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Full Research in Society, for Society

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MESSAGE

The autonomy of research units and the mission of AIST

FEATURE

The 4th AIST Advisory Board meeting

Research Hot Line

UPDATE FROM THE CUTTING EDGE (Jan.-Mar. 2006)

In Brief

The autonomy of research units and the mission of AIST

National Institute of Advanced Industrial Science and Technology (AIST)
President **Hiroyuki YOSHIKAWA**

1. Preface

The Fourth Meeting of the AIST Advisory Board was held on February 6 and 7. Chairman Masuo Aizawa and the Board's seven members from Japan and six from abroad spent two days on industrious discussion and study, including tours of laboratories. And They gave us valuable advise. To sum up my impressions in a few words, I would say that the research and research management of AIST has become well-known not just in Japan but overseas as well. Many opinions were offered, and they were encouraging to us. With deeper understandings, however, there were many opinions which precisely point to insufficiencies. Since many of them are related to the essence of AIST itself, we are aware of our incompleteness but have not acted on that knowledge. Following the opinion of the AIST Advisory Board members that greater effort is required, I believe that we must make our research and research management more concrete than we are currently doing.

As Chairman Aizawa aptly stated, the relationship between the autonomy of research units and the overall mission of AIST is an issue that touches the basic principles of the institution. We understand it conceptually and agree with it, but we have not fully developed it into an explainable idea. As Chairman Aizawa points out, elaboration of that idea and its implementation in day-to-day research and research management are urgent tasks.

The matters pointed out by the Advisory Board members will require some time to resolve. With the Advisory Board having come to an end, though it would be impossible to address each item they pointed out, let us consider the future of AIST bearing these matters in mind.

2. The 10 articles of AIST research management

Among the matters explained at the AIST Advisory Board meeting are the "10 articles of AIST research management." In fact, I articulated these at Tsukuba in my message for the fiscal year 2005. I reiterate them here :

1. Remove the lid
2. People make organizations possible
3. Autonomy of research units
4. Full Research
5. Research strategies written in scientific terminology
6. Separation of powers
7. Fractal organization
8. Time constants for people and organizations
9. A network of outstanding institutions forming an innovation hub
10. Common goal: science and technology to bring about a shift of the center of gravity to sustainable industry

These are not merely ideas that someone happened to think of. They are ideas that have arisen since AIST began in 2001, and they have been debated by AIST as a whole on various occasions. For example, I first stated the principle "remove the lid" on the day AIST began, which was also my first day as President. Many research institutions place their researchers beneath a weighty management structure. In contrast, my impression of AIST was that that heavy management structure had been removed and that without that weight, researchers could be clearly seen from the outside. This was also a necessary condition in order to clarify research autonomy and responsibility. Following that, the other concepts have arisen over time in roughly the same order as the numbering of the articles. Each of them has been debated in Full Research workshops or introduced in "AIST TODAY", so I will not go into detail here. However, I will examine issues such as how these 10 articles are being implemented, whether any contradict each other, and so on.

3. Full Research

I think that international members of the Advisory Board were particularly interested in Full Research as a unique type of research management. For example, with the understanding that innovation hubs only become possible through Full Research, questions were raised regarding how different kinds of researchers can coexist within a single unit and whether it is not excessive to have Type-I basic researchers and product realization researchers each account for one-third of the work when emphasizing the innovation hub. These are matters of great interest to us as we work to build an innovation hub through Full Research. The coexistence of different kinds of researchers is an essential issue for scientific research. Traditionally, it has indeed been considered difficult. This can be seen in the way universities in any country clearly separate organizationally science with the purpose of Type I Basic Research and engineering that emphasizes Type II Basic Research and product realization research because there are reasons to manage them separately. Furthermore, the department of science and the department of engineering are not particularly friendly to each other. Full Research, however, holds that the coexistence of different kinds of researchers is essential. This is not only for the purpose of enabling basic scientific knowledge to quickly aid industry. The separation of science and engineering and the fragmentation of those fields are in fact causing difficult problems today, and Full Research also has the purpose of attempting to correct that at the research implementation level. The former purpose is AIST's goal for the time being, but the latter purpose, including the fostering of researchers free of that fragmentation, is AIST's scholarly raison d'etre. Through this kind of discussion, the Advisory Board came to understand the meaning of Type I Basic Research and product realization research each accounting for one-third, and the question of whether Type II Basic Research alone would be sufficient was also dispelled.

There was much discussion of contact points with industry. We have developed a number of policies to bring Full Research into industry. These include individual joint research with corporations, comprehensive agreements, and patent strategies predicated on them. Items with more clear-cut outlines include the AIST industry reform research initiative, human resources development type joint industry-academia research, high-tech skilled manufacturing, and Intellectual Property integration. High-tech startups (ventures), of course, are another important policy. While we believe that these are effective measures, and that they are making steady progress, they have yet to produce the sort of major results or outcomes that will impress outsiders if we offer them as proposals.

It is difficult and time-consuming to actually apply the results of basic research to industry in a visible way. Therefore, if one evaluates the results of a research institution like AIST based on outcomes rather than on output, various problems will arise. Since one cannot put off evaluation for 10 years by saying that it will take that long for outcomes to be known, other methods must be used to indirectly extrapolate assessment of outcomes. In that sense, I think that the testing of the various policies mentioned above and the fact that many researchers are seriously involved with them are in themselves projections of future outcomes. I believe the Advisory Board members agreed with me. In that sense, these policies should not be thought of merely as experiments for a few relevant people. Instead, they should be considered issues for all researchers who aspire to perform Full Research.

4. The autonomy of research units and the mission of AIST

A question that was raised several times during the duration of the Advisory Board is whether the research units can be autonomous while at the same time the research institution as a whole sets forth a clear mission to be achieved. In other words, the actual question is whether Article 3 and Article 10 can be balanced.

Let us consider the relationship between the two again. First, let us consider the establishment of research units. The first condition for their position is that they are established because they are necessary for the research institution as a whole to achieve its goals. The next condition, of course, is the ability to obtain necessary researchers and other research assets. Even more important are the questions of who will design a research unit that meets those conditions, and who will evaluate it and bring it to establishment.

First, there is an informal preparatory proposal from any person who wants to organize his or her own research unit within AIST. In other words, any (full-time) AIST employee can make a preliminary proposal, and anyone outside AIST who wants to carry out research within AIST can do so as well with the agreement of a full-time employee who will accept responsibility for it.

Led by the Research Coordinator of AIST for the relevant field, researchers examine preparatory proposals mainly for scholarly significance, international excellence, and future potential. At that time, the positioning of the proposal within AIST, connections with other research units, and so on are fully considered. Through this preliminary examination, a formal proposal is created. Planning Headquarters supports this process. Among the researchers assigned to the Planning Headquarters, the person from the relevant field (Senior Planning Manager) is placed in charge and creates a proposal along with the person who made the preparatory proposal. The proposal is examined for practical viability in terms of sustainability as an AIST Research Unit, in other words, for its potential for Full Research configuration, for cooperation with other units, for contributions to industry and society at large, for ability to obtain funding, and for relevance to national science and technology policy and industrial policy. If the examination finds a lack of such potential, then of course the proposal may be either reexamined or rejected. Created proposals are formally proposed to and deliberated by a placement committee chaired by an AIST executive with deep insight into the target research area. Through this process, proposals are placed before the Executive Board. The main purpose of the Executive Board's examination is to determine whether the proposed research unit would be meaningful in terms of achieving AIST's goals.

The reason I went into some detail on this establishment process is that it is a practical process for realizing the second of the 10 articles, "People make organizations possible." It begins with a person who wants to carry out research and who generates a proposal. Subsequently, an external screening regarding the conditions for the research's existence takes place from a management perspective, but basically the process moves forward from a researcher perspective. In the end, however, the decision of the Executive Board is rendered from the perspective of AIST's research management, with responsibility for establishment falling to management. Although I will not go into detail here, the process for eliminating research units is similar. The establishment and elimination of research units thus take place through a tension between the proposals of researchers and the decisions of management. As specialists in their fields, researchers have the greatest judgment and foresight on which to base proposals. Managers, on the other hand, make decisions while maintaining an insightful overview of science and technology conditions in industry and society as a whole. Researchers and managers are not necessarily always in accord. Tension between them because of their differences is therefore an inherent phenomenon. At this point, it should be pointed out that these differences do not give rise to confrontation, but rather have a positive meaning for AIST. That is, the collaboration of specialist and generalist viewpoints gives AIST the needed better perspective that enables it to choose its path for the future. In order for such a situation to be practical, all AIST members must share AIST's goal as noted in Article 10. I will discuss this later. Care is given to including advice from outsiders in this process, and to improve our vision.

As can be understood from the above establishment process, researchers make proposals for the research they want to carry out themselves. Research units are established with freedom of research, as I will discuss below, because the process means that at the time they are established they have been sufficiently imbued with the mission of AIST declared by managers who take a broad view of society and industry as a whole.

The research units thus established are given research autonomy. This means that under conditions that promote Full Research, they are autonomous in how they carry out their research in terms of internal organizational structure, research management, employment of contract employees, creation and selection of research topics, adoption of research methods, use of research funds, publication of research results, obtaining of patents, and so on. Furthermore, cooperation with other research institutions and industry-academia collaboration targeting corporations are also left to the units' decision. In this process, management-related sectors provide cooperation and advice as needed. Since there are a limit to the number of AIST's full-time employees, and also a rather strict limit of the budget because of the obligation as an independent administrative agency to reduce it, the research units cannot simply do as they please even though matters are left to the decision of them. However, let us consider it as a different kind of issue than autonomy which we are considering here.

Research units are imbued with the mission of AIST when they are established, but what guarantee is there that these units will always remain effective in carrying out the mission of AIST as they perform their research with the autonomy they have been given? We must answer this question that was raised by the AIST Advisory Board. I will attempt to find the direction of that answer here.

The mission of AIST is, in short, "the creation of effective industrial technology to bring about a shift in the center of gravity from current industry to sustainable industry, contributing to the realization of a sustainable society". This is found in Article 10. Sustainable industry is industry that will be competitive in the markets of a future sustainable society, which is not possible for existing industry. Research on AIST's frontline is carried out by researchers who have autonomy but who also understand AIST's mission. Looking at individual research, sustainability is the intent, so the results can be expected to be effective. This is abstract, however, and not explanatory to the society. Even to us at AIST, it is too abstract when considering actual research strategy. In fact, clarifying the framework for diverse and autonomous researchers to realistically achieve AIST's abstract but clear mission is an important issue for AIST. We must also clarify future issues while looking back over how we have dealt with matters until now.

