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FEATURE

Biomass Energy

Curbing Global Warming by Increasing the Economic Value of Forests

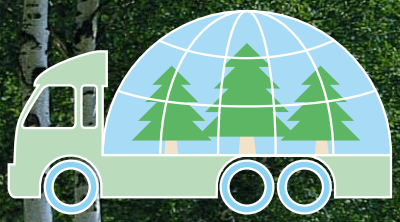
Research Hot Line

UPDATE FROM THE CUTTING EDGE (Apr.-Jun. 2006)

In Brief

Biomass Energy

Curbing Global Warming by Increasing the Economic Value of Forests



The Significance of Liquid Fuel Production from Woody Biomass

Masayuki Kamimoto
Research Coordinator for Environment & Energy

Biomass - Carbon Neutral

Japan is a country poor in energy resources and has flourished by consuming large quantities of cheap fossil fuels. However, with the emergence of global warming as a serious concern in the late 1980's, we entered into a new era when it is necessary to use a balanced combination of fossil fuels, atomic and renewable energy. The need is evident to increase renewable energy as a middle/long term measure in order to attain a low-level emission of greenhouse gases.

Biomass is a renewable energy derived from animal and plant organic matter. Though it generates carbon dioxide when utilized, the biomass was created from solar energy, water, and carbon dioxide, and so does not increase the earth's net volume of carbon dioxide. In this respect, biomass is said to be "carbon neutral" (Fig. 1).

Woody Biomass with High Carbon Fixation

There are enough biomass resources in the world, 1.2×10^{10} kL/year (crude oil equivalent), to cover the world's demand (1×10^{10} kL/year) (World Energy Assessment: http://stone.undp.org/undpweb/seed/wea/pdfs/chapter5.pdf). Owing to rich forests, Japan's biomass has the potential to meet a part its primary energy needs. Biomass can generate not only electric power and heat directly by burning, but can also be efficiently converted to gas and liquid fuels. On this merit, biomass is considered a more appropriate energy to transport if compared to other renewable energies.

Biomass from waste, such as black liquor (the liquid waste produced after fiber extraction), food and agricultural waste, and sewage sludge, are the types of biomass used most in Japan at present (Fig. 2). Up to now, one had to pay for the disposal of waste, so this method is very economical too.

Ethanol is produced from corn in the United States and from sugar cane in Brazil, 8 million kL and 12 million kL respectively, and mixed with gasoline for wide use in automobiles. It is now being investigated to use ethanol or ETBE (Ethyl Tertiary-Butyl Ether), an octane-boosting agent, to mix with gasoline in Japan.

Woody biomass, such as forests, will be important in the future. If we can better manage the forests, more biomass can be utilized and carbon fixation will be increased.

Sustainable Growth of Forests and the Utilization of Woody Biomass

In the beginning, first firewood and charcoal, then coal and oil, were the principal energy sources of mankind. The reason why firewood and charcoal was replaced by coal and oil is because the energy density of the former is low, a lot of energy is needed to collect them, and so it became economically infeasible.

At the National Institute of Advanced Industrial Science and Technology (AIST), the production of fuels from woody biomass

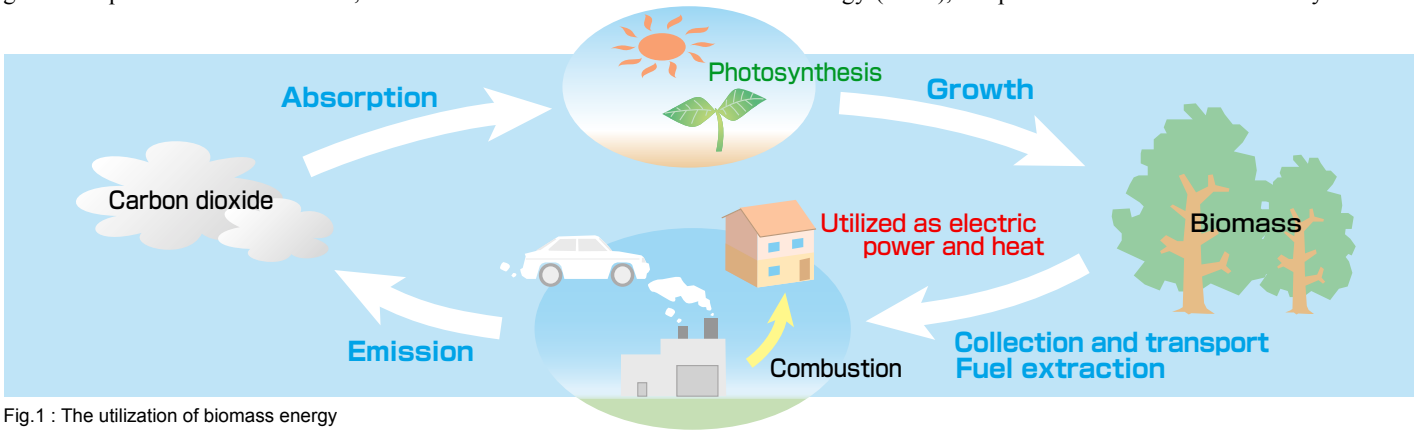


Fig.1 : The utilization of biomass energy

Biomass Technology Research Center Actively Working with Having Its Base of Operations in the Chugoku Region

Akira Yabe
Director, AIST Chugoku

The Biomass Technology Research Center was founded and initiated its activities in October 2005, with a planned term of six and a half years and having its base of operations in the Chugoku Center. About half of the over 100 staff of the Chugoku Center belong to the Biomass Technology Research Center. There are two key reasons why the Biomass Technology Research Center was established in the Chugoku Center.

1. The Chugoku region has been rich in woody biomass resources.
2. The Chugoku region has taken an active role in the utilization of biomass.

