joint research into surface physics and theoretical research
-Personnel composition and structure
Alexander Shluger (PI)
-Collaborative framework
Promotes joint research into surface physics and theoretical research. The main partner in Japan is the theory group (PIs Tsukada and Tokuyama), and an experiment system group will be added. Arranges postdoctoral researchers and assistant professors, etc.

Institution (3) University of Massachusetts Amherst
-Role
Joint research in high polymer chemistry and soft materials
-Personnel composition and structure
Thomas P. Russell (PI)
-Collaborative framework
Promoting joint research into high polymer chemistry and soft materials. Within the framework of the joint research, accepted a Ph. D. student from the Russell Laboratory at the university as a visiting scientist.

Institution (4) Chemnitz University of Technology
-Role
Joint research into MEMS
- Personnel composition and structure
Thomas Gessner (PI), Yu-Ching Lin (assistant professor), Jae-Wang Lee (postdoctoral researcher)
-Collaborative framework
Promoting joint research into MEMS. A joint research structure has been established with Lin placed as assistant professor and Lee as postdoctoral researcher in Sendai. Within the framework of the joint research, accepted Ph. D. students and young researchers from the Gessner Laboratory at the university as visiting scientists.

Institution (5) University College London
-Role
Joint research in surface physics and theoretical research
-Personnel composition and structure
Alexander Shluger (PI), Thomas Trevethan (assistant professor), Keith McKenna (assistant professor), Peter Sushko (adjunct associate professor)
-Collaborative framework
Promoting joint research into surface physics and theoretical research. Joint research structure has been established with Trevethan and McKenna as assistant professors in Sendai. Shluger and Sushko have visited WPI several times to construct a joint research structure in the Physics Group. Within the framework of the joint research, accepted a young researcher from the Shluger Laboratory at the

Institution (7) University of Cambridge -Role Joint research into bulk metallic glasses -Personnel composition and structure Alan Lindsay Greer (PI) -Collaborative framework Promotes joint research into bulk metallic glass. Arranges postdoctoral researchers and assistant professors, etc.	university as a visiting scientist. Institution (6) The University of Cambridge -Role Joint research into bulk metallic glasses -Personnel composition and structure Alan Lindsay Greer (PI), Shantanu Madge (postdoctoral researcher) -Collaborative framework Promoting joint research into bulk metallic glasses. The European Satellite is energetically promoting joint research. A joint research structure has been established with Madge placed as postdoctoral researcher in Sendai.
Institution (8) Institute of Chemistry, Chinese Academy of Science -Role Joint research in nanochemistry and surface chemistry -Personnel composition and structure Li-Jun Wan (PI) -Collaborative framework Promotes joint research in nanochemistry and surface chemistry. Arranges postdoctoral researchers and assistant professors, etc.	Institution (7) Institute of Chemistry, Chinese Academy of Science -Role Joint research in nanochemistry and surface chemistry -Personnel composition and structure Li-Jun Wan (PI), Rui Wen (postdoctoral researcher) -Collaborative framework Promoting joint research in nanochemistry and surface chemistry. A joint research structure has been established with Wen placed as postdoctoral researcher in Sendai. Within the framework of joint research, accepted a Ph. D student from the Wan Laboratory at the university as a visiting scientist.
Institution (9) Pennsylvania State University -Role Joint research in nanophysics -Personnel composition and structure Paul S. Weiss (PI) -Collaborative framework Promotes joint research in nanophysics. Arranges postdoctoral researchers and assistant professors, etc.	Institution (8) University of California, Los Angeles -Role Joint research in nanophysics -Personnel composition and structure Paul S. Weiss (PI) -Collaborative framework Since PI Weiss moved his research base from Pennsylvania State University to UCLA, made the university a partner institution. Promoting joint research in nanophysics.
Institution (10) Johns Hopkins University -Role Joint research into bulk metallic glasses -Personnel composition and structure Kevin J. Hemker (PI) -Collaborative framework Promotes joint research into bulk metallic glasses. Arranges postdoctoral	Institution (9) Johns Hopkins University -Role Joint research into bulk metallic glasses -Personnel composition and structure Kevin J. Hemker (PI) -Collaborative framework Promoting joint research into bulk metallic glasses.

researchers and assistant professors, etc

Institution (11) Tsinghua University
-Role
Joint research in nanophysics
-Personnel composition and structure
Qi Kun Xue (PI)
-Collaborative framework
Promotes joint research in nanophysics. Arranges postdoctoral researchers and assistant professors, etc.

Institution (12) Tokyo Institute of Technology
-Role
Joint research into high polymer chemistry, soft materials, and the properties of high-polymer solid state materials
-Personnel composition and structure
Toshio Nishi (PI)
-Collaborative framework
Promotes joint research into high polymer chemistry, soft materials, and the properties of high-polymer solid state materials. Arranges postdoctoral researchers and assistant professors, etc.

Institution (13) Waseda University
-Role
Joint research into solid-state properties theory
-Personnel composition and structure
Masaru Tsukada (PI)
-Collaborative framework
Promotes joint research into solid-state properties theory. Arranges postdoctoral researchers and assistant professors, etc.

Institution (10) Tsinghua University
-Role
Joint research in nanophysics
-Personnel composition and structure
Qi Kun Xue (PI), Hongwen Liu (assistant professor)
-Collaborative framework
Promoting joint research into nanophysics. A joint research structure has been established with Liu placed as assistant professor in Sendai.

Institution (11) Texas A&M University
-Roles
Joint research in biophysics. Placement of a postdoctoral researcher.
-Personnel composition and structure
Winfried Teizer (PI), Daniel Oliveira (postdoctoral researcher)
-Collaborative framework
Since Teizer has joined as a PI, made the university an associate institution. Promoting joint research in biophysics. A joint research structure has been established with Oliveira placed as a postdoctoral researcher in Sendai.

Institution (12) Harvard University
-Role
Joint research in NanoChemBio. Placement of a postdoctoral researcher.
-Personnel composition and structure
Ali Khademhosseini (PI), Murugan Ramalingam (assistant professor)
-Collaborative framework
Since Khademhosseini has joined as a PI, made the university an associate institution. Promoting joint research in NanoChemBio. A joint research structure has been established with Ramalingam placed as an assistant professor in Sendai.

Institution (13) Hong Kong University of Science and Technology
-Role
Joint research in NanoChemBio.
-Personnel composition and structure
Hongkai Wu (PI)
-Collaborative framework
Since Wu has joined as a PI, made the university an associate institution. Promoting joint research in NanoChemBio with a postdoctoral researcher placed in Sendai.

Institution (14) Advanced Research Laboratory, Hitachi Ltd.
-Role
Joint research into the properties of solid-state surfaces and nanophysics
-Personnel composition and structure
Tomihiro Hashizume (PI)
-Collaborative framework
Promotes joint research into the properties of solid-state surfaces and nanophysics. Arranges postdoctoral researchers and assistant professors, etc.