5. From mission to research

Let us begin with the mission of AIST. What is sustainability? This is now being discussed around the world as the most urgent issue for humanity, so no new definition is required. Sustainability is the achievement of a satisfactory life for all the world's people while maintaining the global environment. What, then, is a shift in the center of gravity to sustainable industry? This is an AIST-conceived concept that has yet to undergo full-fledged debate anywhere else.

AIST has a Committee on Industrial Science and Technology for Sustainability comprising mainly younger researchers. It has begun research on clarifying the scientific and technical definitions of sustainable industry.[1] This is to clarify from a science and technology perspective the industrial technology held by all industries and to carry out scientific and technical assessment of environmental impact. The aggregation about all industry is the impact of all industry. It may be a point in multidimensional space, but it can be called the center of gravity for the impact of each industry. The research attempts to clarify how the center of gravity will shift as conventional technology is replaced through technological development. In the manufacturing industry, for example, products have individual physical processes with individual impacts on the global environment. Various elements such as types of materials, manufacturing technologies, distribution and sales, energy technology for product use, maintenance and repair, disposal methods determine impact. Work pursuing this has much in common with Life Cycle Assessment. This is not just evaluation, however; it seeks to learn whether the effects of technological change can be added to evaluation values.

Quantitative pursuit of the center of gravity will probably require an enormous amount of work. Furthermore, this is not a matter of simply trying to aggregate the scientific and technical characteristics of the industrial technologies of each industry. In the process of finding their sum, how widely products made with them are distributed and how they are consumed will be issues. It is a matter of individually forecasting the products of future society. It is a matter not only of economics, but of ultra-complex fields that include cultural elements.

What can be said clearly at this point is that this kind of effort will not become capable of providing doubt-free solutions to the question of what sort of technological development should be carried out. That expectation is too high. However, it would also be a mistake to reject such efforts on that basis. This is because the goal of AIST's research is for sustainability to point in a positive direction and move the center of gravity. This seemingly odd expression requires some explanation.

Reasons for believing that a center of gravity exists even though current science may not now be able to define or measure it are as follows. If we accept that human industrial activity has some sort of impact on humanity and ecosystems, logically it means that we are assuming an existence of a center of gravity as a precondition. Because our goal is for future industry to have a positive impact, we take the position that it exists. Thus, a center of gravity certainly exists from the perspective of the sustainability of all industry, but with the current scholarly situation, obtaining a quantitative expression all at one time is too difficult. Our tasks, therefore, are what AIST is now doing: independently contributing definite (quantitatively measurable) improvements in sustainability, and, for research that researchers intuitively believe will probably help shift the center of gravity, providing evaluation from an all-industry perspective. Who performs this evaluation? It would be unrealistic for each researcher to carry this out for his or her own research. We expect the Committee on Industrial Science and Technology for Sustainability, comprising members with a sharp awareness of the issues, to perform this task. We expect something very difficult of this committee, but in fact this evaluation will break through the abstractness of AIST's mission as a research institution. This work will continually provide concreteness and draw closer to the research of actual researchers. In other words, it will provide researchers who carry out their work autonomously with the potential to understand AIST's mission in terms of issues in their own research fields. Then, how will researchers access the mission of AIST on their own, with response to this approach?

6. Researchers today

Let us begin by considering what the research autonomy mentioned above is. Autonomy can be translated as "jichi" in Japanese. This translation is easily misunderstood, as it was in the past when the autonomy of universities was misinterpreted to mean the severing of ties between universities and the outside world. Research autonomy does not mean the severing of all ties to the outside world. Instead, it should be interpreted as obtaining a certain amount of freedom by maintaining clearly delimited relationships with the outside world. It means to live freely. An autonomous organism cut off from the outside world will die. Only through its complex and exact relationships with the world around, it can live freely.

Turning, then, to general scientific research, when one speaks of research autonomy, what sort of relationship with the outside world or society will provide it? If we consider it in principle, we come to Jean-Jacques Rousseau who considered this issue perhaps intuitively but most deeply. Rousseau said that it is the "social contract" that gives people civil liberty and property rights. That is to say, "What man loses by the social contract is his natural liberty and an unlimited right to everything he tries to get and succeeds in getting; what he gains is civil liberty and the proprietorship of all he possesses."(2) Rousseau placed the fundamental principles forming human society in the "social contract." If we describe the research autonomy we have in mind in Rousseauian terms, we mean the freedom to perform research and the right to the results obtained. As with the social contract, there is no tangible contract involved. However, scientists definitely receive freedoms and rights. In that case, what do scientists lose in exchange?

One can say that the freedoms and rights that people have today are obtained through the loss of natural rights, just as Rousseau said. The reason one can freely enjoy one's private space without interference and move freely in public spaces is that one has lost the right to enter the private spaces of other people. In this case, there are tangible contracts, namely, the law. Novelists have the right to write whatever they please because they have given up the right to compel others to read. Reading is a freedom of the reader, and a novelist cannot interfere with it. In practical terms, being read by readers guarantees the freedom to write. In other words, selling books provides a livelihood, enabling the novelist to go on writing. This social relationship can be considered an intangible social contract.

While there are rules and laws for practical agreements on research freedom and rights related to the results, their essentials are not decided by the law. Therefore, it is necessary that we clearly contrast the rights gained and the rights lost. What researchers gain is the freedom to perform research. What, then, do researchers lose?

These are not matters that most researchers themselves are conscious of on a daily basis, but are "unforgivable activities for scientists" not permitted within the strict bounds of their behavior. If we limit these to statements (announcing of research), they can be summarized as follows.

(1) Logic: Statements must not include logical contradictions.
(2) Demonstrability: Statements must have been demonstrated or they must be demonstrable (falsifiable).
(3) Logical consistency: All statements, including past ones, must be mutually free of logical contradictions.
(4) Permanent responsibility: One is permanently responsible for every statement one makes.
(5) Affiliation responsibility: The bases of statements must be clarified as coming from one's own inquiry or that of others.

Scientists have lost the ability to make statements that are not permitted under these rules. For example, if one publishes a research paper that includes logical contradictions or claims that are not demonstrable (falsifiable), even if it is interesting paper, one is not qualified to be a scientist. Or, if one were to state, "Diamonds do not replace silicon," one would not be a scientist. (It is impossible for such replacement to take place. One would be permitted to say that if such a thing happens one will become a monk. Though such a statement means throwing away the freedom of scientists, and imposes on them a new responsibility that scientists had never had.) Making claims about this sort of indemonstrable statement or uncertain matter is quite usual. Scientists, however, do not make them when speaking as scientists. In other words, they have lost the right to do so. This has a deep connection with research misconduct, which has recently become a problem, but I will discuss it in another article.

Through this, scientists have obtained the freedom to perform research. Society gives the scientists who have lost such rights special recognition and accepts their freedom. Moreover, the results of their research are accepted unconditionally, without the exercise of the kind of right of selection that readers exercise towards novels, for example. Those who, amidst this freedom, have the purpose of knowing truth and can act based on their curiosity without interference from anyone are the chosen scientists. These are the traditional scientists, and this is the research autonomy they have acquired through various eras.

Recently, Jane Lubchenco, former President of the International Council for Science (ICSU), has attempted to understand the freedom of modern scientists under the same principles in what she calls a "new social contract." Her interest is in the freedom to select research topics, and she discusses how to enable research on global environmental issues to flourish.[3] Modern scientists generally carry out research at public institutions. In other words, researchers are no longer forced to sell the results of their research. People provide researchers with funds through their taxes. In effect, their expectations are sent along with research funding. As a result, scientific researchers have obtained guaranteed livelihoods from public institutions, public research funding, the ability to "freely" carry out research, and rights to the results. This is the new social contract of which Lubchenco speaks. In other words, those who use public funds for research have an intangible contract with the people who place expectations on them. Scientists thus have an obligation to eliminate that part of their curiosity that is not in accord with society's expectations, creating a new prohibition:

(6) Change in curiosity: The curiosity that drives research must not conflict with society's expectations.

The freedoms and rights in the research of modern scientists are thus made clear.

7. From researchers to management

Having clarified the bases on which science and technology researchers receive rights and freedoms, we will next consider how those bases are given substance and guaranteed. The basis is that researchers themselves to understand them as the conditions of their existence. Then, on that basis, they give them substance by making effective use of them in actual research. This differs by research topic and field. One immediately understands this when one considers elementary particle research, research on physical properties, life science research, and so on. Now, our interest is in industrial technology research.

AIST primarily engages in industrial technology research through public research funding. This public research funding is provided by people today and in the future with the expectation that industry is a good thing. Using a broad definition of "industry," it is a major human activity with extremely diverse content and it plays a major role in creating affluence. People's expectations towards it are therefore diverse as well, and this is the cause of the diversity of AIST's research topics. Diversity of research topics is also connected to diversity of research methods. How, then, is it possible for an institution as diverse as AIST to act in a unified way?

While recognizing the diversity in our research, we agree on a single common principle for action that transcends that diversity. This is Full Research. It is the basic form of industrial technology research. It uses the basic scientific and technical knowledge obtained through discovery and invention and is the basic shape of scientific or research management that creates new wealth in society regardless of the research topic. Through various measures such as the industry reform research initiative mentioned in Section 3 above, it provides actually effective technologies to industry.

What we should examine here is whether this principle for action enables the research units to fulfill AIST's mission as a research institution. It is easy to understand that they serve to promote industry, but one does not know what to say on the question of whether they fulfill AIST's mission of shifting the center of gravity of industry as a whole towards sustainable industry. In other words, Full Research is a necessary condition, but it is not sufficient. Figuratively speaking, Full Research and the innovation hub prepare the "container" for the research needed to carry out the mission. It must fulfill the sufficient conditions by the research content that fills the container

At AIST, we are currently seeking methods for judging whether the content of research currently underway is accelerating the shift of the center of gravity towards sustainable industry. This is included in the FY 2006 revised edition of the "Second Term Research Strategy" being prepared under the leadership of the Planning Headquarters. Details will be published later, and I cannot touch on them here, but it is an attempt to use "indexes" to judge whether the fruits of each research topic are part of a competitive sustainable industry and contribute to shifting the center of gravity for all industry when they are effectively provided to society. The indexes are written in scientific terminology, and researchers who continually evaluate their own research in terms of the indexes can adhere to Article 5, "Research strategies written in scientific terminology." This will be significant not only in terms of the ability to clearly describe research plans and roadmaps, but also because it will enable us to judge whether each piece of research is in harmony with the goals and mission of AIST, which are comprehensive in terms of society and affiliated institutions, yet still abstract.

In this way, researchers in the research units will be able to continue their research while judging whether they are in harmony with the mission of AIST. And, researchers will be able to draw nearer to the mission of AIST.