Both the population and the principal economic indices, such as industrial shipping in the Chugoku region, are about 7% of the country of Japan. However, its lumbering sector manages 16% of the total in the country due to its calm waves and busy marine transport in the Seto Inland Sea, and is rated the top in the country among the 8 local Bureaus of Economy, Trade and Industry. Primarily, imported lumber from Canada and Northern Europe is processed and sawmill wastes can produce approximately 1% of Japan's energy consumption if we take advantage of this resource for the whole country. Furthermore, from the Middle Ages to the Taisho era, the whole Chugoku mountainous district, including the Izumo region, produced 80% of the national iron by the traditional iron manufacturing method, "Tatara", using iron sand. The "Tatara" method requires large quantities of charcoal, and 15 tons of charcoal, or approximately 1 ha of forest, is required for one cycle. Assuming 60 annual cycles and the felling of one part of the forest with a 30-year cycle (the usable age of broadleaf trees for charcoal is 30 years), about 1,800 ha (corresponding to a circle of 2.5 km radius) of forest area is required for one "Tatara" installation. As there were more than 30 "Tatara" installations in Chugoku region, it can be seen that this region has used a great deal of forest resource energy.

In the industrial cluster plan of the Chugoku Bureau of Economy, Trade and Industry, there is a plan to create a well-grounded recycling-based and sustainable eco-friendly society with the utilization of biomass as an important key technology. Furthermore, the Biomass Project Center was founded at Hiroshima University and the "Experimental Study on Developing a Regional System for Biomass Energy" of the New Energy and Industrial Technology Development Organization (NEDO) is underway in the Yamaguchi Prefecture and Maniwa City, Okayama Prefecture. And other organizations such as the Industrial Research Institute of Tottori Prefecture are giving high priority to the utilization of biomass. Now, with the challenge of biomass utilization in the Chugoku Region having begun, the contribution of our Biomass Technology Research Center to the local region is strongly anticipated.

The Chugoku Center is spearheading the "Biomass Council." In this council, 40 participating organizations aim at the promotion and creation of a biomass utilization project by focusing on the active exchange of opinions. As a method to achieve this end, the Biomass Technology Research Center will present an economic simulation model of a biomass utilization system, which would be applicable to many kinds of biomass energy utilization systems, and customize it according to the needs of each region. The policy of Biomass Technology Research Center is to promote the practical use of biomass by estimating the concrete economic aspects and environmental effects, and by clarifying the necessary research and development themes and issues. A system analysis has currently been initiated for the biomass utilization needs not only of the Chugoku region, but also all of Japan and Southeast Asia.

With the aim of becoming COE of biomass research in the world, the Biomass Technology Research Center has the objective to increase its contribution to the local area by fostering cooperation between industry, the academic world, and governmental services.

is an important theme of our second term research strategy. If we can establish the technology to utilize woody biomass by converting it into fuels with high added value, rather than simply burning it, a large quantity of woody biomass from unused trees, sawmill wood waste, and the discarded lumber from construction, can be effectively utilized.

If we can elevate the economic efficiency of woody biomass, the economic value of the forest will also increase. As a result we can achieve a real carbon neutral where there is a cycle of tree felling, tree planting, forest thinning, etc., which will contribute substantially to the prevention of global warming.

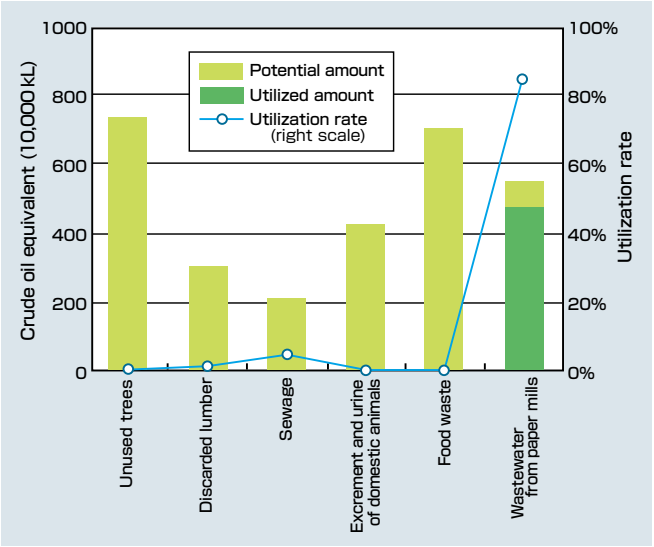


Fig.2 : Examples of utilization amount and potential amount estimations of biomass energy in Japan
Utilization rate = Utilized amount (electric power generation + heat)/Potential amount (Source: Agency for Natural Resources and Energy)

Production of Synthetic Diesel Fuel from the Gasification of Woody Biomass

Kinya Sakanishi
Director, Biomass Technology Research Center

Biomass as Diesel Fuel

Especially in principal cities, the emission of air pollutants PM, NOx, and SOx from diesel engines has recently worsened and the demand has grown for the production of sulfur-free or odor-free super clean diesel fuel. Under these circumstances, research is being undertaken to find a way to produce BTL by the gasification of biomass, in the same way that FT synthetic fuels are made by converting methane-based natural gas to synthetic gas.

If compared to GTL using fossil fuels as raw material, BTL has the effect of reducing carbon dioxide, and so recently the development of BTL technology has been promoted, principally in Europe. Fig. 1 shows carbon dioxide reduction comparisons between DME, methanol, and FT synthetic light diesel oil derived from biomass.

Light diesel oil made from biomass not only shows significantly reduced levels of carbon dioxide, but also the reduction of SPM and acid-rain causing SOx, as previously mentioned. It is also very efficient, and until fuel-cell automobiles come into wide use, is considered the best automotive fuel from the points of view of the prevention of global warming and conservation of the environment.