Institution (15) University of Tokyo
-Role
Joint research into crystal interfaces and theory
-Personnel composition and structure
Yuichi Ikuhara (PI)
-Collaborative framework
Promotes joint research into crystal interfaces and theory. Arranges postdoctoral researchers and assistant professors, etc.

Institution (14) Advanced Research Laboratory, Hitachi Ltd.
-Role
Promoting joint research in surface physics and nanophysics.
-Personnel composition and structure
Tomihiro Hashizume (PI), Taro Hitosugi (associate professor), Katsuya Iwaya (assistant professor), Takeo Ohsawa (assistant professor), Nobuyuki Fukui (postdoctoral researcher)
-Collaborative framework
Promoting joint research in surface physics and nanophysics. Joint research structure is being established with Hitosugi placed as associate professor, Iwaya and Ohsawa as assistant professors, and Fukui as postdoctoral researcher.

Institution (15) University of Tokyo
-Role
Joint research into crystal interfaces and theory.
-Personnel composition and structure
Yuichi Ikuhara (PI), Susumu Tsukimoto (lecturer), Mitsuhiro Saito (assistant professor), Zhongchang Wang (postdoctoral researcher), Lin Gu (postdoctoral researcher)
-Collaborative framework
Promoting joint research into crystal interfaces and theory. A joint research structure is being established with Tsukimoto placed as lecturer, Saito as assistant professor, and Wang and Gu as postdoctoral researchers.

6. Summary of center's research environment

<Initial plan>

1) Environment in which researchers can devote themselves to their research

We will arrange the environment so that the researchers participating at this Center can devote themselves exclusively to research to the greatest possible extent. The environment the Center provides for PIs is similar as that provided for Distinguished Professors in the US.

We will make arrangements so that the researchers themselves will not be involved in the managerial work of the host institution, provide detailed time management (effort management) for the researchers, and otherwise secure ample time for the researchers to engage in research at this Center as much as possible.

We will also prepare strong staff backup for accounting, personnel, research support, liaison and public relations work so that the researchers can devote themselves to research. The function of staff will be to implement various procedures and management tasks on behalf of the researchers. In addition to individuals who will perform day-to-day accounting and other administrative tasks, we will assign as program officers other individuals with outstanding experience in fields such as researcher evaluation, international research coordination, the ordered development of research findings, the publication of research findings, and the planning and support of research conferences. To these ends, in addition to utilizing university staff, we will make use of the annual salary system to actively employ individuals with experience in the private sector, foreigners (individuals with international experience), distinguished researchers, and other diverse personnel. We will also assign the technical staff required for the smooth progress of the research.

Besides the scientific and research issues, it is necessary to provide PIs not only with sufficient facilities and space in laboratories, but also with an enjoyable living environment at home, especially for people from abroad. We will do our best to arrange a comfortable environment.

2) Startup research funding

At the discretion of the Center Director, the necessary start-up funds will be provided in cases when the invited researchers require funds to continue their own research vigorously when they are initially transferred to the center.

We will also promptly provide the invited researchers with opportunities for brainstorming and research and information exchange with Tohoku University researchers and for examining the potential for joint research at the university, support their access to common university experimental and other facilities, and otherwise support the vertical advance of their research.

<Results/progress/alternations from initial plan>

1) Environment in which researchers can devote themselves to their research

We suggested in the initial plan that we would provide an environment similar to that provided to distinguished professors in the US. As the primary factor in working conditions (compensation), an extra allowance (100,000 yen/month, 1000 USD, based on 100 yen per dollar) is provided for full-time PIs at the Center following on from last fiscal year. In addition, three-stage extra allowances are provided from this fiscal year based on an evaluation of research performance to improve the compensation. When deciding the annual compensation for the winners of notable awards, a program was established to provide additional payment for just one year following the fiscal year in which the award was made according to two separate ranks. The program was applied to one researcher this fiscal year.

In order to secure research time at the Center, the Center Director requests the bureau managers concerned to make arrangements so that researchers who belonged to the host institution before the Center was established will not be involved in managing the host institution or in educational activities unless they want to. These arrangements have been followed satisfactorily.

With regard to support staff, full-time technical personnel at the Center are assigned to be in charge of safety control, facility maintenance and network systems again this fiscal year to maintain an environment in which researchers can devote themselves to their research. These personnel contributed to making the environment favorable for research activities by playing a central role in coordinating researchers' requests and the contractor's intention to improve the interior of the research building completed last fiscal year. We have adopted English for almost all paperwork including notices to make things easier for foreign researchers.

2) Startup research funding

The research structure of the Center consists of four research groups: Bulk Metallic Glasses, Nanophysics, NanoChemBio, and Device/System Construction. Each group is provided with startup funding which it uses to introduce basic research instruments essential for the research. This fiscal year again, funding was provided to groups which have not yet been fully equipped with the instruments they need.

We also decided to provide startup funding to promising research projects through the strategic Fusion Research Program, and 13 cases (4 fusion research projects by PIs and 9 fusion research projects by young researchers) for the first

	semester and 14 cases (4 fusion research projects by PIs and 10 fusion research projects by young researchers) for the second semester were adopted.
3) Postdoctoral positions through open international solicitations (Recruitment Method) In the recruitment of post-doctoral researchers, we will secure superior international personnel via international recruitment using Tohoku University's website (English and Japanese), international scientific journals, and Tohoku University's overseas bases, specifically as follows: 1) International recruitment via Tohoku University's website (English and Japanese) 2) International recruitment through recruitment advertisements in *Nature*, *Science* and other international scientific journals, and in the publications of academic societies in which the lead researchers are members 3) International recruitment via the website of the JREC-IN (Japan Research Career Information Network) personnel database (English and Japanese) administered by the Japan Science and Technology Agency 4) International recruitment using Tohoku University's US office, China office, and other overseas offices and bases, and by asking renowned universities worldwide to post the recruitment information on their websites, including global universities which have academic exchange agreements with Tohoku University (119 institutions), and members of university consortia (The Association of East Asian Research Universities [AEARU], etc.) 5) Other international recruitment utilizing the international networks that the lead researchers have developed in each academic field. (Employment Screening Method) Post-doctoral researcher employment screening committees comprised of several members will be organized for each lead researcher, with the lead researcher serving as the committee chairperson. The post-doctoral candidates will be determined through an initial selection by examination of documents and a secondary selection by interviews. The final employment decisions will be made by the Center Director. This process will positively employ post-doctoral researchers with superior results in interdisciplinary research as well as in their field of specialization, in order to promote comprehensive interdisciplinary research efforts.. The Center Director will directly make the employment decisions to secure promising post-doctoral researchers in accordance with the center concept. (Employment of Female Researchers) We have an employment plan that the percentage of female researchers including postdoctoral fellows among all the researchers of WPI reaches at least 10%, hopefully, in between 10 and 20%.	3) Postdoctoral positions through open international solicitations This fiscal year again, we made open international solicitations through our website and WPI-AIMR News with a view to continuing to secure excellent personnel. We received applications from 68 individuals and have recruited 16 researchers in FY2009. Applicants for fields directly linked to PIs underwent document screening by the PIs involved, and interviewed as required before they were selected as competent candidates. Then they were recruited after the final decision was made by the Center Director. Currently, foreigners account for 70%, that is 23 out of 33 postdoctoral researchers, including 3 female researchers.
4) Administrative personnel who can facilitate the use of English in the	4) Administrative personnel who can facilitate the use of English in the

work process

We will prepare an environment which permits researchers to carry out their work duties in English.

