

# FY 2007 WPI Project Progress Report

## World Premier International Research Center (WPI) Initiative

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

### Summary of center project progress

The principles on which the Center is based can be classified into three: (1) We will deploy groundbreaking studies into materials science and construct a world-class research center at Tohoku University. (2) The Japanese traditional research system and the management system will be reformed at the Center, and a system suited to a world-class research center will be put in place. (3) We will strengthen international cooperation, and construct a "visible center" through tie-up research with networks and satellites inside and outside the country. As outstanding overseas researchers gather at the Center, we aim to develop world-class research projects by following the three principles above.

We will explain this more specifically. (1) We are attempting to unite the five existing areas of chemistry, materials science, electronic engineering/informatics, precision/mechanical engineering, and physics, which are expected to create new areas in the field of materials science. For this purpose, 30 Principal Investigators (PI) have been classified into four groups: (i) Bulk metallic glasses (BMG); (ii) Nanophysics; (iii) Nanochemistry; and (iv) Device/system construction. We are aiming at not only cooperation among groups, but also promotion of interdisciplinary research by all the groups. In the bulk metallic glasses group, currently researchers around the world are turning their eyes on our Center, taking a cue from the discovery/creation of the pioneering/original BMG by PI Inoue, and a worldwide research center is now being constructed. In the nanophysics group, creation of a new illuminant based on PI Kawasaki's research using into oxide electronics, and PI Takahashi's development of a photoelectric spectral device for measuring the solid-state properties of superconducting materials lead the world. In the nanochemistry group, PI Itaya's cultivation of pentacene monocrystalline at the solid-liquid interface, and PI Nishi's development of soft materials are worthy of attention. In the device/system construction group, it is expected that PI Ohmi will realize a super-efficient ULSI using the new silicon technology.

(2) In reforming the system for managing the center, the proposals described at the time of application are being steadily implemented. The Center is positioned as a unit in Tohoku University with the title of WPI Advanced Institute for Materials Research (WPI-AIMR) and PIs are full-time researchers at this institution. Public offerings of posts for associate professors, assistant professors, and postdoctoral

researchers have been widely advertised all over the world, and there were more than 300 applicants. Selection of superior talents is now underway. The advisory board that manages the center is composed of prominent international figures that have deep insight, such as Dr. Rohrer, a Nobel laureate in physics, including presidents of the world's major universities, and the board will examine the proposals on system reform. We plan to use English for information exchange among PIs, and administrative staffs that have a good command of English are being employed. For the academic research environment, a new building is being constructed and the existing buildings are undergoing modification. They will be available in April, when research space will be allotted to PIs.

(3) With regard to international cooperation and construction of an overseas network, at the time of application, we thought we should build a network based on the overseas bases that Tohoku University has. But we decided that from the beginning, two satellite centers should be set up, one in Europe and one in America, in order to strengthen international cooperation selectively and intensively. Research related to BMG is a major research topic at the Center, and the European satellite has been set up at the University of Cambridge. We are planning to set up a center for nanophysics and nanochemistry (both are integrated into nanoscience) in the United States, and have selected IBM T.J. Watson Research Center (PI Tromp) as the candidate site. Since research related to the device/system construction at both satellites in Europe and America has common features, it will be possible for researchers to cooperate. Moreover, the BMG group as well as the nanoscience group has a constitution that enables alternate cooperation at both satellites in Europe and America. The WPI Center opening ceremony was held in October, and the Center started to operate with a large overseas attendance. The first workshop was held in February with the participation of many overseas researchers such as PIs and their co-researchers. Discussions on research were held with the theme of cooperative research/interdisciplinary research among both WPI researchers and researchers who are not bound by the WPI framework. From now, we are going to appoint WPI adjunct professors for each PI to expand the network further, and establish a WPI research network that will spread around the world.

We believe that WPI has made favorably progress from these activities.

## 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 system 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. The synergy of 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, 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>

Based on our three basic principles, basic and applied research is progressing steadily.

The research items are shown on the left, and we have built up a research organization that not only deepens research in each of these areas but also achieves a synergy effect by interdisciplinary/cooperative research.

Moreover, we have established a center management system that makes the Center Director responsible for decision-making.

No modifications have been made to the proposals in our application.

## 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, Material sciences, Electronics engineering and information sciences, Precision and mechanical engineering, Physics.

Our project addresses the inter-disciplinary fields consisting of the above 5

### <Results/progress/alternations from initial plan>

To fuse the five academic fields, we elected PIs from each field and started interdisciplinary area research with a total of 30 members (19 from Japan, and 11 from various countries in Europe, America and Asia). From the existing five academic fields, four disciplinary research groups (bulk metallic glasses, nanophysics, nanochemistry, and device/system construction) were organized, and a start was made to cooperative research/interdisciplinary research with the holding of

<p>disciplines. (Importance) Materials science is one of the most important fields for future of science and technology in Japan as well as in the world. Materials science is the most important basis for all materials in the present society and should be continued as a core technology in future in order to maintain the present high technology endeavors in our country.</p> <p>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 material 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 and to produce devices and systems applicable and useful to the benefit of society. Furthermore, it is expected that an entirely new paradigm is born through the fusion approach.</p>	<p>the first workshop for the promotion of interdisciplinary research. No modifications have been made to the proposals in our application.</p>
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### 3. Research objectives