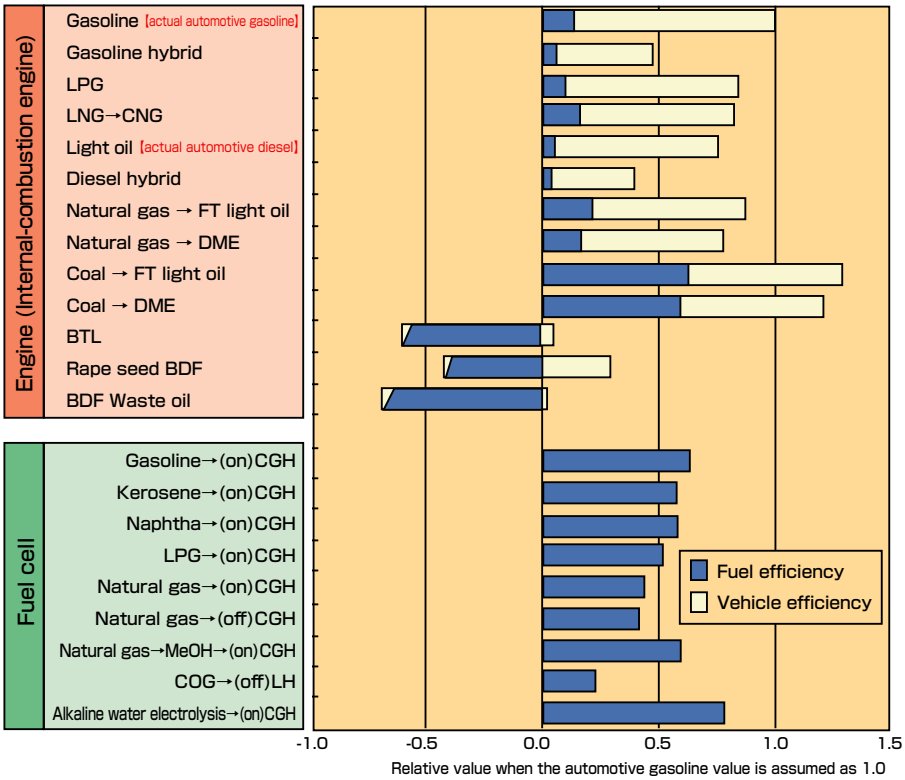


Fig.1 : Carbon dioxide reduction effect of FT synthetic light diesel oil derived from biomass
Calculated by assuming the vehicle efficiency of LPG, CMG and ethanol automobiles is the same as the vehicle efficiency of gasoline automobiles, and assuming the vehicle efficiency of FT light oil, DME, BDF automobiles is the same as the vehicle efficiency of light diesel oil automobiles.
Source: TOYOTA Motor Corporation, Mizuho Information & Research Institute, Inc., November, 2004.

Production Technology and Potential of BTL and DME

A synthetic diesel fuel production technique using the FT synthesis catalytic reaction is the core technology for the production of liquid fuels from synthetic gas components. To be cost-effective when compared to petroleum-based light diesel oil, it is considered indispensable to further develop FT synthesis by introducing new types of technologies in the future. In the case of GTL, the raw-material gas components of FT synthesis are being diversified for different technologies,

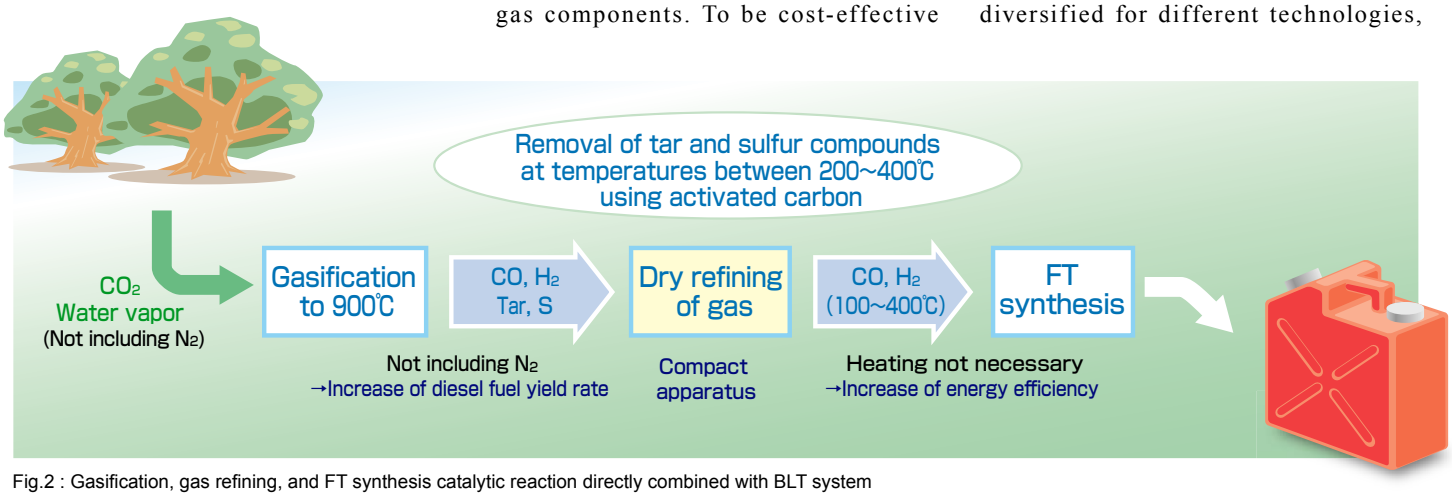


Fig.2 : Gasification, gas refining, and FT synthesis catalytic reaction directly combined with BLT system