We will prepare an environment whereby the exchanges between researchers and administrative staff can always be conducted in English right from the launch of the center by assigning multiple staff members to each section who can perform their work duties in English.

To these ends, we will assign university staff with superior English skills, in addition to expertise in such fields as accounting, personnel and research assistance, as administrative staff on a priority basis. Additionally, to supplement the English abilities of those staff, we will also secure administrative staff who are proficient in English by utilizing dispatched workers and the annual salary system to employ outside personnel, to assign to the center administrative staff who can execute work duties in English.

Furthermore, we will arrange systematic opportunities for administrative staff to participate in English training and constantly improve their English ability (including English in areas of expertise).

Documents for internal use that must be filled out personally by the researchers will be prepared in English, so that the foreign researchers will be able to submit all relevant documents.

We will also incrementally boost the ability to use English in the performance of duties at the center, and progressively shift to a system whereby English will become the official language for all meetings inside the center and English will be used whenever possible for all documents drafted inside the center.

5) Rigorous system for evaluating research and system of merit-based compensation

As for the evaluation of researchers, Tohoku University has already stipulated a university-wide method for the assessment of individual faculty, with a researcher evaluation scheme at each department. The performance of center researchers will be strictly evaluated in accordance with this system, and the researchers' salary assessments (pay-raise system and diligence allowance) and incentives such as priority allocation of research funds will be determined based on the evaluation results. For salaries in particular, in addition to the active adoption of the annual salary system, special allowances will be granted to researchers who make outstanding contributions.

We will establish an international advisory board, including Nobel Prize recipients as members, and an external evaluation board. They help to evaluate not only the research of individual PI but also the system and organization of the WPI center.

Additionally, "invitation allowances" (maximum period of 5 years) will be

work process

We assigned university staff with superior English skills and expertise in fields including accounting, personnel and research assistance, as administrative staff on a priority basis. To supplement the English abilities of these staff, we also secured again this fiscal year administrative staff who are proficient in English as associate personnel to further expand the Center's administrative functions that need to be done in English, especially for PR activities and safety control. This fiscal year, their English abilities were fully utilized in promptly notifying staff of the novel influenza related information.

Following on from last fiscal year, we are providing English training on an outsourcing basis for administrative staff to improve their English abilities. This fiscal year, training was provided for advanced learners to brush up their abilities.

We have also prepared all documents related to the Fusion Research Program including notices, forms and guidance in English for foreign researchers.

When applying for Grants-in-Aid for Scientific Research, the application form has to be filled out on the website, but the application procedure is displayed only in Japanese. The Center prepared and distributed an application manual in English in addition to the English instructions to foreign researchers to urge them to apply. As a result, applications from six foreign researchers were adopted for fiscal 2009 and 21 foreign researchers out of 26 who were eligible applied for fiscal 2010.

5) Rigorous system for evaluating research and system of merit-based compensation

Following on from last year, this year again researchers were evaluated on their research performance and other factors (publication list, external funding acquisition status, awards, and research performance for the past three years). Evaluations are conducted annually, and the evaluation results will be used to decide whether to renew their appointment when their term expires as well as pay raises and promotion.

Full-time PIs have been provided with a extra allowance (100,000 yen/month, 1000 USD, based on 100 yen per dollar) since establishment of the Center, but in addition to this, we decided to provide a extra allowance in three ranks (S, A, and B) for those who received excellent evaluations starting from this April with a view to providing an incentive to researchers. This fiscal year, four researchers qualified for rank S (90,000 yen/month, 900 USD, based on 100 yen per dollar), eight for rank A (70,000 yen/month, 700 USD, based on 100 yen per dollar), and six for rank B (50,000 yen/month, 500 USD, based on 100 yen per dollar).

An annual salary system has been introduced for researchers newly recruited

granted to prominent invited researchers from outside the host institution in accordance with their research accomplishments and most recent salaries.

Moreover, new systems will be introduced including a "Fellow Professor" (tentative name) system for professors playing leading roles in the research, as well as a system for preparations payments or contract conclusion payments to provide additional incentives when trying to attract Nobel Prize–class researchers, etc.

Tohoku University's "University Professor System" will also be actively used for the invitation of prominent researchers.

6) Equipment and facilities, including laboratory space, appropriate to a top world-level research center

To prepare a facilities environment suitable for a global top-level center, the host institution will operate a new core facility (building) for the center's activities so it can be used from around April 2008 as a target date. This facility will be equipped with flexible water supply and drainage equipment, air conditioning equipment, and power sources so that it can be a research space that meets the respective room arrangement, equipment, apparatus and other usage demands of the individual researchers. Considering the great importance of information exchange and brainstorming among the researchers, the researchers' office wing will be arranged with a library section, discussion corners and other spaces where the researchers can gather in a central zone, with the individual offices located on the outskirts of this common area. The security arrangements will ensure safety by zone, covering each research room or each department and the entire building. Energy conservation equipment will be adopted to mitigate pressure on research funds.

In addition to this new building, research space in existing buildings will also be used to conduct the business of center research. In those cases as well, while there will be some limitations on the room arrangements, the research rooms and offices will be upgraded as deemed suitable for a global top-level center with improvements based on the above approach, starting with reinforcement of the structures' earthquake resistance.

Private-sector facilities will also be actively utilized to flexibly secure sufficient research space in accordance with the progress of the research.

Arrangements will be made to provide the researchers with priority access to high-performance electron microscopes and other state-of-the-art research equipment through close coordination with the Technology Center for Research and Education Activities and other related Tohoku University organizations.

from institutions other than the host institution, and the system allows us to set pay raises as we see fit based on the individual's evaluation and a final decision made by the Center Director. In determining the annual salary for researchers, it was decided to provide an additional amount to people who won notable global awards (5 million yen (50,000 USD, based on 100 yen per dollar) for especially notable recipients, and 3 million yen (30,000 USD, based on 100 yen per dollar) for younger researchers who received other prestigious awards) only for the fiscal year following the year in which they received their award. This system has so far been applied to one researcher.