<p>&lt;Initial plan&gt; 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) to create new compounds and materials with innovative functions which exceed existing ones, (2) to construct devices based upon a new fundamental paradigm, and (3) to promote applied research projects on materials and system 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.</p>	<p>&lt;Results/progress/alternations from initial plan&gt; Since a start was only made in October 2007 on working toward the research goals, it is difficult to pick up actual results obtained in such a short period of a few months. But in the flow of continuous research, research into bulk metallic glasses has been advancing toward the creation of a larger BMG. Likewise, good research results have been obtained in other areas. No modifications have been made to the proposals in our application.</p>
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### 4. Management

<p>&lt;Initial plan&gt; 1) Composition of administrative staff Our Administrative staff provides logistic support which allows researchers to conduct their studies flawlessly. We also intend to actively invite the 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. In specific, daily routines such as in accounting, human resources and research support are managed by highly experienced staff who can accomplish their duties without difficulties. They will be selected mainly from intramural administrative staff. To satisfy the means of the Center's official language, which is</p>	<p>&lt;Results/progress/alternations from initial plan&gt; 1) Composition of administrative staff Administrative staffs for the Center have been chosen from within the University with excellent skills in accounting, personnel management, and research support, etc., and in addition, we have officially announced a change in personnel. We have implemented a backup system for the Center in which administrative staff at HQ will support the full-time administrative staffs; the staffs at HQ related to regulations, human affairs/salaries, financial affairs, research support, and international exchange, etc., will also work for the Center. Furthermore, we have employed assistants who can assist with tasks in English. We have also appointed a deputy head to support the head of the administrative unit. The administrative unit</p>
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English, staff who have supportive abilities in English language will be preferentially assigned, and extrinsic 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 and public relation of research results, planning and support of research workshops. We will proactively hire diverse professionals; not only experienced at the University, but also from private sector or non-Japanese with international experience or 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 for the support of 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 at the Administration Bureau, led by Office of the President, which will activate environmental improvements for a center director top-down management concerning flexible approaches, revisions and betterment of the university's system upon the center director's request.

## 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

was started with backup from the administrative system in place at HQ, positioning this year as a run-up period for management of the Center, and we plan further enhancements to the administrative unit such as reinforcement of full-time administrative staffs, and designating an administration building, etc. so that researchers will be able to carry out their research more smoothly after April 2008.

Also, in addition to the staffs in charge of these daily tasks, we have employed staff to take charge of publicizing the research results of the Center, etc.

As we move into 2008, we are looking at employing people with expertise in various areas, such as people who have experience in the private sector, people from overseas, and former researchers who produced outstanding results in the researcher evaluation described in our application, and people with expertise in coordinating international research, etc.

## 2) Decision-making system

We have not installed decision-making machinery similar to the council system, but are enabling flexible and swift decision-making by top-down management under the Center Director.

An "International Advisory Board" was set up with the following members to advise the Center Director on decision-making:

Constituent members:

Dr. Heinrich H. Rohrer, Chair (Honorary Doctor, Tohoku University, 1986 Nobel Laureate in Physics)

Prof. Robert J. Birgrnrau (Chancellor, University of California, Berkley)

Prof. Herbert Gleiter (Director, Institut fur Nanotechnologie Forschungszentrum Karlsruhe)

Prof. Bing-Lin Gu (President, Tsinghua University, Beijing)

Mr. Tadashi Onodera (President and Chairman, KDDI Corp.)

Prof. Konrad Osterwalder (President, The UN University, Japan, and President, ETH Zurich)

Prof. Robert J. Silbey (Dean, College of Science, MIT)

Also, there is flexible communication with the host institution at the request of the Center Director on matters which include revision and maintenance of the regulations necessary for managing the center, etc.

## 3) Allocation of authority between center director and host institution

The center is managed entirely according to the judgment of the Center Director, ensuring that the Center is managed independently. On the other hand, the host institution should have authority only over very limited important matters such as decisions on the election/dismissal of the Center Director, etc.

The Center Director makes the final decision on the appointment of researchers including PIs, and he also has the final say on the budget. Moreover, the host institution has developed a system that enables flexible budget execution.

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.