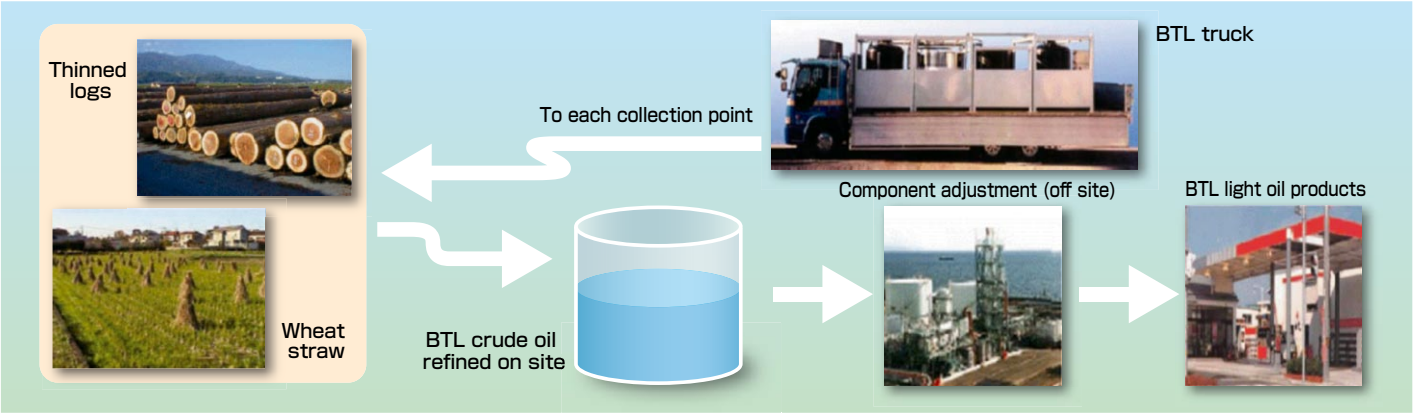


Fig.3 : Scheme of making BTL practicable

such as small to large scale natural gas fields, unprofitable natural gas fields, the gasification of biomass, and the gasification of coal. It is therefore expected that highly efficient FT synthesis technologies appropriate to the characteristics of respective raw materials will be developed.

FT technology is composed of technical fields such as catalysis development, reactor development, and plant development. Fig. 2 shows the BTL Integrated System being developed by AIST. Compared with conventional gasification, gas refining, and the FT synthesis process, this system shows merit, such as improved energy efficiency by Hot Gas Cleaning using activated carbon, and the significant increase in the yield of light diesel oil by combining directly with FT synthesis, hydrocracking, and catalytic isomerization.

DME has similar properties to LPG and is expected to become a new clean fuel that can be utilized in the public sector, transport sector, and as fuel for power generation, due to its ease of transport and storage. DME can be produced not only from fossil resources such as coal, petroleum and natural gas, but also from synthetic gas generated by the gasification of biomass. It can contribute to the diversification of primary energy resources, the reduction of carbon dioxide emissions and due to its super clean composition (sulfur and odor-free), it is expected to become the ultra low polluting diesel fuel in the future.

DME is currently produced by a dehydration reaction of methanol on the scale of several tens of tons per day. However in order to use DME as a fuel, it is necessary to produce it on a larger scale and at a lower cost. The raw material, methanol, can also be produced from synthetic gas, and so the development of a technique is being sought to produce DME directly from synthetic gas instead of from methanol. A DME direct synthetic reaction is very promising from the viewpoint of production cost because it is possible to obtain a higher yield rate at lower pressure if compared to a conventional methanol producing installation.

Making BTL Suitable for Practical Use

We can envisage two prototypes to make BTL practical. One is a mobile BTL truck of about 2 tons which can take a small BTL unit into mountainous areas (shown in Fig. 3), and the other is a middle/large scale BLT production plant using agricultural waste and forest product biomass readily available in large quantities.

In the former type, when the high costs due to the difficulty of collecting raw materials in Japan are calculated, an economically efficient and compact BTL unit which makes possible the production of BTL diesel fuels for “regional production, regional consumption” or a unit to co-produce gasoline and DME will be developed. In the latter type, we would like to contribute to the production of BTL synthetic diesel fuel using the large quantities of biomass from Southeast Asian countries, and to the popularization of BTL by the development and import scheme.

Explanation of terms

PM : Particulate Matter-general term for the soot discharged from diesel engines.
FT synthesis : a method developed by Fischer-Tropsch of synthesizing hydrocarbons by the catalytic reaction of synthetic gas (carbon monoxide and hydrogen).
GTL : Gas To Liquid - liquid fuels made by the FT synthesis catalytic reaction of natural gas to synthetic gas.
BTL : Biomass To Liquid - liquid fuels made by the FT synthesis catalytic reaction of synthetic gas obtained by biomass gasification.
DME : Dimethyl Ether - a new fuel with similar properties to LPG (liquefied petroleum gas, propane gas) and expected to replace diesel fuel and LPG.
LPG : Liquefied Petroleum Gas - fuels with propane as the main component.
SPM : Suspended Particulate Matter – PM of small (micrometer-order) diameter. Soot of microscopic diameter discharged by diesel engines.
Hot Gas Cleaning : the super deep dry refining of synthetic gas using an adsorbent such as activated carbon at high temperature (approximately 400°C) after gasification.

Production of Wood-based Ethanol for Automobile Fuel

Takashi Endo, Shinichi Yano
Biomass Technology Research Center

Ethanol Production from Woody Biomass

When biomass, containing carbon fixed from carbon dioxide in the air by photosynthesis of plants, is burned, the net amount of global carbon dioxide remains the same. Furthermore, the use of biomass-derived ethanol as fuels results in the decreased energy dependence on petroleum. Fuel ethanol is already consumed in large quantities in Brazil and the United States. However, because it is produced from agricultural products such as sugarcane or corn at the present time, the future supply of these commodities is not assured considering the increasing food demand. Under these circumstances, the development of ethanol production technologies from plentiful woody biomass resources, which do not compete with foods, is anticipated.

The major components of wood are cellulose, hemicellulose, and lignin. The cellulose molecules in wood are systematically arranged, while the hemicellulose and lignin fill in the gaps between the cellulose molecules, giving the strength of wood. Among those components, only cellulose and hemicellulose have molecules composed of sugar and can be converted into ethanol by saccharification and fermentation.