6) Equipment and facilities, including laboratory space, appropriate to a top world-level research center

The first-phase Integration Laboratory Building was completed at the end of fiscal 2007 and the second-phase building was completed at the end of fiscal 2008. We started using the entire integration laboratory complex this fiscal year. In May 2009, the building was opened, and interior work and a Helium recovery room and other construction were completed in September. PI Kawasaki, PI Louzguine, PI Chen, PI Hashizume, PI Miyazaki and PI Yamada have moved in to the laboratories and experiment rooms and started research. Rooms for seminars, research staff, and visiting professors are also provided so that the building can function as the main research site of WPI-AIMR. Innovation Space has been provided in the laboratory buildings as a place for information exchange, communication, and brainstorming among researchers to stimulate new ideas. We have been using this space to hold our weekly Friday Tea Time since September to promote fusion among researchers from different fields.

Now, the third-phase Integration Laboratory Building (6,600m^2) is being designed as one of the WPI-AIMR research buildings based on the supplementary budget for fiscal 2009 and it is expected to be completed by the end of fiscal 2010. On completion, Junior PIs being invited from abroad and four PIs staying on the Aobayama Campus are expected to move in. This will achieve a concentration of PIs on the Katahira Campus, and we believe this will substantially facilitate interdisciplinary research.

Since both the Integration Laboratory buildings (1st phase and 2nd phase) are now in full operation, the space used for WPI-AIMR this fiscal year totals 14,300m^2 consisting of: 1) the space used by the center (2,500 m^2) from the strategic common space used by the entire university with the reform of the existing buildings; 2) existing space that we continue to provide to PIs who belonged to the host institution before the Center was established used to educate successors (students, etc.) (4,500 m^2); 3) administrative building for the exclusive use of the Center (300 m^2); and 4) Integration Laboratory Buildings (7,000m^2).

7) International research conferences or symposiums held regularly to bring world's leading researchers together

We will advance international development via researcher and other personnel exchanges and institutional relations for international joint research by positively utilizing Tohoku University's US office, China office, 11 liaison offices and other overseas offices and bases, and via liaison with global universities which have academic exchange agreements with Tohoku University (119 institutions), and members of university consortia (The Association of East Asian Research Universities [AEARU], and Top Industrial Managers for Europe [TIME]).

Specifically we will first organize an international materials cooperation support committee among leading global universities to advance research on the topic "new substances and materials from atomic and molecular control, and functional innovation" and establish a structure to advance research and development under international institutional cooperation.

Then, using this international consortium along with Tohoku University's existing global network described above, we will arrange periodic opportunities for mutual exchange including the short-term overseas dispatch of center researchers and the invitation of global researchers to Japan, hold pacesetting cutting-edge international research conferences assembling top-level global researchers on a regular basis, and otherwise prepare an environment in which the center's researchers can engage in international research exchange, information exchange and brainstorming with the world's leading researchers.

8) Other measures, if any

We will advance the following approaches to build a center that compiles and advances the latest global information and research, and attracts the top minds initiating dramatic scientific developments.

1) We will establish an international advisory board, including Nobel Prize recipients as members. The names of the members are following; Dr. Hans H. Rohrer (Switzerland, 1986 Physics Nobel Laureate), Prof. Herbert Gleiter (Director, Institute for Nanotechnology Research, Karlsruhe), Prof. Robert J. Silbey (Dean, College of Science, MIT), Prof. Robert J. Birgeneau (Chancellor, Univ. California, Berkeley), Prof. Bing-Lin Gu (President, Tsinghua Univ. Beijing), Prof. K. Osterwalder (President, The UN University and President, ETH Zurich), Mr. Tadashi Onodera (President, KDDI Corp). They will report directly to the Center Director to support top-down type decision making by the Center Director. The Center Director and the international advisory board will organically cooperate and exchange opinions, and positively implement reforms to promote a global top-level research center. Further, the evaluation of accomplishments of researchers, which will be carried out every year, and the other evaluation events such as the recruitment of postdoctoral fellows will be performed based on advice of peer

7) International research conferences or symposiums held regularly to bring world's leading researchers together

From August 25 to 28 2009, the European Satellite played a central role in arranging the Workshop WPI-INPG-Europe at Grenoble, France. Participants in this workshop included leading metallic glasses researchers from Japan and Europe, and Professor Yavari of Grenoble CNRS-INPG, who is also a PI at the Center, organized and chaired the conference.

From October 4 to 8 2009, we held an International Conference on Advanced High-Temperature and High-Strength Structural Materials in Hong Kong jointly with Hong Kong Polytechnic University. This conference was organized and chaired by Professor C. T. Liu, who is also an adjunct professor of the Center. Participants at this conference were leading researchers of hard materials.

Besides the above, we held a joint International Symposium on Engineering Neo-Biomimetics (PI Shimomura chaired the executive committee) and Super Green 2009 (PI Adschiri chaired the organizing committee).

The WPI-AIMR Annual Workshop was held in Sendai from March 25 to 27, 2010.

8) Other measures, if any

1) This fiscal year, we added Dr. Benkatesh Narayanamurti and President Inoue, who retired from the position of PI, to the International Advisory Board. Also this fiscal year, Dr. Bednorz, Dr. Gleiter, and Dr. Narayanamurti of the Advisory Board visited the Center to have discussions with researchers and visit the laboratories. They gave advice and exchanged opinions directly with the Center Director.

2) We have changed the procedure for running seminars so as to include ideas and suggestions from young researchers. To be specific, we organized a seminar planning committee that included young researchers to select the lecturers and topics to make the seminars more interesting. At the same time, we made it mandatory for young researchers to attend the roughly two seminars a month. From September on, we linked the seminars and Friday Tea Time to promote further communication among young researchers.

3) We used the Fusion Research Proposal Program to allow young researchers to conduct joint research and fusion research as they wished, beyond the laboratory.

4) We assigned technical staff to be responsible for safety control, networks, and facilities again this year so that researchers can devote themselves to their research.

reviewers consisted of top class researchers from abroad and from domestic institutes. 2) We will arrange a flat research organizational structure with as few hierarchical relations as possible to create an environment where even young researchers can develop their own ideas. 3) We will provide young researchers with research support from senior mentors and otherwise promote the organic development of research. 4) We will assign the necessary technical staff to ensure the smooth development of research apparatus to support superior state-of-the-art research and creative research. 5) We will prepare a system to provide highly detailed lifestyle and education advice to support the daily life in Japan of foreign researchers at the center and the education of their children. For example, concerning schooling and education of researchers' children, Tohoku International School (having kindergarten, elemental school, junior high school, and high school) accepts children from abroad, so researchers can focus their research without being bothered by educational problem. Further we consider about possibility for supporting the expenses for children's education. Not only Tohoku International School, but also the ordinary schools nearby Tohoku University are used to accepting children from abroad. We contact the regional public organizations, which founded such schools, and intend to ask them cooperation on the acceptance and education of children from abroad.	5) Tohoku University plans to construct at its own cost on the Katahira Campus an accommodation building for researchers from abroad. Construction is expected to take two years starting in the next fiscal year. Thanks to the cooperation of the host institution, we are allowed to reserve a certain number of rooms for foreign researchers invited by the Center. We expect the living environment for researchers from abroad will improve significantly upon completion of the facility (March 2012).