## 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 2007	April, 2008
Researchers from within host institution	15	15	15	15	15
Foreign researchers invited from abroad	11	11	11	11	11
Researchers invited from other Japanese institutions	4	4	4	4	4
<b>Total principal investigators</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>

### All members

	At beginning	Planned for end of FY 2007	Final goal (Date: Oct. 2008)	Results at end of FY 2007	April, 2008
<b>Researchers</b> <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%>	42 < 16, 38%> [ 2, 5%]	82 < 32, 39%> [ 5, 6%]
<b>Principal investigators</b> <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%>	30 < 12, 40%> [0, 0 %]	30 < 12, 40%> [0, 0 %]
<b>Other researchers</b> <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%>	12 < 4, 33%> [ 2, 17%]	52 < 20, 38%> [ 5, 10%]
<b>Research support staffs</b>	44	44	53	1	8
<b>Administrative staffs</b>	35	35	40	16	22
<b>Total</b>	<b>139</b>	<b>169</b>	<b>213</b>	<b>59</b>	<b>112</b>

<p>ii) Satellites  <u>&lt;Initial plan&gt;</u>  Institution (1)  -Role    - Personnel composition and structure    - Collaborative framework    <u>Institution (2)</u></p>	<p>&lt;Results/progress/alternations from initial plan&gt;  At first, we did not plan to set up any satellites, but we subsequently decided to set up the following satellites to intensively promote joint research with specific partners. The centers we designated as satellites are more specialized in the aims of WPI than the existing Tohoku University network center.    <u>Institution (1)</u> The University of Cambridge  -Role  Joint research that is both wide and deep into the creation, characterization, function evaluation, and theory establishment, etc. of bulk metallic glass.  - Personnel composition and structure  Alan Lindsay Greer, and a few supporting researchers  - Collaborative framework  Expands the network based on Cambridge University in cooperation with the other European BMG group (Alain Reza Yavari).    <u>Institution (2)</u> IBM Thomas J. Watson Research Center (under examination)</p>
<p>iii) Partner institutions  <u>&lt;Initial plan&gt;</u>  <u>Institution (1)</u> University of Wisconsin-Madison  -Role  Joint research in nanophysics.  - Personnel composition and structure  Max G. Lagally  - Collaborative framework  Promotes joint research in nanophysics. Arranges postdoctoral researcher and assistant professors, etc.    <u>Institution (2)</u> Grenoble Institute of Technology  -Role  Joint research into bulk metallic glasses.  - Personnel composition and structure  Alain Reza Yavari  - Collaborative framework  Promotes joint research into bulk metallic glasses. Arranges postdoctoral researchers and assistant professors, etc.</p>	<p>&lt;Results/progress/alternations from initial plan&gt;  <u>Institution (1)</u> University of Wisconsin-Madison  -Role  Joint research in nanophysics.  - Personnel composition and structure  Max G. Lagally  - Collaborative framework  Promotes joint research in nanophysics. Lagally visited WPI several times, and has started to prepare for joint research.    <u>Institution (2)</u> Grenoble Institute of Technology  -Role  Joint research into bulk metallic glasses.  - Personnel composition and structure  Alain Reza Yavari  - Collaborative framework  Promotes joint research into bulk metallic glasses. Yavari visited WPI several times, and has started system-making in the BMG group.</p>

Institution (3) IBM Thomas J. Watson Research Center

-Role

Joint research in nanophysics.

-Personnel composition and structure

Rudolf M. Tromp

-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

-Collaborative framework

Promotes joint research into high polymer chemistry and soft materials. The partners in Japan should be PI's 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

-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

-Collaborative framework

Promotes joint research into surface physics and theoretical research. The main partner in Japan is the theory group (PI's Tsukada and Tokuyama), and an experiment system group will be added. Arranges postdoctoral researchers and

Institution (3) IBM Thomas J. Watson Research Center

-Role

Joint research in nanophysics.

-Personnel composition and structure

Rudolf M. Tromp, Abdullah Al-Mahboob (scheduled for April 1)

-Collaborative framework

Promotes joint research in nanophysics. Al-Mahboob has been appointed as an assistant professor while the joint research system is being developed. It is also feasible that the base would become a satellite, and that joint research will advance significantly after April.

Institution (4) University of Massachusetts Amherst

-Role

Joint research into high polymer chemistry and soft materials.

-Personnel composition and structure

Thomas P. Russell

-Collaborative framework

Promotes joint research into high polymer chemistry and soft materials. There is a possibility that this will become a satellite for nano material in the future.

Institution (5) Chemnitz University of Technology

-Role

Joint research into MEMS.

-Personnel composition and structure

Thomas Gessner

-Collaborative framework

Promotes joint research into MEMS. Gessner visited WPI several times, and is examining starting up joint research into MEMS.

Institution (6) University College London

-Role

Joint research into surface physics and theoretical research.

-Personnel composition and structure

Alexander Shluger, Peter Sushko (scheduled for April 1)

-Collaborative framework

Promotes joint research into surface physics and theoretical research. The joint research system is being reorganized by allocating Sushko in Sendai as an associate professor.



assistant professors, etc.

Institution (7) The University of Cambridge

-Role

Joint research into bulk metallic glasses.

-Personnel composition and structure

Alan Lindsay Greer

-Collaborative framework

Promotes joint research into bulk metallic glass. Arranges postdoctoral researchers and assistant professors, etc.

Institution (8) Institute of Chemistry, Chinese Academy of Science

-Role

Joint research in nanochemistry and surface chemistry.

-Personnel composition and structure

Li-Jun Wan

-Collaborative framework

Promotes joint research in nanochemistry and surface chemistry. Arranges postdoctoral researchers and assistant professors, etc.

Institution (9) The Pennsylvania State University

-Role

Joint research in nanophysics.