In the conventional ethanol production procedure by saccharification and fermentation of wood, the hydrolysis with sulfuric acid has been the mainstream for saccharification. Even though the saccharification rate is higher in the sulfuric acid process, it is difficult to control the reaction due to high reaction temperatures. Therefore, problems arise, such as the generation of substances which inhibit fermentation, and the decrease of yield due to the excessive decomposition of sugar. Furthermore, the cost of collecting the sulfuric acid used and wastewater treatment is expensive, along with a high environmental load. In consequence, an enzymatic saccharification process, which does not exhibit excessive decomposition and has less environmental influence, is receiving much attention. However, appropriate pretreatment is necessary for enzymatic saccharification.

Development of Pretreatment Techniques for a Non-Sulfuric Acid Process

We are advancing the development of a hydrothermal and mechanochemical treatment process as pretreatment techniques for enzymatic saccharification which does not require large quantities of chemical agents such as sulfuric acid and is environment-friendly. In the hydrothermal process, it is possible to decompose and separate selected components of wood using hot-compressed-water (HCW).

Fig. 1 shows the process results using Japanese cedar in a HCW flow type reactor. With the HCW temperature increased to between 140 and 230°C, saccharide from hemicellulose, such as xylose, elutes. And at between 230 and 260°C, the glucose elutes from cellulose. In the mechanochemical treatment, the energy from crushing grinds the wood into fine particles and induces chemical reactions (bond breaking and formation).

Fig. 2 shows the results of a basic experiment to improve enzymatic saccharification with mechanochemical treatment. Without mechanochemical treatment, enzymatic saccharification generates very little glucose, however, increasing treatment time improved enzymatic saccharification degree significantly. Macroscopically, during mechanochemical treatment the wood is finely ground to approximately 20 μm, though with increased treatment time the wood cannot be ground any smaller.

Detailed analysis has shown that mechanochemical treatment destroys the strong network of woody components, which enhances the mobility of cellulose molecule bundles and lets enzymes approach more easily, therefore allowing accelerated enzymatic saccharification. In the next stage, we will try to reduce treatment time and improve efficiency of saccharification by using additives that will not influence saccharification and fermentation and by the appropriate combination of hydrothermal and mechanochemical treatment processes.

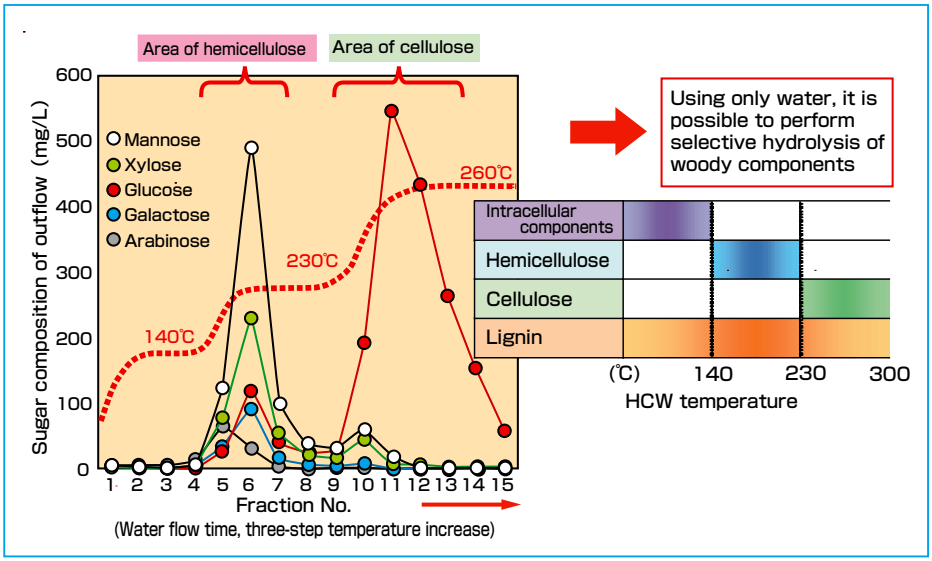


Fig.1 : Sugar composition of Japanese cedar extract treated with HCW using a HCW flow type reactor

Research and Development for Saccharification and Ethanol Fermentation

We also advance the research and development of saccharification and ethanol

fermentation. Regarding saccharification, we will examine saccharification enzymes, such as cellulase and xylanase (xylanase breaks down xylan, a major structure of hemicellulose) to establish an enzymatic saccharification technology suitable for hydrothermal/mechanochemical pretreatment. Regarding fermentation, since the conventional ethanol fermentation yeast cannot use pentose originating from hemicellulose, the biggest research challenge will be to overcome this problem. We will develop microorganisms which can convert both pentose and hexose into ethanol at a high yield by the genetic engineering of yeast and thermophilic bacteria. And we will investigate a fermentation method to produce high yields of ethanol using the developed microorganisms . In this method, after hydrothermal-mechanochemical pretreatment and enzymatic saccharification of the woody biomass, the resultant product will be fermented with high concentrations of microorganisms using the agglutination and immobilized method in order to obtain high yields of ethanol.