8. Postscript: What is industrial technology?

Five years have passed since AIST was launched as an independent administrative agency. It may seem strange at this point to once again ask what industrial technology is. By asking the question now, we may be criticized for carrying out five years of research without knowing something so basic. However, this has a new significance. Namely, we know what industrial technology is by "denotation" through our own specialties, but now we seek "connotative" expressions to describe industrial technology. As noted in the previous section, the concept expressed in connotative terms sets future industry and the industrial technology to support it as AIST's goals. It is an essential, radical concept when AIST's researchers consider how to meet the goals. The raw material for this concept already exists in the form of the research actually being carried out at AIST. This raw material is already written denotatively in the Second Term Research Strategy. However, as one will realize from reading the strategy, it is not easy to express a connotative definition that includes everything but is not overly abstract. It includes almost all scientific fields, from basic research to application, as well as many factors that consider relationships to society. I think a sense of this difficulty was common in the statements of AIST Advisory Board members as well. In the future, in order to express AIST's goals more clearly to society and to deepen our own internal discussions, the definition or connotative expression of industrial technology will probably become important. Here I will only point out the importance of the topic, and I will end this article by touching on a matter that I think is relevant to its examination.

That is "skilled manufacturing". Skilled manufacturing is considered a characteristic ability of Japanese industry. Not only did it support Japan's period of high economic growth in the past, it is an ability that has been preserved and is likely to be important to the nation's future. However, it is not far behind industrial technology as a term that is difficult to define. Because it centers on highly-skilled technicians, their shortage is considered a problem, and Total Quality Control

(TQC) is considered important. Furthermore, Japan's culture and traditions are often brought up. The importance of having skilled technicians on-site is often indicated. These are all correct, yet somehow they do not seem to capture the essence of the term. As a result, the policy on skilled manufacturing is difficult to draw as an attractive form. Currently, I am considering measures to define industrial technology by clarifying the meaning of skilled manufacturing. What can be said with certainty about skilled manufacturing is that there are people who use an accumulation of the most advanced scientific and technical knowledge most skillfully, and that those people constantly look to those responsible for the unique progress of that knowledge. The users are technicians, engineers, managers, and so on, while those responsible are science and technology researchers. Skilled manufacturing is creative intellectual work carried out on the frontier between human beings and knowledge by users and those responsible. If we are to try to say what industrial technology is, I believe it may be necessary to do so by clarifying the essence of skilled manufacturing. However, I will take some other opportunity to address that question more fully.

References

(1) Study Group on Industrial Science and Technology for Sustainability, AIST Technology Information Department, September 2005 (Chairman: Koji Masuda)

(2) Jean-Jacques Rousseau, The Social Contract, Japanese trans. by Kuwabara and Maeda, Iwanami Shoten, 1954, p.36

(3) Jane Lubchenco, "Entering the Century of Environment: A New Social Contract for Science," Science, 23 January 1998, Vol. 279, p.491

The 4th AIST Advisory Board meeting

The AIST Advisory Board consists of leading domestic and overseas experts in various fields. At every meeting, members of the Advisory Board comprehensively examine various aspects of AIST's operations, including overall research activities, methods of resource allocation and evaluation of systems, and consider the future direction of AIST from an external viewpoint, with an eye to offering advice to AIST. A total of three meetings were held over a four–year period during the first term. For the second term, biannual meetings are scheduled for the first, third and fifth year. The first meeting of the second term, the 4th Advisory Board Meeting, was held on 6 and 7 February 2006, at the AIST Tsukuba Headquarters.

The agenda of the 4th meeting was the "second term strategy for AIST as an innovation engine". The discussions focused on the President's presentation, entitled "Vision for AIST's Second Mid-term Period", and on the presentation given by Masanori Yoshikai, Director of Planning Headquarters, entitled "Establishing the innovation Hub at AIST". The Advisory Board members and AIST executives held active discussions about the Innovation hub strategy, and other issues. They divided into three groups to visit laboratories and exchange opinions with researchers. The following text provides an outline of the meeting and the main comments from each member of the Advisory Board.

Table 1 List of AIST Advisory Board Members

Masuo Aizawa (Chaired)	President, Tokyo Institute of Technology
Wataru Aso	Governor, Fukuoka Prefecture
Takeshi Isayama	Vice Chairman, Nissan Motor Co., Ltd.
Hiroshi Komiyama	President, The University of Tokyo
Tomoko M. Nakanishi	Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo
Tomoyo Nonaka	Chairman, SANYO Electric Co., Ltd.
Isao Uchigasaki	Chairman of the Board, Hitachi Chemical Co., Ltd.
Katsuhiro Utada	Senior Corporate Adviser, Ajinomoto Co., Inc.
Lord Broers	President, Royal Academy of Engineering, UK
Hans-Jörg Bullinger	President, Fraunhofer-Gesellschaft, Germany
Geoff Garrett	Chief Executive, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Binglin Gu	President, Tsinghua University, China
Richard K. Lester	Professor, Nuclear Science and Engineering, Massachusetts Institute of Technology (MIT) and Founding Director, MIT Industrial Performance Center, USA
Sakarindr Bhumiratana	President, National Science and Technology Development Agency (NSTDA), Thailand
Hratch G. Semerjian	Deputy Director, National Institute of Standards and Technology (NIST), USA

Structure of Advisory Board Meeting

AIST reshuffled the Advisory Board as it entered the second term. For the 4th Advisory Board meeting, a total of fifteen people were selected as members; eight were from universities, industry and local governments in Japan, the others were from universities and public research organizations outside Japan (Table 1). The meeting took one and a half days and followed the program as shown in Table 2. In the morning of the first day, AIST President Hiroyuki Yoshikawa made a presentation entitled “Vision for AIST's Second Mid-term Period ” to give an outline of AIST, focusing particularly on the way research activities should be conducted in the second term, which was followed by a question and answer session. In the afternoon, members visited laboratories implementing an “innovation hub strategy”. These strategies include collaboration between industry and academia, human resource development and venture creation. The laboratory tours were followed by a presentation by Masanori Yoshikai, Director of Planning Headquarters, entitled “Establishing the Innovation Hub at AIST”; this set out the innovation hub strategy AIST should implement in the second term. On the second day of the meeting, the Advisory Board members and AIST executives engaged in active discussions on various issues surrounding the operation of AIST, including research management, collaboration between industry and academia, intellectual property, human resource development, safety management, security management and public relations. At the end of the meeting, each member was asked to give a comment and advice on future AIST research activities and operations.

Table2　Schedule

Feb 06 (Mon)

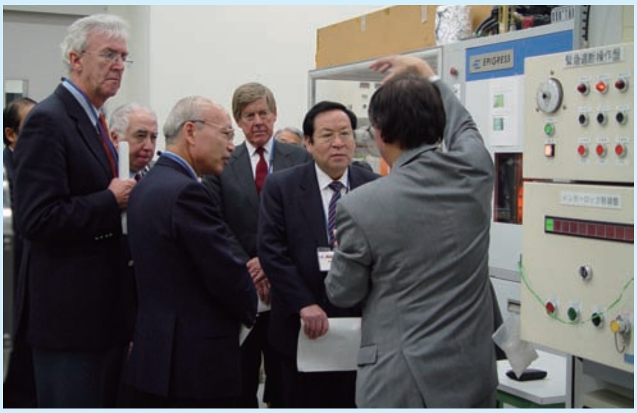
- Opening / Welcome address (H. Yoshikawa, President, AIST)
- Introducing AIST Advisory Board Members
- “Vision for AIST's Second Mid-term Period” (H. Yoshikawa, President, AIST)
- Exchanging views with President
- Lunch
- Laboratory Tour: Meeting with AIST research scientists
- “Establishing the Innovation Hub at AIST” (M. Yoshikai, Vice President, AIST)
- Discussion on “AIST Innovation Hub Strategy”
- General discussion
- Banquet

Feb 07 (Tue)

- Discussion with AIST executives based on day-old discussion
- Summary discussion for wrap-up
- Adjourned / Luncheon

Laboratory Tours by Advisory Board Members in Three Groups

As an innovation hub, AIST uses various systems to promote transfer of research outputs. Members of the Advisory Board were invited to inspect the conditions of various laboratories and to exchange opinions with researchers. The laboratories and research programs that were inspected included Power Electronics Research Center and its joint research program focusing on SiC semiconductor research; Institute for Human Science and Biomedical Engineering and its research program on surgical-assist technology, jointly conducted by a U.S. medical institution; Advanced Manufacturing Research Institute and its innovative ceramics compaction technology that uses nano-fracture of fine particles at room temperature and is based on IP integration; Research Institute of Instrumentation Frontier and its research program on defect characterization using positron beams, a program promoted as an AIST consortium; Nanotechnology Research Institute and its human resource development program; and IQUANTUM, a high-tech startup company formed by Nanoelectronics Research Institute.



Members' Comments and Advice for AIST in the second term

Ms. Tomoyo Nonaka

I was very pleased to know that AIST has reached the stage where you have raised the question, "Is the direction of AIST's innovation and outcomes appropriate?" The question clearly reflects your vision for the future, which is to act in concert to move into the direction of sustainability. No other word can describe your vision for the future.

You introduced research units and shifted the focus of evaluation of research outcomes to strengthen your competitiveness in the market and to change the awareness of researchers. By stressing the importance of autonomy of research, you sent a clear message: research institutes will not survive unless they produce research outcomes that are valued by the market. I think it's time that you considered how to contribute to the economy and society. I believe it's important to formulate and implement concrete measures to address the needs of the future.

A network of excellence, as well as sharing of information and research themes, and personnel exchanges with the industry, will be one of the pillars of Japan as a country that is built on intellectual property. A methodology of intellectual property hasn't been firmly established in Japan. Therefore, I think it is very important for AIST to strengthen its intelligence and analytical capabilities. It is also important for AIST to promote financial literacy and recruit financial management experts in intellectual property management. You have to distinguish between public and private funds. That will help you adhere to the openness principle of public funds and the non-disclosure agreement concerning private funds. I expect that AIST will strive to accumulate the know-how required for establishing a completely new way of managing intellectual property.

Mr. Wataru Aso

AIST's seven regional centers are very important for local industries because they play a role in the world-class research efforts at AIST. Over a long period of time, regional centers have played an enormous role in giving guidance to local industries in research and development through technical guidance, commissioned research, joint research and seminars.

Regional centers conduct a very high level of research activities. Their research objectives and methods are closely linked to those adopted by AIST Headquarters, thereby providing much insight (stimulation) to local research institutes and universities. I therefore hope that AIST will foster further development of its regional centers to establish them as a very important arm of AIST research activities. I also hope that regional centers will play a key role in the creation of industry clusters in their respective regions.