-Personnel composition and structure

Paul S. Weiss

-Collaborative framework

Promotes joint research in nanophysics. Arranges postdoctoral researchers and assistant professors, etc.

Institution (10) Johns Hopkins University

-Role

Joint research into bulk metallic glasses.

-Personnel composition and structure

Kevin J. Hemker

-Collaborative framework

Promotes joint research into bulk metallic glass. Arranges postdoctoral researchers and assistant professors, etc.

Institution (7) The University of Cambridge

-Role

Joint research into bulk metallic glasses.

-Personnel composition and structure

Alan Lindsay Greer

-Collaborative framework

Promotes joint research into bulk metallic glasses. As the European satellite, joint research will progress significantly after April.

Institution (8) Institute of Chemistry, Chinese Academy of Science

-Role

Joint research in nanochemistry and surface chemistry.

-Personnel composition and structure

Li-Jun Wan

-Collaborative framework

Promotes joint research in nanochemistry and surface chemistry. PI Wan and PI Itaya are now scheduled to employ a postdoctoral researcher and allocate him/her to Sendai.

Institution (9) The Pennsylvania State University

-Role

Joint research in nanophysics.

-Personnel composition and structure

Paul S. Weiss

-Collaborative framework

Promotes joint research in nanophysics.

Institution (10) Johns Hopkins University

-Role

Joint research into bulk metallic glass.

-Personnel composition and structure

Kevin J. Hemker

-Collaborative framework

Promotes joint research into bulk metallic glass.

Institution (11) Tsinghua University

-Role

Joint research in nanophysics.

-Personnel composition and structure

Qi Kun Xue

-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

-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

-Collaborative framework

Promotes joint research into solid-state properties theory. Arranges postdoctoral researchers and assistant professors, etc.

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

-Collaborative framework

Institution (11) Tsinghua University

-Role

Joint research in nanophysics.

-Personnel composition and structure

Qi Kun Xue, Hongwen Liu (scheduled for April 1)

-Collaborative framework

Promotes joint research in nanophysics. The joint research system is being reorganized by allocating Liu as an assistant professor.

Institution (12) Tokyo Institute of Technology (PI Nishi will be transferred to the Center at Tohoku University in April)

-Role

Joint research into high polymer chemistry, soft materials, and the properties of high-polymer solid state materials.

-Personnel composition and structure

Toshio Nishi, Ken Nakajima (scheduled for April 1) Sou Fujinami (scheduled for April 1), Dong Wang (scheduled for April 1)

-Collaborative framework

Promotes joint research into high polymer chemistry, soft materials, and the properties of high-polymer solid state materials. The joint research system is being reorganized by allocating Nakajima as an associate professor and Fujinami and Wang as postdoctoral researchers.

Institution (13) Waseda University

-Role

Joint research into solid-state properties theory.

-Personnel composition and structure

Masaru Tsukada, Kazuto Akagi (scheduled for April 1), Akira Masago (scheduled for April 1)

-Collaborative framework

Promotes joint research into solid-state properties theory. The joint research system is being reorganized by allocating Akagi as an associate professor and Masago as a postdoctoral researcher.

Institution (14) Advanced Research Laboratory, Hitachi LTD.

-Role

Joint research into surface physics and nanophysics.

-Personnel composition and structure

Tomihiro Hashizume, Taro Hitosugi, Katsuya Iwaya (scheduled for October 10), Nobuyuki Fukui (scheduled for April 1)

<p>Promotes joint research into the properties of solid-state surfaces and nanophysics. Arranges postdoctoral researchers and assistant professors, etc.</p> <p><u>Institution (15)</u> The University of Tokyo</p> <p>-Role Joint research into crystal interfaces and theory.</p> <p>-Personnel composition and structure Yuichi Ikuhara</p> <p>-Collaborative framework Promotes joint research into crystal interfaces and theory. Arranges postdoctoral researchers and assistant professors, etc.</p>	<p>-Collaborative framework Promotes joint research into surface physics and nanophysics. The joint research system is being reorganized by allocating Hitosugi as an associate professor, Iwaya as an assistant professor, and Fukui as the postdoctoral researcher.</p> <p><u>Institution (15)</u> The University of Tokyo</p> <p>-Role Joint research into crystal interfaces and theory.</p> <p>-Personnel composition and structure Yuichi Ikuhara, Susumu Tsukimoto (scheduled for April 1), Mitsuhiro Saito (scheduled on April 1), Zhongchang Wang (scheduled for April 1)</p> <p>-Collaborative framework Promotes joint research into crystal interfaces and theory. The joint research system is being reorganized by allocating Tsukimoto as a lecturer, Saito as an assistant professor, and Wang as a postdoctoral researcher.</p>
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#### 6. Summary of center's research environment