7. Criteria and methods used to evaluate center's global standing

<Initial plan>	<Current assessment>
i) Criteria and methods to be used for evaluating the center's global standing in the subject field We evaluate each PI and researcher by the following indicators; publication in internationally well-recognized top-class journals, citation number of those papers, invited and plenary lectures at the well-recognized international symposiums, receiving international awards, and acquisition of research funds. As possible as we can, we want to use numerical and objective factors for evaluation. The center's global standing is primarily evaluated by the ranking of institutions of each discipline, based on citation analysis made by ISI. Besides, other factors, such as visible contribution to society by providing really useful materials, are used for evaluation. ii) Results of current assessment made using said criteria and methods Evaluation of the PIs based on the above criteria is attached to their CVs. The institution ranking of materials science in TU is the number 3 among 536 institutes in the world. According to the citation analysis, Max-Planck is the number 1 and Chinese Academy is the number 3 in materials science, but they are large	There is no need to change the indicators and methods used to evaluate the Center's global standing. Events that are good news for the Center are listed below. (1) Center Director Yamamoto received the 2009 Centenary Prize from the Royal Society of Chemistry. (2) In the Thomson Essential Science Indicators database, Center Director Yamamoto's Chemical Review, 2008, 108, 3395, was featured as a New Hot Paper in the chemistry field. This indicates that this paper is one of the most cited chemistry papers in the past two years. (3) PI Esashi was chosen as a leading researcher for a Funding Program for World-Leading Innovative R&D on Science and Technology by the Ministry of Education, Culture, Sports, Science and Technology to support research and development in most advanced science studies. (The program allocates a total of 100 billion yen (1 billion USD, based on 100 yen per dollar) from the fiscal 2009

organizations including several independent institutions in different cities. The ranking of physics in TU is the number 9 among 592 institutes, and that of chemistry is the number 18 among 774 institutes in the world.
iii) Goals to be achieved through the project (at time of interim and final evaluations)

As one of the outcomes, in the basic research fields, we strongly expect the world premier award in science will be given to a researcher (or hopefully researchers) in our institute, at the very least a world top-class international award will go to researchers. Also, it is expected that the ISI citation ranking of Tohoku University will be elevated dramatically. In the applied research fields, we are sure that many new systems will be developed on the basis of the newly created materials with their innovative functions will become commercially realizable and contribute very much to society's wellbeing. We think that the second issue (contribution to social welfare) is more and more important than the first one for evaluating accomplishments in our WPI center. In the interim, the relative indicators similar as above mentioned will be employed.

supplementary budget to promote world-class research activity by 30 researchers who have been chosen by screening.)

(4) PI Nishi received an award from IRCO (International Rubber Conference Organization).

(5) The most recent research outcomes of PI Miyazaki, PI Kawasaki, PI Esashi and PI Adschiri were featured in major domestic newspapers.

8. Securing competitive research funding

<Initial plan>

i) Past record (dollars)

FY2002	10,554,000	FY2003	8,460,000
FY2004	14,689,000		
FY2005	12,439,000		
FY2006	10,528,000		
Total	56,670,000		

ii) Prospects after establishment of the center

The host institution constructs a new building for the WPI research center until April, 2008. The salary for PIs, who have been researchers at each institute or Faculty in TU, is essentially paid by TU, even after they join the WPI center. Further, the fund for research, setting up instruments and equipments necessary for research at the Center, renovation of research space and laboratory, and smooth management of the Center will be supported by TU. For this purpose, TU will prepare approximately 1700000 US $ annually.
Besides the supports from TU mentioned above, the PIs joining from TU have obtained the research funds of approximately 11000000 US $ from outside in 2006 fiscal year, so we expect that similar amounts of research funds (or even greater amounts) will be obtained by them in future.

<Results/progress/alternations from initial plan>

Past records（units: dollars）are listed below.
Fiscal 2007 13,829,000 USD（based on 120 yen per dollar）
Fiscal 2008 20,228,000 USD（based on 120 yen per dollar）
Projected amounts for this fiscal year are shown below.（units: dollars）
Fiscal 2009 23,736,000 USD（based on 100 yen per dollar）
(2,373,600 thousand yen)

The amount of research funds PIs obtained externally in fiscal 2009 was equal to the initial projection.

9. Other important measures taken to create a world premier international research center

<Initial plan>

After the implementation term of this program is completed, the center will continue with its activities in order to enhance the potential for research at this center.

Also, within this program, we will actively introduce new research methods incorporating new concepts into the existing graduate course and research center at our university.

Noteworthy of Tohoku University, is its offering of the Institute for International Advanced Research and Education Organization (established in April, 2007) on basis of the 21st Century COE Program achievements. Incorporating the Institute for International Advanced Research and Education (initiated in April, 2006), it supports the graduate students who pursue integrated research; and the Institute for International Advanced Interdisciplinary Research (introduced in April, 2007) which promotes research in the many areas. We will initiate and develop a method reform and human resources cultivated in this center for enhancing the level of the fusional areas, fostered into the organization's activities, to rank as one of the best centers in the world. In order to insure that the research institutes collaborate intimately and to increase its research abilities of emerging or fusional areas, we contemplate about the reorganization and integration of existing graduate course and research center in our university as well.

<Results/progress/alternations from initial plan>

1) Active introduction of system reforms, established at the Center

When the application to build the Center was submitted, the same employment conditions as those for distinguished professors in the U.S. were proposed. As a first step to ensure these conditions, a special monthly allowance of 100,000 yen (1000 USD, based on 100 yen per dollar) has been provided to a PI since establishment of the Center in October 2007. Based on this initial step, the host institution introduced its "Tohoku University Distinguished Professor" system in December 2007 to be implemented at the discretion of the university's President. This system awards special financial benefits to faculty members who play a leading role in education, research and social contribution.

2) Partnership with research institutes within the host institution

AIMR offers the occasion of joint research in the PI's laboratories to young researchers from the Global COE and a unique organization of the host institution named "The Institute for International Advanced Interdisciplinary Research of the International Advanced Research and Education Organization".

10. Host institution's commitment

<Initial plan>

-Provision in host institution's mid-to-long-term plan

Tohoku University will clearly stipulate the advance of research and organizational development based on this program as a priority in its interim plan.