The kind of research activities conducted at AIST matter so much to local industries. I know that local industries need to learn more about various assistance measures such as the nanotechnology human resource development program and other human resource development programs, research and development projects, and assistance to small and medium enterprises. I urge you to ensure that such assistance measures are communicated to all those in need of them.

Local research institutes often face the difficulty of pursuing a research theme, due to the lack of researchers with relevant expertise. There isn't sufficient mobility of human resources in Japan. Efficient mobility of human resources is indispensable to the stimulation of research activities in local regions. I sincerely hope that AIST will increase mobility of human resources, including researchers, in local regions.

Dr. Geoff Garrett

It is necessary to clearly position AIST in the national innovation system and define its advantage over other research organizations in order to differentiate AIST from others, by focusing on full research. The key differentiator is its particular uniqueness in certain areas and how it can make a contribution.

Second, I would like to emphasize the importance of establishing networking between innovation, technology transfer and mobility. This networking is far more important than papers or talks. Roles individuals play within the network thus established are also important.

Third, it is important to nurture leaders who can move across some fields of science and technology, those of nano and bio in particular, in order to achieve porosity. As convergence of technologies is increasingly prevalent, it is important to nurture a generation of individuals who can easily transcend the traditional disciplinary boundaries or go beyond the framework of the organization.

4th, it is very important that we clearly understand what the measurements of success are, that we communicate it and that we roll down those measures throughout the organization. It is also important to respond to unintended consequences. For example, we can measure health and safety. However, measurement results could drive us in the wrong direction, depending on the measurement method we used. Therefore, we have to be very careful about how we measure performance and how we advertise or announce research outcomes.

There are two meanings of the words "look out". The first meaning is "danger or beware". As it implies, we need to monitor the situation in which a publicly funded research organization is operating. Another meaning implies that our existence is justified by the existence of others. In other words, we can only exist when there is a society. Perhaps you tend to place the sole emphasis on internal affairs. You need to place importance on the perspective of social contribution.

Mr. Katsuhiro Utada

AIST is a large and complex organization and it is difficult for an outsider to understand what AIST does. AIST is departmentalized and there are more than ten research units specializing in biotechnology alone. From a standpoint of industry-academia collaboration, AIST needs to develop a community-based industry cluster. AIST's regional centers are important as they help to foster new industries.

As a research organization, AIST needs to have autonomy. I think that you need to achieve harmony between individual researchers and the organization. That will be a big challenge for AIST. You also need to consider individual research programs carefully, or your leadership will be called into question. Corporate governance, information transmission and transparency (mutual information exchange with the outside world) are important for companies. The same is true in the case of AIST. I think that the ability of AIST's management to address the issue of "selection and concentration" is in question.

Your ability to respond to various issues such as compliance and personal information, in addition to antisocial problems such as unethical activities, is also in question. President Yoshikawa said, "A director of a unit must be a philosopher". That is a sublime idea. I know that it's not easy to realize that idea, but I strongly hope that you will strive to realize that.

Dr. Hratch G. Semerjian

I think the strength of AIST has been its emphasis on interactions with business and industry. I advise you to make these interactions even more efficient. If the industry speaks up for AIST and communicates the positive impacts of your work on industry and society, you will secure the understanding of the public and help them to recognize the importance of your work.

I understand that autonomous research is encouraged in the context of the strategic plan. However, most of the cutting-edge research is in fact happening in the interdisciplinary research areas, for example between nano and bio. I feel that you should step up efforts to coordinate research activities conducted at the 54 organizations (which have different research objectives), particularly those in the interface area.

Prof. Hiroshi Komiyama

Subsidy reductions at the rate of 1.5% per annum and the employment of aging staff provide an important perspective on formulating advice regarding the issue of "how to evaluate what is an appropriate for AIST". There is a larger proportion of administrative staff to researchers in research settings, including universities. Although there have been discussions at this meeting as to how elderly researchers can improve their careers, I believe it's more important to consider how to develop younger researchers.

In the meantime, it is important to collaborate with society in order to justify the work conducted by 2,500 researchers. To increase the impact of collaboration with society, AIST needs human resources that can play the role of catalyst. It means that AIST needs to secure funds and use these funds efficiently. It is therefore necessary to promote efficiency of funds procurement and to increase the amount of external funds and donations that you currently receive.

What matters most is not the appropriate size of AIST, but how capable AIST is. I don't think that universities and research institutes should reduce the number of researchers they have. In an extreme case, it could mean that it's best to stop doing research. The number of researchers reflects the amount of research work that the organization can do. In that sense, I believe that AIST should maximize the number of researchers as far as possible.

Prof. Sakarindr Bhumiratana

I think that you might be able to do a little more innovation in terms of linkage with the private sector.

As for mobility, it seems that you have no problem bringing in visitors into AIST. I think that the number of people who are going out is a little small. I would like to know how you manage human resources to keep them full of vigor and keep them happy to produce results. I would also like to know how you manage young people who come from universities so that they can produce many results.

I hope that AIST will continue to demonstrate unsurpassed leadership in fostering development of science and technology in developing countries in Asia, and do more to help small developing countries to survive further globalization. By doing so, AIST will find more innovative ways of engaging people from developing countries in development of science and technology. With the emergence of China and India as major industrial countries, I think that AIST's role in this area should be strengthened further.

Lord Broers

Metrics are clearly important if they're the right metrics. If you look at the development of the high technologies in the world over the last two or three decades, we have seen some marked changes. The fashionable way to do research in the 60s, 70s and 80s was in large industrial laboratories. However, the large industrial laboratories that have indulged in pure research, fundamental research, have diminished in importance and mostly stopped that work. This was because technology became too broad, too interrelated, and no single company was really large enough to cover the entire research base. The trend has been to move it into universities. In general, intermediate laboratories and organizations, such as AIST, have not been the favored route. If you look at these trends over the years, there are some advantages and disadvantages. I think that the judgment has been made.

With regard to porosity, it's not untypical for the average age of employees of a research lab in industry to advance by almost one year every year. If that's happening, you have to look into it. You have noted that the people entering research are older than they used to be. This is an issue that you really must look at.

There is also an issue of communication. The moment you sit yourself between, if you like, universities and industry, you've introduced two interfaces where there used to be one, or perhaps three, depending on how you want to think about all of this. It means that you need many different types of communication.

I would urge you to have a more specific financial policy. You have to decide on overhead charging rates and what sort of agreements you will have with an industrial collaborator, who owns the intellectual property, whether you have to pay for it or you don't have to pay for it, and individual rights with intellectual property. In the creative world, there used to be a feeling that individuals found it difficult to gain recognition in your society. However, the situation has changed significantly. The research we saw was outstanding. I hope that you will keep up the good work.

Prof. Binglin Gu

I think it's wonderful that AIST has adopted a strategy of innovation for the future. The meritorious knowledge originated from AIST and its sustained contribution to industry and economy are important.

It is good to hear that AIST has been pursuing comprehensive researches. I believe that the research on SiC and positron spectroscopy will be beneficial to industry.

I would like to make a few suggestions. Japanese and Chinese students go to universities in the US because their favorable environment for overseas students. In view of the present situation, Japan and China need to make universities and research organizations globalized and more open to overseas talents.

It is good to conduct comprehensive researches. While the focus of research can vary, depending on scientists and researchers. There are three areas: basic research 1, basic research 2, and production. I am sure that AIST has the capabilities to conduct comprehensive research in all these areas. However, there may be an area in which you are more competent than in other areas. Perhaps you should concentrate more on one area rather than distributing your resources to all three areas.

Prof. Richard K. Lester

AIST is clearly a very high quality organization with very strong leadership. Like all good organizations it's evolving in parallel with, and in response to, changes in its environment.

Innovation is the "realization of new knowledge on a large scale and for the benefit of humanity". It has become increasingly cross-disciplinary and cross-industry. It cuts across countries and institutions. The challenge for AIST is to find its place in this increasingly complicated context.

It makes sense to extend the concept of full research to one of full innovation. What full research has done for AIST is to raise the sights of its people and make them think about research activities that they weren't necessarily themselves actually engaged in.

Maybe we have to raise the sights even a little further, to think about other aspects of innovation. That includes the educational aspect, the human resources aspect and the capacity of industry to take up the results of research. Individual researchers may not be necessarily involved in these activities themselves.However, they need to know about things that are going on beyond the research activity itself in order to implement effective innovation.

Mr. Isao Uchigasaki

AIST has to raise its awareness of the role it plays to "serve industry with information and technology". I hope that AIST will position itself between industry and academia and broaden further research to cover life science, standardization and metrology.

It is very important to have a broad and deep technology platform. Individual optimization can be achieved by universities and research institutes. However, general optimization can't be achieved without a diversified technology platform. That is where AIST can prove its merits.

Specifically, AIST needs to collect research results from various fields, select and concentrate on research themes and bring research results to the market within a short time, for their evaluation. I hope that AIST will actively participate in international meetings for reading research papers, either for the special field or for general interest, to make itself better known.

Mr. Takeshi Isayama

Diversity is one of the unique qualities of AIST, when compared with other research organizations and universities in Japan. There has been increased diversification of the AIST staff, which now includes women and foreigners.

Out of all the directors of the research centers, thirteen were appointed from outside AIST. These people could have been recruited by any other research organization. That is quite exceptional.

I think that AIST needs to recognize and highlight its traditional strengths in a positive way. It is important to set a global standard in the field of metrology. However, it is also particularly important to step up standardization efforts in those areas other than metrology.

AIST's research programs have more complementary effects than those conducted by companies and you should put greater emphasis on that. We would like excellent people to engage in research, so that we can take advantage of their know-how and knowledge. We make a conscious effort to create a star researcher, because that will have a significant impact on the company as a whole.

AIST is in an advantageous position because of its network base, as typified by the advisory board.

It is very important to visualize research results. You don't have to publicize research results, once their visualization is incorporated routinely. I think that is what you should do in a strategic way.

Prof. Tomoko M. Nakanishi

AIST takes the top-down approach to strategy formation and bases its strategy on national and societal strategies. I think you should take more of a bottom-up approach, to strike a balance. I believe that talented researchers will lead research projects at AIST. Perhaps you should do something to help researchers pay attention to areas other than those in which they are working. I think that you need to create an environment in which individual researchers can fully capitalize on their abilities and uniqueness, because advanced technologies belong to the interface area.

As a national research organization, AIST should look ahead to the future, predict social structures and demands for future technologies in 10 to 20 years' time, and present us with a vision for future technology. I think that only AIST can take the lead, as to conducting good research in Japan.

I have an impression that AIST has been concentrating on secondary industry. Please conduct more research in energy and food because they are indispensable for survival of human beings. Agricultural research lacks a kind of innovation implemented in production process in other industries. I strongly hope that AIST will initiate technological innovation in the area of agriculture.