<p>&lt;Initial plan&gt;</p> <p>1) Environment in which researchers can devote themselves to their research</p> <p>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 provided by the Center to PIs is similar as that for Distinguished Professors in US.</p> <p>We will make arrangements so that the researchers themselves will not be involved in the managerial works of the host institution, provide thorough 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.</p> <p>We will also prepare strong staff backup functions for accounting, personnel, research support, liaison and public relations works so that the researchers can devote themselves to research. These staff functions will implement various procedures and management works 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 such fields 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 positively employ individuals with experience in the private sector, foreigners (individuals with international experience), distinguished researchers, and other diverse personnel.</p>	<p>&lt;Results/progress/alternations from initial plan&gt;</p> <p>1) Environment in which researchers can devote themselves to their research</p> <p>In our application, we proposed offering the same environment as those offered by Distinguished Professors in the United States, and as the first steps, we have provided an extra allowance (100,000 yen a month) with a PI dedicated to the Center from the start of the Center. Furthermore, to secure research time at the Center, the Center Director requested related departments that, in principle, researchers who belonged to the host institution before the Center started up should not be involved in administrative work at the host institution nor in educational activities unless at their own request.</p> <p>We have decided that the research support staffs positions should be filled in conjunction with future environmental development at the facility, and when the Center started up, we allocated administrative staffs who were capable of carrying out their duties in English, and who were well versed in accounting, personnel management, and research support at the University. Moreover, for the program officer and other staffs who will be responsible for international coordination, publication of research results, and project/support for research meetings, etc., we are examining the possibility of employing experienced people from the private sector system, overseas people, former researchers, etc. on an annual salary in fiscal 2008.</p> <p>For accommodation, we are offering domestically invited researchers intramural staff apartments on a preferential basis for the time being, but for</p>
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We will also assign the technical staff required for the smooth progress of the research.

Besides the scientific and research issues, it is needed to provide the PIs not only enough facilities and space in laboratories, but also enjoyable living environments at home, especially for people from abroad. We will do our best for arranging comfortable environments.

## 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 vigorously continue their own research 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.

## 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 Web sites 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.

researchers invited from overseas, we are examining appointing a special agent who can offer apartments on a monthly basis at short notice.

## 2) Startup research funding

In the research system at the Center, researcher groups are classified into four: bulk metallic glasses, nanophysics, nanochemistry, and device/systems construction, and start-up costs were made available to each group for the purchase of research equipment, which is indispensable, fundamental, and used in common to promote the research.

We held two workshops, inviting domestic and overseas researchers, and individual research meetings for each group, and offered positive cooperation regardless of the research topic, as well as a place for the active exchange of opinion and information. This is expected to enhance the performance of future research.

## 3) Postdoctoral positions through open international solicitations

We held international open recruitment of post-doctoral researchers, associate professors, and assistant professors through our homepage (host institution/center, Japan Science and Technology Agency, and related academic societies, etc.), major international magazines (*Nature*, *Science*, etc.), and the journals of the relevant academic societies, etc., and we received about 300 applicants from inside and outside the country.

For fields directly related to a PI, the relevant PI examined the documentation (including an interview, where necessary), and selected the candidates. Finally, the decision on employing basic researchers was made by the Center Director. Moreover, giving priority to interdisciplinary research, which is a cross-sectional area among PIs, the Center Director, by his own discretion, should make all-out efforts to accept interdisciplinary researchers.

To continue to retain outstanding researchers, we will periodically hold international open recruitment using similar methods.

(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 - 20 %.

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

4) Administrative personnel who can facilitate the use of English in the work process

We selected full-time administrative staffs with good English skills from among University staffs that have expertness in accounting, human affairs, and research support. Moreover, we appointed people with a good command of English as assistants to support them, and developed an administrative structure that will enable them to carry out tasks in English.

In addition, to improve the English ability of the administrative staff, we brought in outside people to conduct language training. We intent to continue with the training in the next fiscal year to further improve their language skills.

We have introduced English versions of some of the application forms in the University that researchers must complete. By producing English versions of these forms one by one, we will develop a system that enables overseas researchers to prepare their applications and associated documentation entirely in English.

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 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.

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

For evaluating individual researchers, we will prepare evaluation criteria based on the ideal way of evaluating individual teachers and researchers that has been adopted by our host institution by the end of this year, and use them to evaluate the research results every year. We will use the results of the evaluation to assess pay raises and promotion, and also use it to decide on whether to renew the appointment of researchers on expiration of their term of office. For new researchers who are employed from outside the host institution, we have introduced an annual salary system, and put in place a system in which pay increments can be set freely by the Center Director according to our evaluation of the researcher's ability. We have been providing full-time PIs with an extra allowance (100,000 yen a month) since the start of the Center. We have also introduced a system for this, in which a pay raise is possible depending on the evaluation.

We have decided to carry out a Center-wide evaluation by an external assessment committee every five years.

When we invite a renowned researcher from outside the host institution, it is assumed that we should match this with a flexible pay system which provides them with an invitation allowance, preparation allowance, and contract conclusion allowance.

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

A dedicated first-stage integrated laboratory building (3,650 m<sup>2</sup>) was constructed for the Center at the end of fiscal 2007, and the area that the Center can use (2,500 m<sup>2</sup>) will be allocated as part of the strategic common use space held by the University as a whole, which is scheduled to take place following the repair of an existing building. The existing space (4,500 m<sup>2</sup>) will continue to be available to PIs that belonged to the host institution before the Center was formed, for educational purposes. In addition, a new administrative building (300 m<sup>2</sup>) will be allocated to the Center, giving a total Center space of 10,950 m<sup>2</sup> by the end of fiscal 2007. A new second stage integrated laboratory building (5,350 m<sup>2</sup>) will be constructed in fiscal 2008. It is designed as an open laboratory with a mechanical space that can be flexibly used for various research tasks and to be equipped with a full-scale security system that will cater for the entire building and each laboratory.