Specifically, the relevant section of Tohoku University's interim plan—2 Measures to Achieve Research Goals (1) Measures to Achieve Goals Concerning Research Levels and Research Results, Fields to be Addressed by the University on a Priority Basis—presently reads "Advance organizational development and promote research in basic research fields for which we have been recognized by the 21st Century COE Program and others on the basis of our performance and proposals for organizational restructuring." If the university is selected for this program, this passage will be amended to read "Advance organizational development and promote research in basic research fields for which we have been recognized by the World Premier International Research Center (WPI) Initiative, the 21st Century COE Program and others on the basis of our performance and proposals for organizational restructuring." and the university will give priority

<Results/progress/alternations from initial plan>

-Provision in host institution's mid-to-long-term plan

A medium-term plan developed by Tohoku University when the Center was established in fiscal 2007 set specific goals for research standards and research achievements. Measures proposed to meet these goals include promoting innovative studies at WPI-AIMR, a world-class research base, to create advanced materials for practical application and giving priority to establishing an organizational framework for such studies. The same measures are also incorporated in the second-phase medium-term plan formulated at the end of March, 2010. Tohoku University's action plan, the "Inoue Plan," states, under the chapter <Achieve world-class status rapidly by focusing on specific areas of research>, "Take steps to reinforce the organization of WPI-AIMR, so that it may play a leading role as part of a top-class international research network." As the host institution, in this fiscal year Tohoku University clarified its policy for providing focused support for research and for establishing an organizational framework. The university continues to provide that support based on this policy.

support to advancing research and organizational development based on this program. -Concrete Measures (1) Competitive grants obtained by researchers participating in the project and in-kind contributions, etc. The host institution will provide the necessary space in accordance with the advance of the research and the expansion of the center's research organization by operating a new core facility for the center's activities so it can be used from around April 2008 as a target date, and research space will also be secured within the host institution's existing facilities. Additionally, the host institution will basically pay the personnel expenses of all researchers who were affiliated with the host institution prior to the formation of the center. Beyond that, the host institution will expend enough money each year on such items as research expenses and other researcher support, the installation of apparatus required for research at the center, the refurbishing of research space, and management, administration and other items required for the smooth execution of the center's research. Aside from that, the host institution will provide the researchers with priority access to the Technology Center for Research and Education Activities' high-performance electron microscopes and other research equipment and assistance so that the center can implement global top-level research. In addition to this support from the host institution, the researchers who will participate in the center obtained approximately 11000000 US $ in outside funds in FY 2006, and they are projected to obtain an equal or greater amount of research funds once they are at the center. Thus overall the host institution fully expects to secure an amount of resources for the center that is equal or greater than the amount of support provided by this program. (2) System under which the center's director is able to make substantive personnel and budget allocation decisions To secure the independence of the center administration, the host institution will limit its authority to extremely important items such as the appointment and dismissal of the Center Director, and leave all other personnel, budget execution and other items effectively under the discretion of the Center Director. For personnel matters, the host institution will only retain authority over the appointment and dismissal of the Center Director, and have all other personnel items within the center including the employment of lead researchers determined by the Center Director. The budget allotted to the center (personnel expenses and non-personnel expenses) will be turned over in its entirety for free execution at the judgment of the Center Director, and it will be possible to carry over funds allocated for budget	-Concrete Measures (1) Competitive grants obtained by researchers participating in the project and in-kind contributions, etc. An existing facility for comprehensive materials and physical-properties studies in the Katahira district was renovated so that researchers invited to the Center can undertake their research smoothly after they are recruited. A new building was constructed to serve as an integrated laboratory (1st phase, 2nd phase). This enabled additional research space to be secured for senior research fellows who have belonged to the host institution since before the Center was established. Research space became necessary for these researchers because of the progress of their studies following the creation of the Center. Satisfactory research environments have been established by providing financial support and goods and equipment. Among the specific support measures were financial support in the salaries of senior research fellows and administrative-related clerical employees, subsidies for research activity, establishment of the facilities deemed necessary for research and development at the Center, renovation of research facilities to secure more research space, and allotment of funds to support the running of the Center. In addition to support from the host institution, researchers working at the Center obtained funds worth 23,736,000 USD (based on 100 yen per dollar) in fiscal 2009 from outside sources. This means that the host institution secured financial resources which are equal to or more than the total financial support under the program. (2) System under which the center's director is able to make substantive personnel and budget allocation decisions Authority vested in the host institution in running the Center is limited to appointing and dismissing the Center Director. Decision-making responsibility for other things is vested in the Center Director—all personnel-related affairs including approval for the recruitment of PIs, and flexibility in authorizing spending budgeted by the host institution. The head of the host institution made a pledge to honor that divesting of authority when the application for the Center was submitted to the government. That pledge has been honored since the establishment of the Center. It has been agreed that in the future, the preparation of all documents in English will be approved as a model case for the host institution, which will be linked to the enhancement of the support staff. This is in consideration of a workplace environment where English is used as the common language, which is a characteristic of the Center.

items that are not implemented by the end of the fiscal year to the subsequent fiscal year.	
(3) Support for the center director in coordinating with other departments at host institution when recruiting researchers, while giving reasonable regard to the educational and research activities of those departments After Tohoku University is selected for this program, the Council of Department Heads Concerned with the World Premier International Research Center (WPI) Initiative will continue to actively support the Center Director, meeting at his request and as otherwise needed to secure the cooperation of the related departments for the greater vitality of the center research activities.	(3) Support for the center director in coordinating with other departments at host institution when recruiting researchers, while giving reasonable regard to the educational and research activities of those departments A conference consisting of the heads of eight relevant divisions was set up at the host institution under the chairmanship of the president of the institution when the application to establish the Center was made. The conference acts as an in-house panel to coordinate the deployment of researchers working for the host institution. The conference continues to be chaired by the president of the host institution after adoption of the program. The conference is convened as needed at the request of the Center Director and has established a system that actively supports the Center Director with the backing of the relevant divisions. In this fiscal year, a strong request was filed to the heads of relevant divisions for their cooperation with the proposed transfer of PIs to the Katahira campus. The proposal to move them from the Aobayama campus when the Integration Laboratory mentioned above (third phase) was completed was approved.
(4) Revamping host institution's internal systems to allow introducing of new management methods (e.g., English-language environment, merit-based pay, top-down decision making) unfettered by conventional modes of operation We plan to establish an international advisory board, including Nobel Prize recipients as members, which will report directly to the Center Director to support top-down type decision making by the Center Director. To these ends, the president of the host institution will make the necessary requests for cooperation from Nobel laureates. In addition, an environment will be established, including the use of Internet technologies, to facilitate swift consensus building and organic linkages between the Center Director and the international advisory board, and . Also, so that work at the center can be conducted smoothly in English, we will assign staff with superior English skills, in addition to expertise in such fields as accounting, personnel and research assistance, as administrative staff on a priority basis. To introduce a compensation system that reflects researchers' abilities, we will urgently examine the introduction of new systems including a "Fellow Professor" (tentative name) system aiming at balance with the salaries paid by universities in the Tokyo area for professors playing leading roles in the research, as well as a system for preparations payments or contract conclusion payments when absolutely necessary for the invitation of Nobel Prize class researchers, etc. Tohoku University's "University Professor System" will also be actively used	(4) Revamping host institution's internal systems to allow introducing of new management methods (e.g., English-language environment, merit-based pay, top-down decision making) unfettered by conventional modes of operation Dr. Benkatesh Narayanamurti, Harvard University, was added to the international advisory board along with Tohoku University President Inoue, who had earlier withdrawn as a PI. Among advisory board members for this fiscal year, Dr. Bednorz, Dr. Gleiter and Dr. Narayanamurti visited the Center and held informal talks with researchers. These doctors also took a first-hand look at the laboratories at the Center and gave advice to and exchanged views with the Center Director. Administrative staff, who are capable of working in English and are well versed in accounting, personnel affairs and research support activities at the host institution were placed in the Center when the Center was inaugurated. Also recruited were administrative staff who are proficient in English as part of the effort to ease the acceptance of foreign researchers. In addition, outside teachers are brought in to give English lessons to employees of the Center to improve their foreign-language skills. At the Management Office for Safety and Health, safety-related education for new employees is offered both in Japanese and English. This is to support foreign researchers in matters of safety. From the first application to create the Center, we proposed that the same employment conditions as for the Distinguished Professor system in the United States be offered to PIs at the Center. As a first step under this proposal, from the