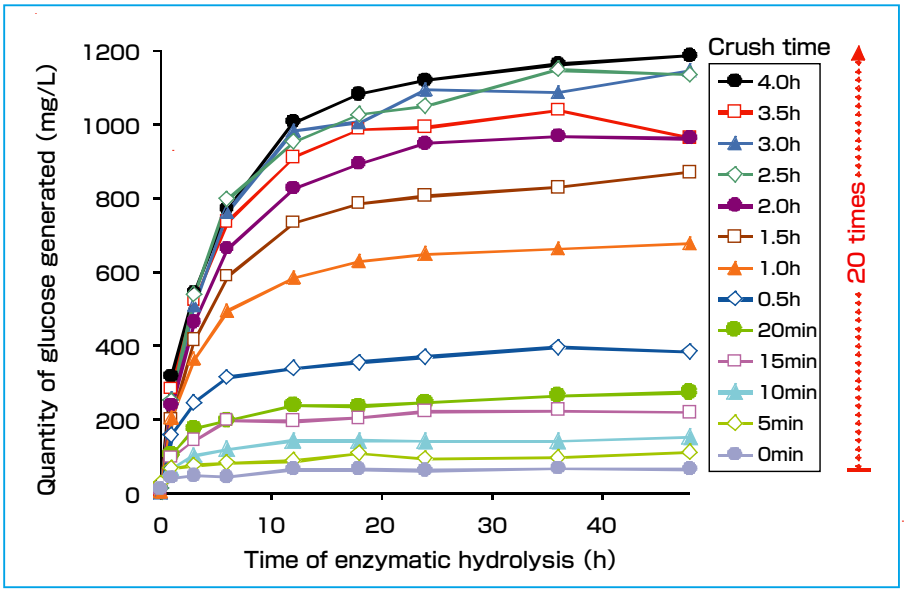


Fig.2 : Improved enzymatic saccharification of eucalyptus by mechanochemical treatment

Process Development and Utilization as Automobile Fuel

In the first phase of research and development, the hydrothermal treatment, mechanochemical treatment, rapid saccharification, fermentation using genetically modified microorganisms, and the essential techniques in each process will be investigated. In the second phase we would like to develop a practical combined method which consists of the hydrothermal, mechanochemical and chemical treatments, and simultaneous saccharification and fermentation (Fig. 3). In addition, we will work on the research and development of ways to add value to lignin and wastes as polymer materials, which cannot be utilized in saccharification and fermentation, in order to improve the profitability of an integrated woody biomass utilization system.

To be used as automobile fuel, ethanol can be simply mixed with gasoline. However, its utilization as Ethyl Tertiary-Butyl Ether (ETBE), obtained in a reaction between ethanol and isobutylene, has attracted much attention recently. ETBE is an excellent gasoline additive because it has a higher octane number than ethanol and is easily handled as it is not hygroscopic like ethanol. Since both ethanol and ETBE can be used directly in the existing cars, their wide use is expected as a fast acting countermeasure to global warming.

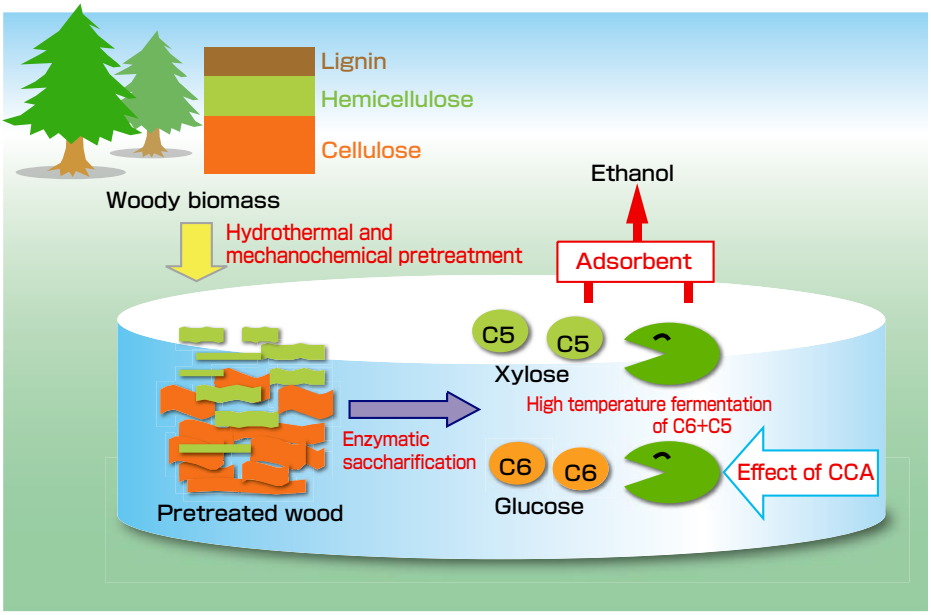


Fig.3 : Outline of the next generation high-yield bio-ethanol production technology from woody biomass
Under high temperature, saccharification and fermentation are performed simultaneously. The produced ethanol is collected using an adsorbent.

Creating a Data Base (DB) to Promote the Utilization of Biomass

Tomoaki Minowa
Biomass Technology Research Center

Introduction

There are various types of biomass such as wood from forestal biomass, straw from agricultural biomass, and their residues (waste). And there are all sorts of wood: green wood with a high water content, cut dried wood obtained from sawmills, discarded lumber from construction sites, etc. There are many ways to utilize these biomasses as energy, such as for heat, electric power generation, and conversion to gas and liquid fuels. And there are various conversion methods depending on the type of biomass. How will we choose which one to use, and which way shall we convert it so as to efficiently use the available biomass? We are working on the creation of a data base (DB) to answer these questions and to design the optimum biomass utilization system which is environmentally friendly and economically efficient.