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.

#### 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

In addition to the separate laboratory spaces an "Innovation Space" is available to researchers in the second stage laboratory building for the exchange of information and for brainstorming on new ideas.

For the research facility, we will study our policy to organically coordinate the start-up facility developed for the Center with the state-of-the-art facility offered by the Technology Center for Research and Education Activities at the host institution.

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

In addition to the existing representative offices in the United States and China, and liaison offices that the host institution has set up, the Center incorporates an International Frontier Center for Advanced Materials (IFCAM), which is an affiliated organization of the Institute of Materials Research and plays a role as an international think tank as well as a recruitment center in the field of advanced substances/materials science, and we have completed the structure for an international consortium.

Along with the above system, we held the WPI-IFCAM Workshop from February 18 to February 19 this year. About 100 researchers, including PIs, overseas researchers, joint researchers, domestic and foreign materials researcher communities, and members of the International Advisory Board including the Nobel Laureate in physics, Dr. Rohrer, participated in this workshop. Each PI was requested not only to report on their research activities to date, but also to announce their policy on future research activities at the Center, especially focusing on the interdisciplinary research fields. Accordingly, the research policy as a center involved in the "New substance/material and function innovation by the atom/molecular control method" was formulated.

#### 8) Other measures, if any

1) The International Advisory Board is to be established as originally scheduled. And we are studying introduction of a "Network Discussion System" to contribute

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 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.

to efficient coordination between the Center Director and the Advisory Board. This system will enable us to give guidance/advice, evaluate the activities of each PI, and carry out a review of the employment of post-doctoral researchers, etc.

2) In the research system at the Center, researcher groups are classified into four: bulk metallic glasses, nanophysics, nanochemistry, and device/systems construction. One feature of the Center is that a PI's term of office is five years. International open recruitment will be held for all positions including those currently occupied and support for young researcher's blue-sky research (research that does not need the permission of a professor). To meet these appointment conditions and produce research results based on a fusion between the research fields at the Center, not only young researchers but also PIs are encouraged to join two or more groups (with each choice being related to the researcher's major and minor subjects). In addition, a non-hierarchical research structure has been created.

3)/4) It is assumed that the development of staff as senior mentors and technical staff should be improved in conjunction with the future development of facilities.

5) For overseas researchers' living in Japan, we are studying appointing a special agent who can offer monthly apartments at short notice to resolve the residence issue, and to arrange education for their children, Tohoku International School that offers education from kindergarten to high school levels is available in the city. In the future, to improve the educational environment for the children of overseas researchers, we hope to request the cooperation of the host institution in constructing a system that can accept children through the coordinated efforts of, for example, Tohoku University and regional schools (from elementary school to high school).



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

### <Initial plan>

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 material 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 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.

### <Current assessment>

There have been no modifications to the index or evaluation techniques. Good news is shown below.

- (1) It was decided that Inoue PI will be elected as a member at the National Academy of Engineering (NAE).
- (2) Miyazaki PI won the Asahi Prize.
- (3) It was also decided that PI Russel will be elected as a member of the NAE.

## 8. Securing competitive research funding

### <Initial plan>

i) Past record (dollars)

FY2002 10,554,000

### <Results/progress/alternations from initial plan>

FY2007 11,395,000 USD (exchange rate: JPY/USD=120)  
(1,367,363,000 JPY)

FY2003	8,460,000	PIs joining from Tohoku University obtained the research funds from of approximately 11,000,000 USD from outside in 2007 fiscal year.
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.

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

<p>&lt;Initial plan&gt;</p> <p>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.</p> <p>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.</p> <p>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 21<sup>st</sup> 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.</p>	<p>&lt;Results/progress/alternations from initial plan&gt;</p> <p>(i) Extensive introduction of system reformation technique developed at the Center to the host institution</p> <p>At the time of the application we proposed that the Center would offer the same environment as that of a Distinguished Professor in the United States, and as the first step in this, we have provided full-time PIs with an extra allowance (100,000 yen a month) since the start of the Center. Based on this, the "Tohoku University Distinguished Professor System" was implemented by the President last December for the host institution too, and a mechanism to provide University personnel who will carry the pace-setting role of providing education, research, and social contribution with an extra allowance has been introduced.</p> <p>(ii) Pursuing the potentials of reorganization, and integration, etc. of the existing research courses and laboratories</p> <p>Our future vision for the Center envisages the formation of a unique and inimitable international materials science research center based on the results of past research into materials science at Tohoku University as well as the international exchange resulting from those activities. For the host institution, since the International Frontier Center for Advanced Materials (IFCAM), an</p>
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	organization affiliated to the Institute of Materials Research, has already played a role as an international think tank as well as a recruitment center in the field of advanced substances/materials science, we have incorporated this function into the Center and are making good use of it.
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10. Host institution's commitment