to invite the world's cutting-edge researchers to the center.

A standing task team will also be established with the office of the President taking the lead of it for rapid examinations and responses in cases when the Center Director requests the flexible administration, revision, improvement or adjustment of the host institution's systems, and the host institution will otherwise prepare an environment for the smooth conduct of top management by the Center Director.

(5) Accommodation of center's requirements for infrastructural support (facilities, e.g., laboratory space; equipment; land, etc.)

The host institution will operate a new core facility (building) for the center's activities so it can be used from around April 2008 as a target date. Research space will also be secured within the host institution's existing facilities. To secure research space in accordance with the advance of the research and the expansion of the center's research organization, the center will be given priority use of joint-use space at the university or campus level, and the Facilities Preparation and Administration Committee will deliberate all items of concern regarding the use of research space and other facilities and accommodate the center's needs.

(6) Support for other types of assistance

The Tohoku University action plan "Inoue Plan 2007 (Toward Becoming a World Leading University)" released in April 2007 already clearly stipulates that the university will apply for the World Premier International Research Center (WPI) Initiative as a measure for strengthening Tohoku University's research foundations as a research-centered university.

Moreover, based on the results of the 21st Century COE Program, Tohoku University established the International Advanced Research and Education Organization (completed April 2007) comprising the Institute for International

very beginning, full-time PIs have been granted an extra monthly allowance of 100,000 yen (1000 USD, based on 100 yen per dollar). On top of this, additional financial benefits started to be offered in fiscal 2009 to PIs who earn high grades in the center-wide evaluation of research achievements. In the three-grade evaluation, researchers who received grade S are given 90,000 yen (9000 USD, based on 100 yen per dollar) per month, those who received grade A, 70,000 yen (7000 USD, based on 100 yen per dollar) per month and those who received grade B, 50,000 yen (500 USD, based on 100 yen per dollar) per month. Systematized payment of an extra allowance based on the evaluation of research results are the first of their kind at a host institution. Annual salaries are to increase by a significant sum for researchers who have received internationally prestigious awards—by 5 million yen (50,000 USD, based on 100 yen per dollar) for those who received internationally prestigious awards and 3 million yen (30,000 USD, based on 100 yen per dollar) for younger researchers who received other prestigious awards. This salary increase is only for the year following receipt of the award. The annual salaries of faculty members at Tohoku University are set flexibly at the discretion of the heads of each department. These substantial salary increases based on awards received are the first attempts to set salaries outside the discretionary system.

(5) Accommodation of center's requirements for infrastructural support (facilities, e.g., laboratory space; equipment; land, etc.)

The host institution renovated a facility for comprehensive materials and physical-property studies in fiscal 2007. It also constructed a building that serves as an Integration Laboratory (first phase) for researchers invited to the Center. In fiscal 2008, the second phase of the Integration Laboratory was completed. As a result, the host institution provides a combined research space of 14,300 m^2 for researchers at the Center in fiscal 2009. The fiscal 2009 supplementary budget allots funds to cover the third phase of the Integration Laboratory. Land has been provided on which to construct the lab. The use of large-scale facilities is shared with the research infrastructure center in the university.

(6) Support for other types of assistance

With its goal of becoming a world-class university, Tohoku University is receptive to academic evaluation by outside entities. The European University Association (EUA) had been conducting the evaluation since October in 2009, and in January in 2010 the Center received EUA evaluation visit from the viewpoint of promoting internationalization of research and integrated studies.

Advanced Research and Education (established April 2006), which supports graduate students pursuing interdisciplinary fields, and the Institute for International Advanced Interdisciplinary Research (established April 2007), which promotes interdisciplinary research by young researchers. The global COE Program at the University is advancing its activities in coordination with this Organization, and those activities will be smoothly transferred to this Organization when the COE Program is finished.

Tohoku University intends to provide the maximum support to the center as a special research zone within the host organization, arrange organic relations with the International Advanced Research and Education Organization, making them into vehicles for education and research and help us contribute, as one of the world's leading universities, to the development of our society.

11. FY 2009 funding

i) Overall project funding

(Exchange Rate: JPY/USD=100)

Cost Items	Details	Costs (10,000 dollars)
Personnel	Center director and Administrative director	27
	Principal investigators (no. of persons):19	233
	Other researchers (no. of persons):88	447
	Research support staffs (no. of persons):20	54
	Administrative staffs (no. of persons):24	106
	Total	867
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):11	12
	Cost of dispatching scientists (no. of persons):2	2
	Research startup cost (no. of persons):37	69

Ten thousand dollars (Exchange Rate: JPY/USD=100)

WPI grant for FY 2009	1350
Costs of establishing and maintaining facilities in FY 2009	732
Establishing new facilities (Number of facilities: 6,600m²) Costs paid:	656
Repairing facilities (Number of facilities: , m²) Costs paid:	
Others	76
Cost of equipment procured in FY 2009	1,091
Multi-Beam System Number of units:1 Costs paid:	94
Sample Carrying System Number of units:1 Costs paid:	16