Prof. Masuo Aizawa (Chairman)

I would like to give full credit to AIST because it has adopted a challenging strategy for the second term, made an effort to survive structural reform, and reduce public funding and labor costs in order to keep going in the right direction.

During the first term, AIST was unable to fully capitalize its scale merit. It was pointed out back then that AIST was more of a departmentalized sort of institution and it was not doing "what it was supposed to do". Therefore, I highly appreciate the management policy presented by AIST at this meeting.

During the first term, there were also discussions on what AIST should do to contribute to industrial technology. To answer this question, AIST has come up with the strategy of establishing an innovation hub and taking an industry reform initiative, and I do appreciate your efforts. I think that you should clearly demonstrate your strength and unique selling position, not simply for publicity, but from a strategic point of view.

I highly commend your objective for the second term: realization of research outcomes. However, I feel that you should change your research strategy if you aim to realize research outcomes. The AIST President said that AIST would strive to achieve autonomy of research units and the separation of three powers. In my view, what he said contradicts the objective of realizing research outcomes. I think that a strong emphasis on autonomy of research units will most certainly lead to discipline-oriented research. That's all right when you place an emphasis on outputs. But to achieve outcomes, you should not set up research units with a very limited horizon. Therein lies the problem.

Discipline-oriented research alone will not produce the outcomes that you aim to achieve.

At the meeting, promotion and planning of research were mentioned, in connection with separation of the three powers. I fear that your research strategy may not function if there is a strong emphasis on independence and autonomy of promotion and planning of research.

I feel AIST needs to establish a new structure for the main body that moves ahead on proposals for the implementation of management policies suggested at the meeting.

Research Hot Line

UPDATE FROM THE CUTTING EDGE

Jan.-Mar. 2006

The abstracts of the recent research information appeared on the Vol.6 No.1-No.3 of "AIST TODAY" are introduced and classified by research area.
For inquiry about the full article, please contact the author directly.

Information Technology

Manufacturing of radio frequency ID tags on flexible films using an all printing process

Development of a technique to fabricate very low-cost radio frequency ID tags

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AIST TODAY Vol.6, No.1 (2006)
p.22-23

We have drastically reduced electrical resistance of antennae and wirings, etc. of radio frequency (RF) ID tags, which are produced using a screen printing method. After printing an antenna and wirings with metallic inks, a pressure annealing technique is applied at low temperature, instead of ordinary high temperature baking. All-screen-printed RF ID tags on flexible films were realized using the pressure annealing technique. The technique will lead to further reduction of manufacturing cost of RF ID tags and acceleration of wide use of them.

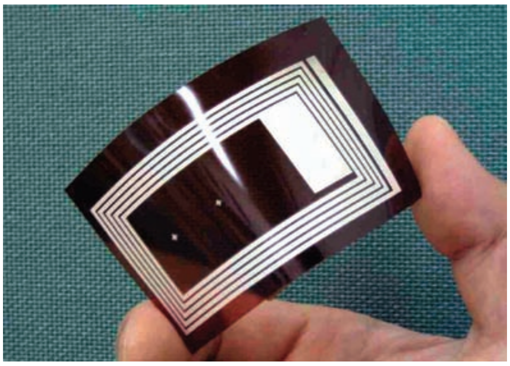

Figure 1: Screen-printed antenna for a RF ID tag.

Figure 2: Demonstration of object identification using all-screen-printed RF ID tags on flexible plastic substrates.

Improved radiation resistance of a polymer by silica coating

An environment and human friendly technique for improved performance of materials

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AIST TODAY Vol.6, No.1 (2006)
p.24-25

We demonstrate that deposition of gas barrier film is effective to suppress radiation oxidation of a polymer and can improve its radiation resistance. The gas barrier silica films were successfully formed on polypropylene by magnetron sputtering. Long-term irradiation of cobalt-60 gamma-rays in air resulted in oxidation of samples without silica coating, whereas samples with silica coating were hardly oxidized. Furthermore, the radiation resistance of polypropylene was significantly improved by silica coating. Because of non-toxicity of silica, the technique may be applicable to polymeric medical items subjected to radiation sterilization.

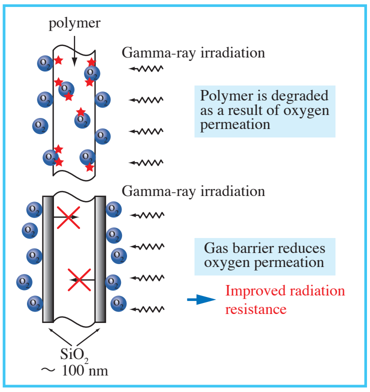

Figure 1: Improved radiation resistance of polymers by gas barrier silica coating.

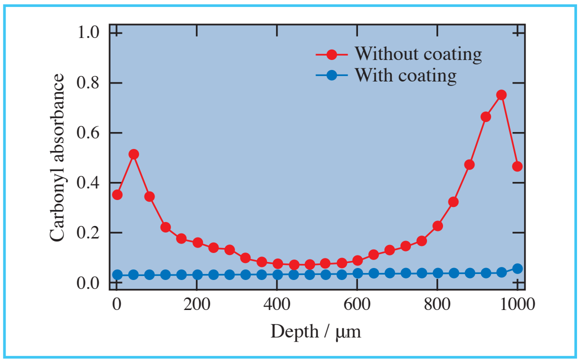

Figure 2: Depth profile of carbonyl groups formed in polypropylene of 1mm thickness after gamma-ray irradiation for 2000 h in air. Gas barrier silica films suppress oxidation of the coated sample.

Superhydrophobic surface fabricated from hydrophilic materials

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p.26-27

Super-hydrophobic surface (contact angle : 178 degrees) has been fabricated from hydrophilic material through a nano-structure control technique. Nanometer-sized pins, which align perpendicular to surface, were grown from Co aqueous solution, and the pins were coated with lauric acid, subsequently. The surface with the pins of 6.5nm diameter showed super-hidrophobicity even the pins were hydrophilic.

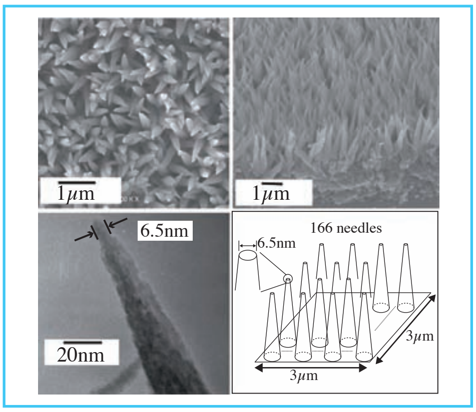

Figure 1: (top-left,top-right) FE-SEM images of the nano-pin films observed from the top and side, respectively. (bottom-left) TEM images of the nano-pin films (bottom-right) Simple model of the film with the fractal structure.

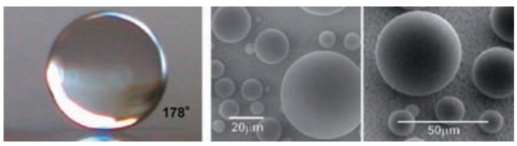

Figure 2: (Left) the image of the water on the nano-pin film. (Center,Right) E-SEM images of the water on the nano-pin films observed from the top and side, respectively.

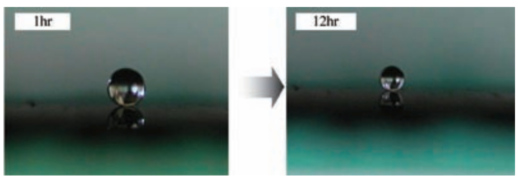

Figure 3: The stability of the Superhydrophobic surface fabricated from the nano-pin.

"Ubiquitous Echo"

As we age, various problems threaten us in turn or at the same time: obesity in childhood, diseases related to lifestyle choices in middle age, and the possibility of becoming bedridden in later years. "Ubiquitous Echo" is a new portable supersonic echo imaging equipment. It can be used to visualize key components of the body (muscles, bones, subcutaneous fat) and give fat and muscle measurements in health care or beauty facilities, or even at home. We hope that this technology will help to maintain our health and to prevent elderly people from being confined to their beds.

Figure 1: "Ubiquitous Echo", a portable supersonic echo imaging equipment.

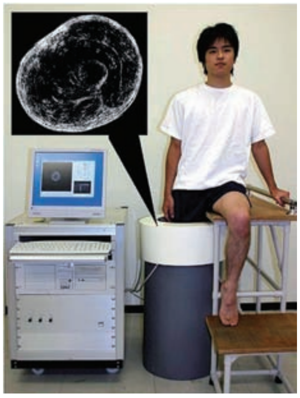

Figure 2: Cross-sectional imaging based on "Ubiquitous Echo".

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Realization of 1.3 μm semiconductor laser using uniform quantum dots of high density

We fabricated a five-layered InAs quantum dot (QD) with a high density and uniformity of 1.0×10^{11} cm^{-2} and 23 meV, respectively, by employing an As_2 source and a gradient composition strain reducing layer. This five-layered QD laser with a 0.5-mm cavity length and cleaved facet emits 1.3 μm wavelength light at room temperature. Moreover, we could achieve a high modal gain of 43 cm^{-1} at 1.3μm due to the high density and uniformity of the QDs.

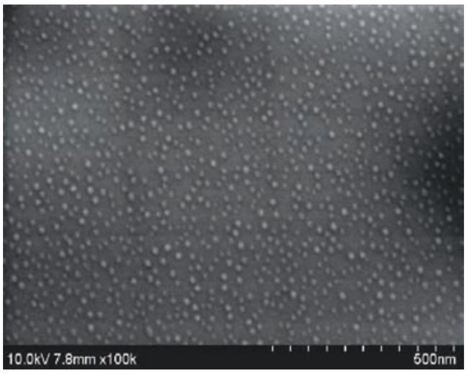

Figure 1: Surface SEM image of the quantum dots

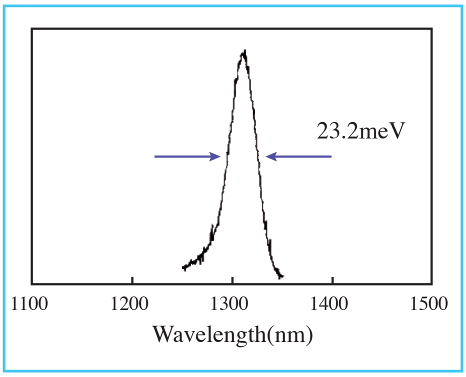

Figure 2: Emission spectrum of the quantum dots

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p.20-21

Automated carbohydrate synthesizer "Golgi™"

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AIST TODAY Vol.6, No.2 (2006) p.22-23

An automated carbohydrate-synthesizer (glycoconjugate-synthesizer) "Golgi™" was developed by mimicing biosynthetic system of the Golgi apparatus in cells. The system was improved by using tailored-magnetic beads for immobilizing glycosyltransferases and fine-filter membrane system to achieve fully-automated synthesis in 36 or 96-well reaction vessels. It was demonstrated that combined use of "Golgi™" with a conventional peptide-synthesizer gives high throughput parallel synthesis of biologically important glycopeptides.