<p>&lt;Initial plan&gt;          -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 21<sup>st</sup> 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 21<sup>st</sup> Century COE Program and others on the basis of our performance and proposals for organizational restructuring.” and the university will give priority support to advancing research and organizational development based on this program.</p> <p>-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</p>	<p>&lt;Results/progress/alternations from initial plan&gt;          -Provision in host institution's mid-to-long-term plan          We have established a new independent medium term plan (see below) in the area that the University must work on, and clarified support for research and the structure of the organization at the WPI Research Advanced Institute for Materials Research (WPI-AIMR), a center for international advanced atom/molecule/materials research.</p> <p>2. Measures to achieve the research targets          (1) Measures to achieve the target for the research level and research results              ○ Area the University must work on                  84-2 At "WPI-AIMR," the world top-level research center, the promotion of the research related to the creation of innovative, advanced, and practical materials as well as the associated organizational maintenance must be implemented.</p> <p>-Concrete Measures          (1) Competitive grants obtained by researchers participating in the project and in-kind contributions, etc.          The general research building for the properties of materials/solid-state situated in the Katahira district was modified and a new integrated laboratory building was constructed so that researchers invited to WPI could proceed with research activities smoothly after employment. As a result, the research space that has become necessary for a PI, who belonged to the host institution before the formation of the Center, for the development of his/her research, has been secured. Moreover, in regard to the expenditure for the salaries of PIs and clerical staff, support for research costs, etc., facility installations etc. necessary for research, repairs of research space and general center operations, sufficient funds (grants and payments) were secured, leading to the smooth development of the academic research environment.          Besides financial support from the host institution, researchers involved with</p>
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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 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

In applying for this program, Tohoku University established a "Council of Department Heads Concerned with the World Premier International Research Center (WPI) Initiative" as a coordinating committee within the university to assemble researchers from within the host institution, and this council has fully completed the coordination within the host institution.

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.

(4) Revamping host institution's internal systems to allow introducing of

the Center acquired funds externally amounting to 11,395,000 US\$ in fiscal 2007. This amount is likely to be equal to or greater than the amount proffered to the Center.

(2) System under which the center's director is able to make substantive personnel and budget allocation decisions

When the Center is managed, it is assumed that the host institution has the authorities over the very limited important matter (it can only decide the election/dismissal of the Center Director). The head of the host institution asserted at the application stage that authority over all personnel matters including the approval of PI employment and the flexible execution of the budget etc. related to the budget allocated from the host institution would be assigned to the Center Director. This assertion has been in play since the start of the Center operation.

From now on, considering the workplace environment where English is set as the base language, which is a characteristic of the Center, it has been decided that the preparation of all documents in English should be approved as a precursor example at the host institution in synchronization with the complete improvement of the support staff.

(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

At the host institution, as the intramural coordination committee to put together the researchers in the organizations, we have established the related departments directors meeting (the chairperson is the head of the host institution) consisting of the heads of the related eight departments and implemented the coordination within the University since the application stage. The meeting is installed continuously under the head of the host institution even after the program was adopted, and is held, as need arises, based on the request from the Center Director. We have straightened the system to aggressively support the Center Director while receiving the cooperation from the related departments.

(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 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

new management methods (e.g., English-language environment, merit-based pay, top-down decision making) unfettered by conventional modes of operation

The International Advisory Board will be installed with the members as originally scheduled. And we are studying introducing a "Network Discussion System" to contribute to efficient cooperation between the Center Director and the Advisory Board.

When the Center started up, as in the host institution, we allocated administrative staff who were capable of carrying out tasks in English, and who were skilled in accounting, personnel management, and research support in the University. And to improve their English ability, we have arranged for language training with an outside agency.

At the time of the application we proposed that the Center would offer the same environment that of a Distinguished Professor in the United States, and as the first step in this, we have provided full-time PIs with an extra allowance (100,000 yen a month) since the start of the Center. Based on this, the "Tohoku University Distinguished Professor System" was implemented by the President last December for the host institution too, and a mechanism to provide University personnel who will carry the pace-setting role of providing education, research, and social contribution with an extra allowance has been introduced. In order to invite Nobel Prize class researchers, it was decided to make good use of the "University Professor System" of the host institution. However, it was decided that if the content of the existing system became an obstacle, the system would be revised to suit the current conditions by a task team whose head would be the manager of the president's office when cooperation is requested by the Center Director.

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

The host institution repaired the general research building for the properties of materials/solid-state and built an integrated laboratory building, and made efforts to secure space for researchers who will be invited to WPI in April 2008. For the research spaces in the existing facilities, we have developed the system under which the open laboratory space shared by the entire University can be used depending on the progress and assignment of the research.

(6) Support for other types of assistance

The program aimed at becoming a world premier international research center initiative was one of Tohoku University's action plans announced in April 2007, and

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 21<sup>st</sup> Century COE Program, Tohoku University established the International Advanced Research and Education Organization (completed April 2007) comprising the Institute for International 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.

we have fulfilled part of that commitment in establishing the Center.