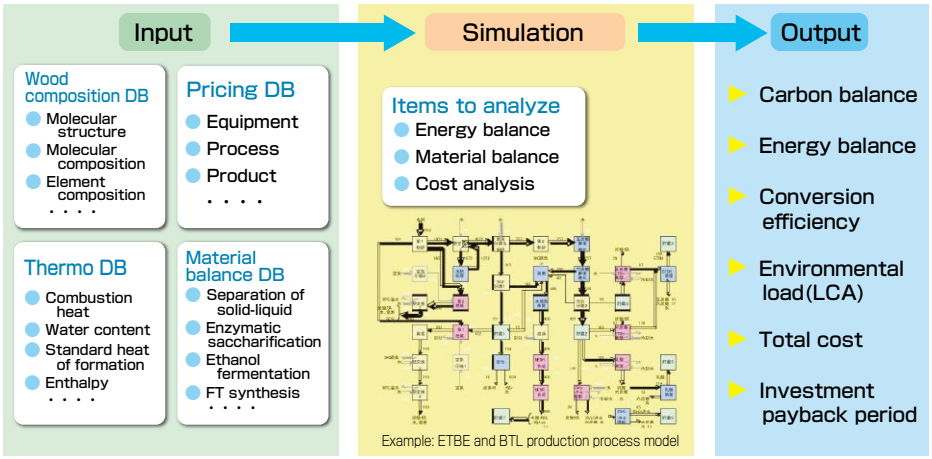


Fig.1 : Biomass utilization system design flow

System Design Flow and Biomass DB

Fig. 1 shows the calculation flow from DB. First, input the biomass type to be used in order to design a process to obtain the desired energy product (process model of the simulation). For heat, it is enough to burn it. However, to produce ethanol or ETBE from wood as a gasoline substitution, processes such as component separation, saccharification, fermentation, and the collection of ethanol by distillation are required. When the process model is complete, the material balance of the whole process can be calculated by recording wood composition data and material balance data in the process model.

The next step is to calculate the necessary heat and power for the process on the basis of the thermophysical properties of the raw materials, end products, and intermediate products. With the pricing data, the cost of main equipment can be calculated and the construction costs of the plant can be estimated. As a result, the efficiency and total cost of the designed system can be obtained, and the carbon dioxide savings when compared to petroleum can be calculated on the basis of product yield. In addition, from the product price and total cost, economic indices such as the investment payback period, can be output.

With the DB of wood components and thermophysical properties, one can examine how total efficiency and product yield rate vary with wood type, and the effect on total economic efficiency when the

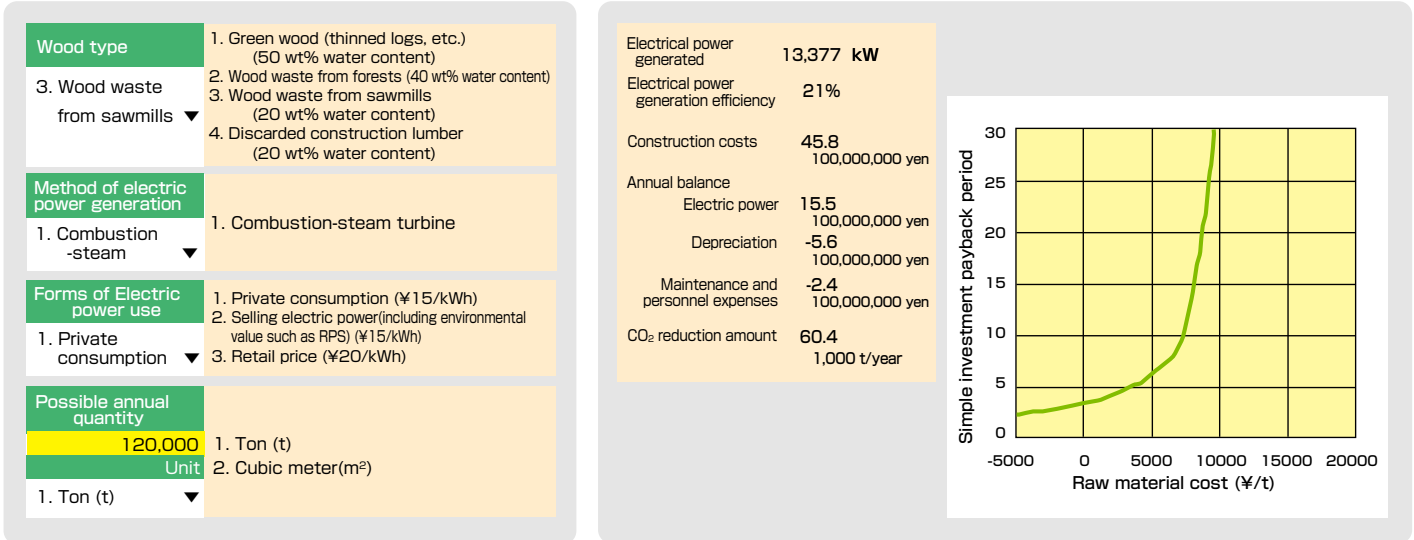


Fig.2 : Input screen image (left) and output screen image (right) of the simplified simulator

process is partially changed. Every time a new system is being considered, usually researchers themselves must investigate and collect the necessary data. However, if such a DB is prepared, not only will the chore of data collection be lightened, but expanding the DB will make technology or use comparisons easier as well.

Simplified Simulation Example Using DB

Though detailed investigations will be needed for practical utilization, using DB permits simplified examination. DB is currently under construction, however, we elaborated an electrical power generation case as a simplified simulation example.

Fig. 2 shows an input image and an output image. By recording wood type, electrical cost, and potential annual yield (scale), the resulting electric power generation scale, efficiency, total construction costs, annual balance, and the carbon dioxide savings will be estimated. The example shows the scenario when 120,000 tons of woodcutting wastes were consumed in one year at private-consumption electrical rates. It is possible to examine how economic efficiency can be improved, or which type of project can be considered, by performing a case study simply by changing the input data.

ETBE/BTL Integrated Production System using Biomass

The Biomass Technology Research Center of AIST is working on the research and development of the important future step to convert woody biomass to liquid fuels, specifically, the production of the gasoline additive ETBE, and diesel fuel which is synthesized by gasification and indirect liquefaction. We are working on the design of an integrated system for the production of ETBE/BTL as shown in Fig. 3. It performs several processes: the separation of cellulose and lignin, the main components of wood; the saccharification and fermentation of cellulose to produce ethanol; the production of ethanol to ETBE; the production of diesel fuel by gasification and indirect liquefaction of lignin, etc., obtained in the separation process; and the process that offers utilities of the whole system.