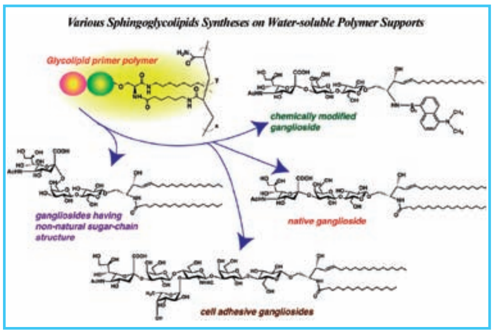

Figure 1: Application for glycolipid synthesis.

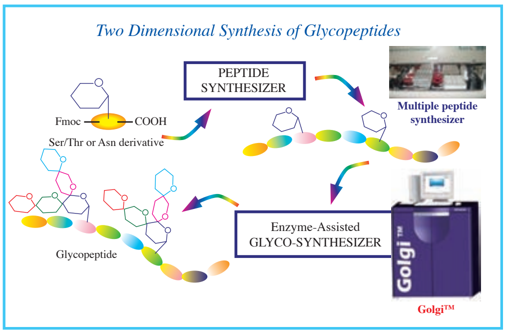

Figure 2: Strategy of the glycopeptide synthesis

A novel intergrowth form of TiO_2 between rutile- and ramsdellite-type structure

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Titanium dioxide with a new crystal structure was synthesized upon heating the ramsdellite-type TiO_2. The new form has an intergrowth structure between the rutile- and ramsdellite-type ones. The band gap can be controlled from 3.34 eV to 3.00 eV upon heating, accompanying a continuous structural change. As the electronic structures can be controlled by the heating temperatures, the new form of TiO_2 will be expected as candidate photofunctional materials.

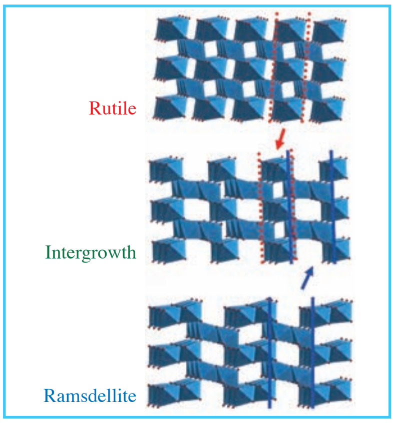

Figure 1: Crystal structures of rutile-type, the hypothetical intergrowth with ramsdellite and rutile (1 : 1) domains and ramsdellite-type TiO_2, respectively.

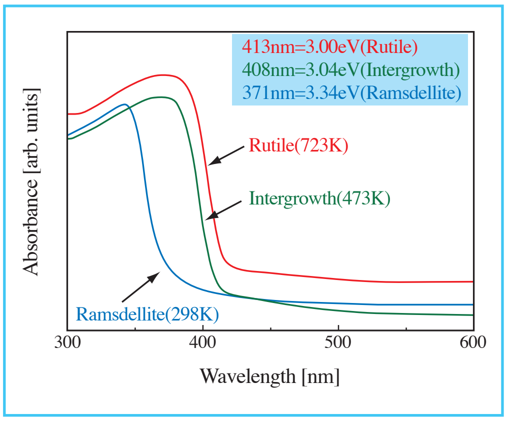

Figure 2: UV-Vis absorption spectra for as-repared ramsdellite-type TiO_2 at 298 K, after calcinations at 473 K and 723 K, respectively.

Transfection microarray for genome-wide gene validation

Cell Informatics Research Group of Research Institute for Cell Engineering has developed a novel DNA microarray for multiple gene transfection. We found a method to significantly increase the on-chip transfection efficiency. Real-time and multiple gene transfection assays are performed on the microarrays under the variable tissue culture conditions. The newly developed microarrays are applied to analyze intracellular signaling pathways.

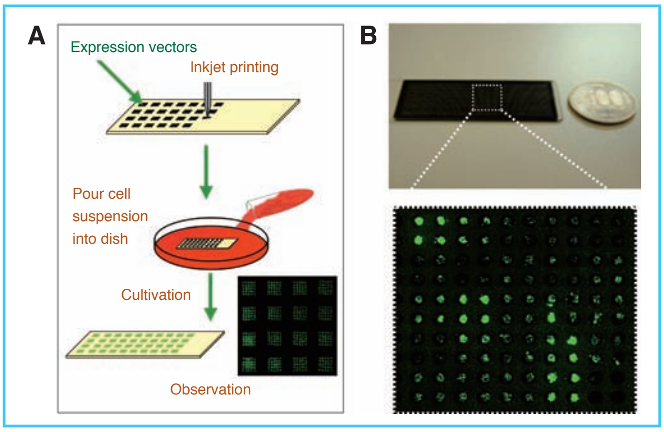

Figure : Scheme of transfection microarray experiments.
(A) Outline of the procedure. (B) An example of the transfection microarray format. HEK 293 cell line was transfected.

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p.26-27

Rulers with nanometer-size scale

Development of thin and multilayer film standard materials

We have been developing a traceable X-ray reflectometer (T-XRR) which keeps traceability to the national standard by using an angle standard. Thickness of thin SiO_2 and GaAs/AlAs multilayer films will be certified by the T-XRR. These certified standard materials are expected to be reference standard materials, and will be rulers with nanometer-size scale.

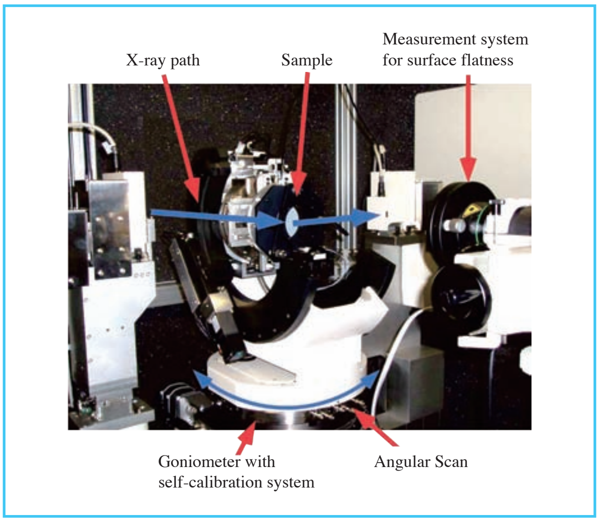

Figure : Traceable X-ray reflectometer system

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p.28-29

Coordination of a grid scheduler and optical network services

A new grid scheduling system was demonstrated at iGrid2005 held in San Diego, U.S.A. The system consists of a grid resource scheduler, computing and network resource management systems, computers at 6 sites in Japan and a network test-bed with the GMPLS protocol. Through a web services interface, the scheduling system in San Diego was able to reserve the resources in Japan and molecular dynamics calculations were performed successfully.

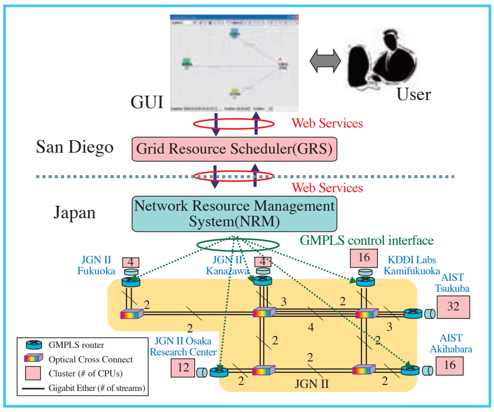

Figure 1: Overview of the experimental demonstration at iGrid2005.

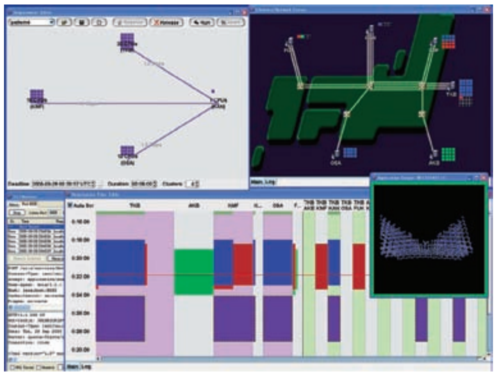

Figure 2: The GUI windows shown at iGrid2005
The request editor, the reservation timetable (left: cluster status, right: network status), the map view, and the application panel.

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Information Technology

Development of a robot system for handling of medical ampoules

We have developed a robot system which can handle medical ampoules. A new three dimensional object recognition system, which can measure even objects with glossy surface, was adopted in the handling system. The system can sort randomly laid glossy ampoules. We hope this system will reduce medical mistakes due to human error, and improve work environment of pharmacists.

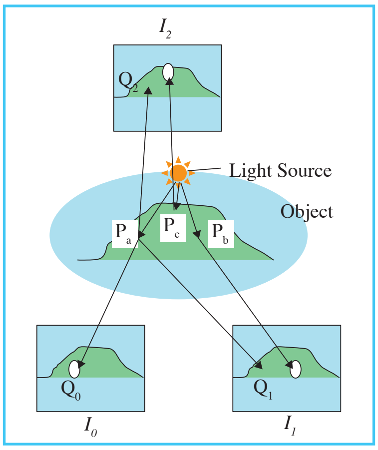

Figure 1: Basic principle for measuring glossy surface

Figure 2: The robot system

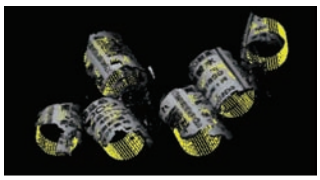

Figure 3: A result of recognized medical ampoules

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Quality control of GPI-anchored proteins in the endoplasmic reticulum

Cells possess several quality control mechanisms for a proper folding and function of protein. Malfunction of the mechanisms causes some protein folding diseases. Many proteins are modified with a glycosylphosphatidylinositol (GPI) anchor in the endoplasmic reticulum (ER), but the quality control mechanisms of GPI-anchored proteins are not clear, so far. We developed a model misfolded GPI-anchored protein (Gas1*p). Gas1*p can be modified with a GPI anchor in ER, however, the modified Gas1*p was excreted and degraded rapidly *via* a proteasome. We found that deacylation of GPI by an enzyme (Bst1p) plays important role in the quality control of GPI-anchored proteins.