At the host institution, the International Advanced Research and Education Organization (IAREO) was set up last April as a research support organization for the "fusion" of different research fields. As the Institute for International Advanced Research and Education, which aims to support postgraduates who intend to work on interdisciplinary research, IAREO is a center whose main constituent members are researchers (post-doctoral) who also intend to work in interdisciplinary research. The activities of IAREO are not limited to the materials science field. It also functions as an interdisciplinary research support organization with an incubation function so that research education organizations in interdisciplinary areas in the host institution (e.g., between medicine and engineering, and physics and mathematics) could be produced one after another. With the establishment of the Center, it can be assumed that the educational research support, etc., for postgraduates who enter into the field of disciplinary research mainly targeting the materials science field, will be implemented by cooperation between the Center and IAREO. The host institution can thereby assume that a career support system for postgraduates, post-doctoral researchers, and a tenure track is now in place.

#### 11. FY 2007 funding

(Exchange Rate: JPY/USD=120)			Ten thousand dollars (Exchange Rate: JPY/USD=120)	
Cost Items	Details	Costs (ten thousand dollars)		
			WPI grant for FY 2007	472
Personnel	Center director and Administrative director	12		
	Principal investigators (no. of persons): 29	96	Costs of establishing and maintaining facilities in FY 2007	251
	Other researchers (no. of persons): 12	17	Establishing new facilities: Integration Lab Bldg. "Phase II" (Number of facilities: 2,600m <sup>2</sup> )	Costs paid: 251
	Research support staffs (no. of persons): 1	0	Repairing facilities (Number of facilities: 0m <sup>2</sup> )	Costs paid: 0
	Administrative staffs (no. of persons): 16	15	Others	0
	Total	140		
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):0	0	Cost of equipment procured in FY 2007	230

	Cost of dispatching scientists (no. of persons):0	0	Name of equipment: Nano Indenter Number of units:1	Costs paid: 13
	Research startup cost (no. of persons):4 Groups	0	Name of equipment: High-speed AFM Number of units:1	Costs paid: 13
	Cost of satellite organizations (no. of satellite organizations): 1	0	Name of equipment: AFM Number of units:1	Costs paid: 9
	Cost of international symposiums (no. of symposiums):2	5	Name of equipment: HPES System Number of units:1	Costs paid: 10
	Rental fees for facilities	0	Name of equipment: fs Laser Amplifier System Number of units:1	Costs paid: 13
	Cost of consumables	3	Name of equipment: SoC Test System Number of units:1	Costs paid: 9
	Cost of utilities	0	Name of equipment: Glovebox System Number of units:1	Costs paid: 9
	Other costs	95	Name of equipment: LP-CVD Number of units:1	Costs paid: 17
	Total	103	Name of equipment: Scanning Nano Indenter Number of units:1	Costs paid: 11
Travel	Domestic travel costs	2	Name of equipment:PLD System Number of units:1	Costs paid: 9
	Overseas travel costs	8	Others 73units	117
	Travel and accommodations cost for invited scientists (no. of domestic scientists):33 (no. of overseas scientists):32	9		
	Travel cost for scientists on secondment (no. of domestic scientists):5 (no. of overseas scientists):0	1		
	Total	20		
Equipment	Depreciation of buildings	0		
	Depreciation of equipment	254		
	Total	254		
Other research	Projects supported by other government subsidies, etc.	0		
	Commissioned research projects, etc.	537		

projects	Grants-in-Aid for Scientific Research, etc.	82	
	Total	619	
Total		1136	

## 12. Efforts to improve points indicated as requiring improvement in application review and results of such efforts

### -Points specified as needing improvement

The domestic network is not very active, in spite that there are many good material scientists in Japan. Expansion of domestic collaborations is recommended.

Clearer plan on how collaboration with other countries is to be accomplished is needed.

Involvement of advisory and other peers abroad is recommended to enhance and push forward the program's globalization.

Further efforts for the creation of a welcoming environment for international researchers are encouraged. Particularly, efforts to accommodate the educational needs for foreign researchers' children are needed. Collaborations with local governments are encouraged.

Expansion of the participation of female researchers is needed.

### -Efforts to improve them and results

• It was decided that co-researchers related to each PI would be positioned as Tohoku University WPI adjunct professors, and that the circle for these adjunct professors should be expanded inside and outside the country. With this, networking will be promoted in other countries, as well as inside Japan.

• We have set up one satellite (The University of Cambridge) in Europe, and built a worldwide network with a strong BMG group centering on Sendai in cooperation with the European satellite. Furthermore, we are going to advance the networking for nanophysics by setting up a satellite at one location (scheduled to be at IBM) in the United States. Subsequently, one for nanochemistry is also scheduled. A WPI and cooperative relationships with institutions in Europe and America will be constructed through these networks.

• We are developing accommodation facilities, since many overseas researchers will stay here after April. Coordination is already underway with an American school in the Tohoku district for the educational needs of their children, and their educational needs can be met upon their arrival in Japan.

• Three female researchers: two assistant professors and one post-doctoral researcher, will join the Center on April 1, and we plan to expand this in the future.