	Cost of satellite organizations (no. of satellite organizations):0	0
	Cost of international symposiums (no. of symposiums):3	24
	Rental fees for facilities	0
	Cost of consumables	75
	Cost of utilities	21
	Other costs	99
	Total	302
Travel	Domestic travel costs	5
	Overseas travel costs	23
	Travel and accommodations cost for invited scientists (no. of domestic scientists):76 (no. of overseas scientists):35	13
	Travel cost for scientists on secondment (no. of domestic scientists):3 (no. of overseas scientists):4	3
	Total	44
Equipment	Depreciation of buildings	76
	Depreciation of equipment	799
	Total	875
Other research projects	Projects supported by other government subsidies, etc.	0
	Comissioned research projects, etc.	1,197
	Grants-in-Aid for Scientific Research, etc.	266
	Total	1,463
Total		3,551

Ultra-High Quality Vacuum Chamber Number of units:1	Costs paid:	15
High-Temp. Vacuum Autoclave Number of units:3	Costs paid:	15
Compact Kneading Machine Number of units:1	Costs paid:	14
CL Measurement System Number of units:1	Costs paid:	13
Excimer Laser Number of units:1	Costs paid:	12
Sputtering System Number of units:1	Costs paid:	11
Parallel Computing System Number of units:1	Costs paid:	10
High-Speed Scanner Number of units:1	Costs paid:	7
Others		884

ii) Costs of Satellites and Partner institutions

(Exchange Rate: JPY/USD=100)

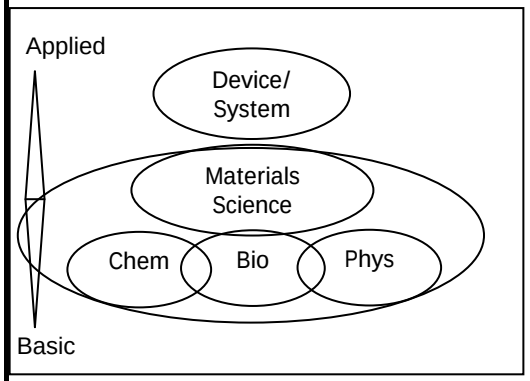
Cost Items	Details	Costs (10,000 dollars)
Personnel	Principal investigators (no. of persons):2	
	Other researchers (no. of persons):10	
	Research support staffs (no. of persons):0	
	Administrative staffs (no. of persons):0	
	Total	53
Project activities		16
Travel		12
Equipment		0
Other research projects		0
Total		81

12. Efforts to improve points indicated as requiring improvement in follow-up review and results of such efforts

-Points specified as needing improvement	-Efforts to improve them and results
1. Identification as the WPI research center	1. On the research front, our aim has been to promote research and development in soft materials studies in addition to hard materials and phys-materials studies - a physical science-based field in which the Tohoku University Institute for Materials Research is very competitive in the world scientific community. By doing so, we tried to strengthen the research foundation for materials science, which is based on the fields of chemistry and bioscience. The Nanochemistry Group changed its name to the NanoChemBio Group. This means that our research activity is focusing on chemistry-bioscience material studies. We recruited two promising young researchers in this field as PIs—one from Harvard University and the other from the Hong Kong University of Science and Technology. Also recruited a researcher in the field of physics-bioscience materials, from Texas A&M University as a PI. Their laboratory is in Sendai and they engage in research at AIMR. In addition, we plan to recruit one more PI in the field of chemistry-bioscience materials from University of Wisconsin in October 2010. The Center Director and the Center's Administrative Director are

2. Clear strategy for fusion studies

responsible for decisions on administrative affairs at the Center. Their decision-making authority is independent of the decision-making system operating in the administrative division of Tohoku University headquarters. Salaries of PIs at the Center are set flexibly, depending on evaluation of their academic performance. The administrative division of the university headquarters has no control over salaries of Center PIs. The Administrative Director who had been concurrently serving both as manager and professor was converted to the full-time function, and Mr. Iwamoto was appointed to replace Dr. Sakurai.



2. Materials science is an academic field based on three basic science fields—physics, chemistry and bioscience. Practical application concerns development of devices and systems (chart on left). Tohoku University and its affiliated institutions, including the Institute for Materials Research, have scored major achievements that have influenced the world's scientific community. Behind their reputation have been the university's strengths in the field of hard materials and physics materials, which is based on physics. Tohoku University aims to build a world-class research center for materials studies by stepping up studies in soft materials fields such as chemistry materials and bioscience materials in addition to promoting studies in physics materials, a field in which the university already boasts significant strengths. In our basic policy to promote integrated studies, we strongly request that research in materials science should cover more than two basic fields. These fields are physics-chemistry materials, chemistry-bioscience materials, and physics-bioscience materials. To promote the fusion research, the Center Director took the initiative in launching the Fusion Research Proposal Program. Already, a start-up budget has been allocated to research proposals that are deemed highly feasible and of good quality. Applications are accepted twice a year (spring and autumn). Progress of the proposals, which were given the green light in the spring of 2009, is now under review. Fusion research is expanding beyond the borders between research groups (thrust)—not only between PIs but also between young researchers. Some positive results have already become apparent. To back up this proposal program, seminars for

	integrated studies have been launched and a Friday Tea Time session has started to promote dialog.
3. Accountability for participation of the president of the host institution as a PI	3. President Inoue stepped down from the position of PI. As the President of the host institution, he commits to doing his utmost to advance the aims of the Center from a broad viewpoint.
4. Strategy for collaboration with oversea satellite institutions	4. University of Cambridge has been selected as a satellite research base in Europe. Led by the satellite, an international conference on metallic glass was held in Grenoble, France, this fiscal year. Next fiscal year, a satellite for physics, chemistry and bioscience is planned to be set up at an institute, China. In addition, we have established a system in which young foreign researchers from research institutes to which foreign PIs belong will be dispatched to Sendai for one to three months on a permanent rotational basis to promote joint and fusion research. This system is called the GI^3 program. This program is being promoted as part of our efforts to make Sendai a place where young American and European researchers with excellent brains come and go.
5. Strong leadership of center director	5. A Specially appointed professor was assigned to head the Administrative Department at the Center to support the Center Director. The Center Director, the Administrative Director and leaders in four groups together comprise the Executive committee recently launched to run the Center. The committee is designed to disseminate the intentions of the Center Director and to operate the Center smoothly. Numerous points raised by members of the program committee were really helpful. We used these advices to drastically reform the structure of the Center in this fiscal year. As mentioned earlier, we have clarified the differences between research at the Center and activities at other existing research institutes. We have also clarified the direction of research being carried out at the Center including fusion research, and launched a system aimed at accelerating the movement in that direction. We are endeavoring to make research by foreign PIs substantive by having them engage in research at the Sendai laboratory. We have also made efforts under the leadership of the Center Director to position the Center in a world-wide flow of bright brains.