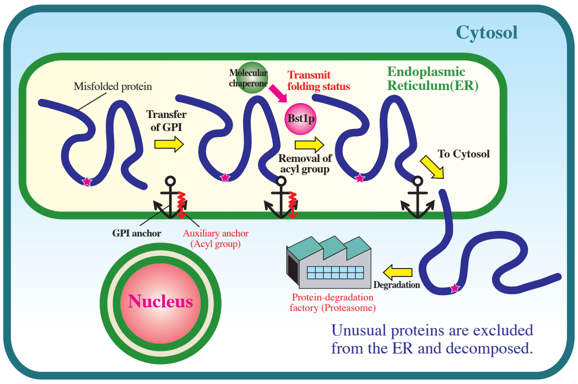

Figure : Proteins are monitored by quality control systems that ensure correct folding before exiting from the ER. There are a number of molecular chaperones and enzymes to assist proper protein folding in the ER. Misfolded proteins that fail to pass the quality control checkpoint are transported back to the cytosol, and degraded by the proteasome. GPI inositol deacylation by Bst1p is required for the quality control of GPI-anchored proteins.

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p. 18-19

Traceable calibration for nanometrical step heights with AFMs

Step height standards are demanded in nano-manufacturing fields. NMIJ of AIST provides the calibration service for them since 2005 with a nanometrological AFM and an AFM with differential laser interferometers (DLI-AFM). In nanometric dimensional calibrations, microasperity and form deviation of object surfaces affect measurements. We have formulated a robust calibration method for nanometrical step height standards based on ISO 5436-1.

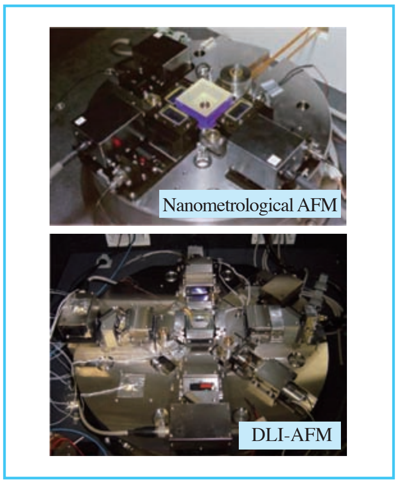

Figure 1: Instruments for nanometrical step calibration.

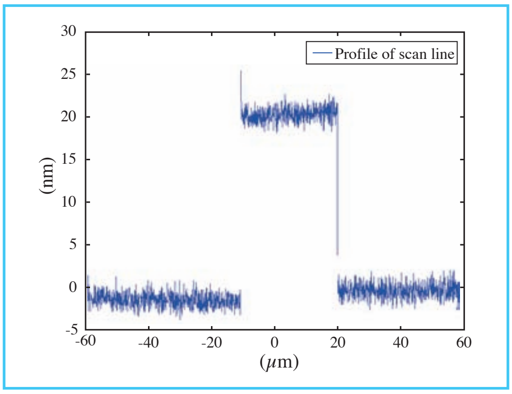

Figure 2: Microasperity on object surface.

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p.20-21

Surface fault rupture of the 2005 Pakistan earthquake

Reconnaissance field investigation conducted by our international team revealed the outline of the 65-km-long surface fault rupture associated with Mw 7.6 earthquake in northern Pakistan on October 8, 2005. Among the historically known large earthquakes along the Indian-Eurasian collision zone and elsewhere in the world, this earthquake provided very rare opportunity to study extensive surface rupture of reverse-fault type. More detailed study on this rupture in March 2006 will make great contribution to the evaluation of future earthquakes from active faults of this type.

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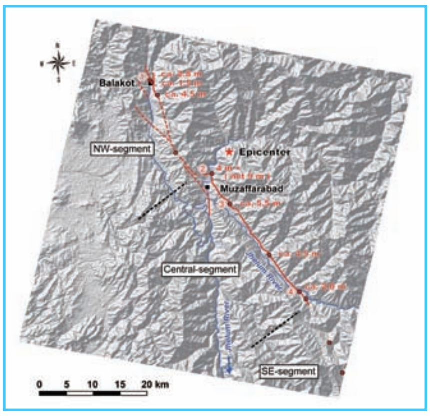

Figure 1: Surface fault rupture associated with the 2005 Pakistan earthquake occurred along pre-existing active faults.

Figure 2: Photographs of surface faulting.
A: Tilting of ground in the town of Balakot. B, C and D: 2-5.5 m high fault scarps across river beds.

Development of three major tools for research on sugar chains

Dramatic advances in sugar chain researches, the key for cancer, immunity, infections and regeneration medicine researches

Like proteins and nucleic acids, glycans, the third class of repeating biopolymers, have essential roles in living organisms. However, tools to synthesize and analyse the glycans have been lacking. Research Center for Glycoscience in AIST has successfully developed three important tools for glycomics research; a glycogene library, a preparation robot for the glycan library, and a rapid and sensitive analyzing system for glycans. Exploring the perplexities of life which cannot be explained with nucleic acids and proteins will be accelerated by using these innovative tools.

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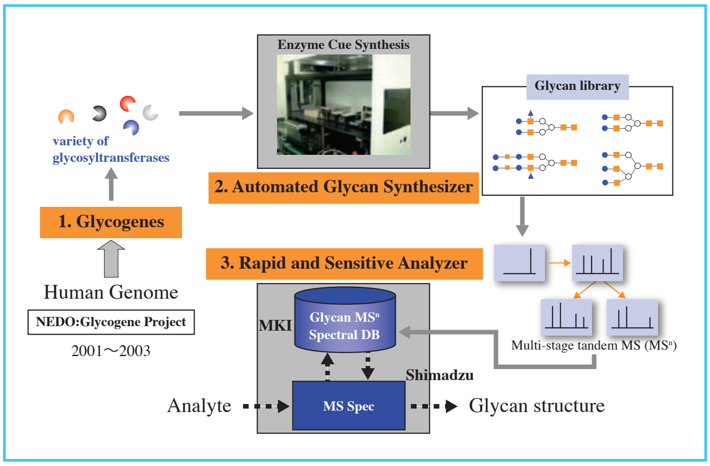

Figure : Three major tools for research on sugar chains.

Spin-torque diode effect in magnetic tunnel junctions

Rectification function has been observed in a CoFeB/MgO/CoFeB magnetic tunnel junction (MTJ), which shows the giant tunneling magneto-resistance effect. The junction size was about 100nm x 200nm. Applied radio frequency (RF) current exerts a spin-torque interaction on magnetization in the MTJ, and causes resonant precession of spins. The MTJ shows high resistance only for one direction of the applied RF current and yields dc voltage as a result. The output voltage would be larger than those of semiconductor diodes if critical voltage to switch magnetization is smaller than 25mV. We named this device a "spin-torque diode". New applicatons of spin-tronics devices such as high freqency devices, are expected.

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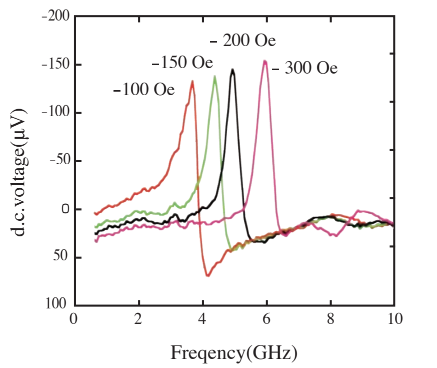

Figure : Spin-torque diode effect measured at room temperature. A very small CoFeB/MgO/CoFeB magnetic tunnel junction (100nm x 200nm) rectify RF current. Rectified dc voltage is large for a resonance frequency of a magnetic layer in the device. The resonance frequency is larger for larger external field. Given RF power is –15dbm.

Genomics of *Aspergillus oryzae* and its application to industries

The *A. oryzae* genomics is expected to make a large contribution to traditional fermentation industries in Japan

The genome sequencing of *Aspergillus oryzae*, a filamentous fungus widely used in Japanese fermentation industries, has been completed by a Japanese research group. The *A. oryzae* genome consists of c.a. 37 Mb nucleotides and about 12,000 predicted genes. The genome sequence revealed that *A. oryzae* has redundant secretory hydrolases and that specific genes of *A. oryzae* are enriched in the blocks without synteny to other *Aspergilli*. Establishment of genomic research basis of *A. oryzae* has facilitated functional analysis and the research for industrial applications of the *A. oryzae* genes.

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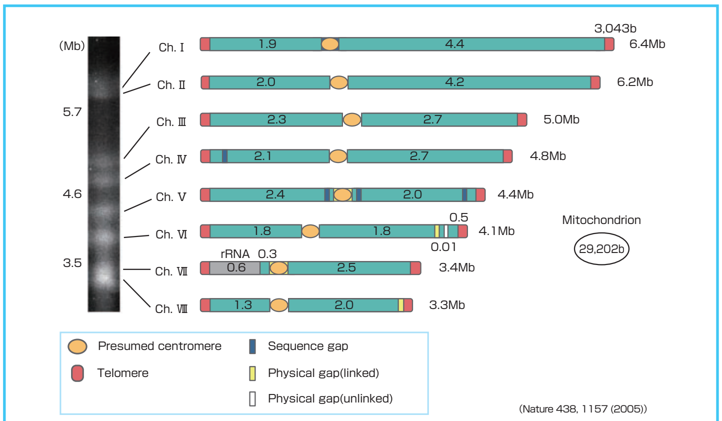

Figure : Analytical results for each chromosome

Algerian Minister of Post and Communications Visits AIST Tsukuba

On December 7, Dr. Boudjamâa Haichour, Minister of Post, Information Technology and Communications of the People's Democratic Republic of Algeria, visited AIST Tsukuba, accompanied by Ms. Ghania Houadria, Director-General of Algerie Poste: the Postal Service, and Mr. El Hachemi Belhamdi, President-Director-General of Mobilis: the Mobile Telephone Service. The Minister and his colleagues first met with Vice President Yoshikai and later visited Science Square and other facilities of AIST.

During the tour, the visitors showed interest in robot technologies such as a humanoid robot and PARO, photocatalysts, drug-delivery systems and Cyber Button.

Their tight schedule restricted the tour duration to one hour, which meant they were unable to see every laboratory, but they promised to spend more time at the center on their next visit. The Minister stated, “Thanks to today’s visit, we’ve gained a good understanding as to why AIST is at the heart of Japan’s industrial technology development. We are hoping to expand the scale of exchange programs between AIST and our own research centers.”

International Workshop “Application of Life Cycle Assessment (LCA) to Local Measures”

On November 30, we held an international workshop at Hatsumei Kaikan Hall under the theme, “Application of LCA to Local Measures”. Organized by the Research Center for Life Cycle Assessment, this event attracted 111 participants from Japan and other countries.

The primary purpose of the workshop was to present the results of application of LCA to local measures, which has been spearheaded since 2003 by the Ministry of Economy, Trade and Industry (METI). Actual domestic and overseas cases were also introduced. Results of case studies were presented by domestic representatives from Iwate, Chiba and Mie Prefectures, and there were also presentations on EU cases, mainly dealing with waste disposal, and some German cases.

During the latter part of the workshop, a panel discussion was held to discuss the central issue of how LCA could be utilized in regional environmental administration, and domestic and overseas participants were given an opportunity to exchange ideas on topics such as unification of indices of environmental influence. This was very successful and a great deal of useful discussion took place.

This is a research field in which discussion has primarily taken place between domestic researchers, but we are now at the stage to start positive interaction with overseas researchers in pursuit of multinational cooperation and information exchange.

Joint Japanese-French Robotics Laboratory (JRL): Renewal of Research Agreement and Workshop

On December 8, 2003, the Intelligent Systems Research Institute of AIST and the Institute of Communication and Information Science & Technology of CNRS (Centre National de la Recherche Scientifique) established JRL (Joint Japanese-French Robotics Laboratory) as a part of a research cooperation program pertaining to individual research fields under the General Agreement, signed November 22, 2001, between AIST and CNRS. These relationships are ongoing.

As a result of the transfer of the French research center to the CNRS Laboratory for Analysis and Architecture of Systems (LAAS) in Toulouse, September 1, 2005, we renewed the collaborative research agreement, at LAAS on November 14, 2005, and held a JRL workshop to discuss trends in Japanese-French research on humanoid robots, as well as reviewing JRL activities.

Series of International Workshops held in Thailand

As part of AIST's Asia strategies and Asia environment/energy partnerships, a number of international conferences, primarily involving AIST, were held in Bangkok, Thailand, on December 13- 16, 2005. The intensive, consecutive conferences proved to be very efficient and synergetic.

Second Biomass-Asia Workshop – Multilateral Conferences

The 2nd Biomass-Asia Workshop was held on December 13-15, co-organized by AIST, which serves as the secretariat for the "Biomass-Asia Research Consortium" (agro-industrial coalition research team comprised of domestic public research institutions, universities, and industries), the Ministry of Agriculture, Forestry and Fisheries (MAFF, head office for the "Biomass Nippon Comprehensive Strategy Council"), and the government of Thailand (Biomass-Asia Committee involving the Minister of Science and Technology, under-secretaries of other ministries, and core research institutions).

At this workshop, policymakers and researchers involved in Asian biomass utilization were given the opportunity to gather in one place and exchange ideas on practical approaches to and future directions for technology development in the respective countries. On the first day, participants heard greeting remarks from Minister Pravich of the Ministry of Science and Technology of Thailand, the under-secretaries of other Thai ministries, Prof. Nakajima, Vice-President of AIST (representing the Research Consortium), and Mr. Some, Director-General for Technical Affairs, MAFF. Subsequently, the 500 attendees listened to presentations on the current situations and future directions of biomass utilization in each country. Prof. Sakarindr, President of NSTDA (National Science and Technology Development Agency) presented the keynote speech, while Dr. Fujimura, Chairman, Zero-emission Forum of the United Nations University, and other speakers presented papers on interesting biomass utilization technologies. Mr. Kobayashi, the Japanese ambassador to Thailand, also welcomed the audiences. The second day was dedicated primarily to in-depth panel discussions on important topics such as sustainable utilization of agricultural/forestry resources, applications to automobile fuels, future biomass energy technologies, materials technologies, LCA evaluation, etc. Latest research results were presented in the poster session. Summarizing the day's discussions, the chairperson remarked on the superiority of Asia in biomass utilization, future directions for research and development, follow-ups, etc. On the final day, a plant tour enabled participants to see at first hand an example of bio-ethanol production, which Thailand is pushing ahead.

Representatives from institutions at the opening ceremony of the 2nd Biomass-Asia Workshop. Vice-President Nakajima is third from right.

Following this workshop, an international workshop, "Capacity Building on Life Cycle Assessment in APEC Economies" was held on December 15-16, cosponsored by NSDTA and AIST.

Third Thailand-Japan Workshop (NSTDA-TISTR-AIST)

In November 2004, AIST signed comprehensive research cooperation agreements with NSDTA and TISTR (Thailand Institute of Scientific and Technological Research). A follow-up meeting was held in March 2005 for a overall exchange of ideas to refine strategies for partnership subjects and future developments. In September 2005, Japan and Thailand endorsed a program of collaborative research and development, as part of JTEPA (Japan-Thailand Economic Partnership Agreement).

These agreements led to organization of the 3rd Japan-Thailand Workshop, aimed at ascertaining the current status, and progress from the previous meeting, of individual collaborative research and development subjects, involving energy/environment, IT, and geological information-related fields, and discussing future action plans.

Topics of discussion in the workshop included the application for NEDO funds in accordance with the progress on each theme, and the AIST Fellowship program started in FY2005. Both measures will promote personnel exchange and accelerate collaborative research activity.

It was reported that one NEDO fund, "Cooperative Research Programs for Development Support", is already being actively used for "Research and Development for the Standardization of Solar Cell Characterization Technology in Low Latitude Region". Also, a facility to verify solar panels was recently built in order to collect outdoor exposure data in tropical areas and develop standardization technology for evaluation schemes, providing evidence that the project is on course. It was further reported that, as part of the overall project, a workshop organized by the Institute of Research and Innovation, AIST Research Center for Photovoltaics, and NSTDA was held in Bangkok on December 14, to facilitate information exchange for project promotion.

Minister of Information & Communication, Republic of Korea, visits AIST Tsukuba

On January 16, Dr. Daeje Chin, Minister of Information & Communication, the Republic of Korea, visited AIST Tsukuba. He was greeted by Dr. Kodama, Senior Vice-President, and Mr. Matsuo, Director-General for International Affairs, before being briefed on AIST.

At the Minister's request, the subsequent tour concentrated primarily on the Intelligent Systems Research Institute. He was briefed by Dr. Hirai, Director, about overall activities of the Institute, and then visited laboratories of humanoid robot, task intelligence, ubiquitous function, and PARO, receiving explanation from each researcher. A scientist himself, the Minister showed great interest in a number of specific subjects, including the ability of a humanoid robot to stand up from a face-down position, and global standardization of IC tags and sensors. "I was impressed with AIST' s broad range of research interests and high-level research qualities." the Minister remarked. He also expressed his hopes for expanded cooperation between Korean research institutions and AIST, and suggested his attendants to adopt a similar approach.

"Symposium on Photoreaction Control and Photofunctional Materials (PCPM2006)"

"The 7th AIST International Symposium on Photoreaction Control and Photofunctional Materials (PCPM2006)" was held on January 17-18 at AIST Tsukuba Auditorium.

This symposium was a part of "Photoreaction Control/ Photofunctional Materials", a COE development program by the Special Coordination Funds for Promoting Science and Technology of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) since 1997, when this institute within the National Institute of Materials and Chemical Research of the former AIST. The last symposium was held in October 2003, i.e. 2 years and 3 months ago. The program included 9 overseas guest speakers, 15 oral presentations from AIST, and 100 presentations in the poster session. There was considerable intense discussion on photoreaction mechanism, light energy conversion, laser-induced reaction, and photofunctional materials. The 3-day event had a total attendance of 220 participants.

The First Japan-China Seminar on Hydrogen Storage Materials

On January 26, "The 1st Japan-China Seminar on Hydrogen Storage Materials" was held at the AIST Tokyo Waterfront, organized by the Energy Technology Research Institute of AIST. This institute, a hub of global hydrogen storage materials research, energetically promotes research and development and plays an active role as an interface channel for domestic and overseas researchers. Hydrogen storage materials represent a key technology for efficient storage and transport of hydrogen energy, and consequently worldwide involvement in research on this field is vigorous. This seminar was held on the occasion of a visit to Japan by Cheng Hui-Ming, First Deputy Director of the Institute of Metal Research, CAS, which is China's central research institution for hydrogen storage materials.

Following greetings by Mr. Xu Tongmao, Minister-Councilor, Embassy of the People's Republic of China in Japan, and Mr. Haruhiko Ando, Director, New and Renewable Energy Division, METI, papers were presented by world-leading researchers, five each from Japan and China. The seminar was a great success, with 90 participants from universities, public research institutions, and industries. A post-seminar reception provided an opportunity for further interaction between attendees. AIST hopes to develop opportunities for enhanced interaction between researchers engaged in the field of hydrogen storage materials.

Workshop with Chinese Academy of Sciences: CAS-AIST-NEDO Workshop 2005

The CAS-AIST-NEDO Workshop 2005, co-hosted by CAS (the Chinese Academy of Sciences), AIST, and NEDO (New Energy and Industrial Technology Development Organization), was held in Guangzhou, China on November 17-18.

This workshop was planned as an action item to follow up on the Comprehensive Collaborative Research Agreement between AIST and CAS (signed May, 2004), and focused on the field of environment/energy, which is globally urgent and could generate mutual benefits for both China and Japan (Win-Win, or " 双赢 " in Chinese). At the same time, AIST and NEDO, which are mutually complementary institutions, were seeking a partnership with CAS, a core Chinese research institution. Consequently, the three organizations came together for this workshop at GIEC (the Guangzhou Institute of Energy Conversion), which is regarded as a COE (Center of Excellence) of new-energy/renewable-energy research in China.

Designated as key topics were evaluation of biomass and energy systems (in particular, Dispersed/Renewable Energy). Participants included: representatives of CAS, mainly from GIEC and other related Chinese research institutions; Dr. Nakajima, Vice-President, Drs. Kamimoto and Yamabe, Research Coordinators, personel of Dept. International Affairs, and researchers of related research units; Mr. Sasaki, Exectiv-Directer, and Personel of Headquarter and Beijin office of NED. A general session introducing each institution and its approaches to the environmental/energy field was followed by technical sessions, which produced spirited discussion on potential candidates for future collaborative research subjects. In respect of the biomass area, AIST and CAS agreed to move forward by establishing research relationships with a view to implementing NEDO's international joint project proposal.

On November 16, the day before the workshop, vice-Dr. Shi Er Wei, vice-President of CAS, Dr. Nakajima of AIST and Mr. Sasaki of NEDO held a tripartite meeting to present each organization's position and exchange ideas on the current status and directions of research in the environment/energy area, with particular focus, from the Chinese perspective on formulation of China's 11^{th} 5-year Plan (commencing in 2006).

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