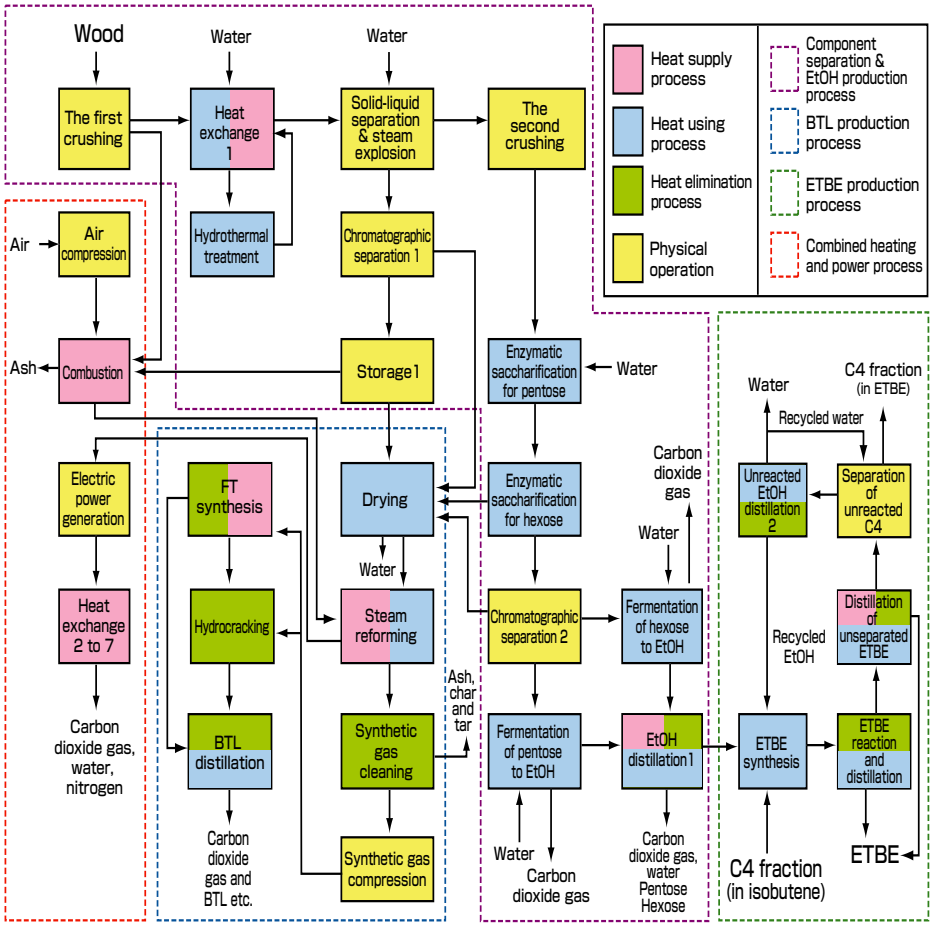


Fig.3 : Basic flow chart of the ETBE/BTL integrated production system from biomass

The construction and use of DB make it possible to examine the economic efficiency of an ETBE/BTL integrated production system and to plot a course for the development of technology by sensitive analysis. Inversely, performing these simulated case studies can expand the DB.

Future Activities

We believe that by creating the biomass DB we can contribute to promote biomass utilization as it makes possible system design and simplified simulations. We will not only work on ETBE/BTL production, but will also actively collaborate on various biomass utilization systems, promote research and development by analyzing economic efficiency, and publish simulation results.

In the future, we will perform more case studies in order to improve the contents of DB, so it can be used as a reference when biomass will be utilized.

Development of Biomass Utilization in Asia

Keizo Hashimoto
International Affairs Department

Promotion of the Asian Environment and Energy Partnership

With booming economic development spurring energy consumption in Asian countries, it is estimated that this region will be the biggest global energy consumer by 2030. A global environment forecast is that by 2030, China will surpass the United States as the country with the highest CO_2 emissions in the world. And it is estimated that CO_2 emissions in developing countries will increase to be three times those of developed countries by 2100.

In the common and urgent "environment and energy" issues in Asia, it is important that relevant organizations from each country promote projects such as an integrated technical system, integrated evaluation techniques, and the introduction of standards and specifications, with the view of fostering mutually complementary relationships, the creation of new industries, and the establishment of international standardization. These projects should take into consideration biomass, a distributed energy network (including the use of fuel cells, photovoltaics, biomass, and hydrogen energy), clean fuels and engines that contribute to the improvement of the atmospheric and global environment, environmental friendliness, energy efficiency, and economic production efficiency. AIST also is concluding comprehensive research agreements with principal organizations.

The Asian region has the largest biomass resources in the world. Important tasks in this region are the promotion of sustainable biomass production, the creation of a circulation system of renewable energy and useful products, and to make this system practical by the mutual collaboration of Asian countries and research institutions (including the collaboration between agricultural and industrial sectors) with the aim to prevent global warming and improve energy efficiency. AIST is collaborating with individual research institutes from each country, and also multi-nationally promoting the development of "Biomass-Asia." We believe that AIST can contribute to the creation of a sustainable and global industrial structure by promoting an Asian environment and energy partnership.

Strategic Development of Biomass-Asia

The conventional mass production/mass consumption/mass disposal social system dependent on fossil resources has worsened various environmental problems such as global warming, waste, and toxic substances. Therefore, the utilization of biomass that is a renewable organic resource has become more important.

To advance "Biomass-Asia" (Fig. 1) leading to a post-petroleum society, AIST is promoting the collaboration between the agricultural and industrial sectors, and also between industry, the academic world, and governmental services in Japan. We are making efforts to create a network with the administrative bodies and principal research institutions of Asian countries, and to establish biomass utilization strategies by collaborating with Asian countries.

Asia is endowed with abundant biomass resources (Fig. 2) due to its climate, etc., with more than 30% of the world's biomass resources distributed in this area. However, it is worrying that in many Asian countries, rapid economic development and rising population result in increased energy

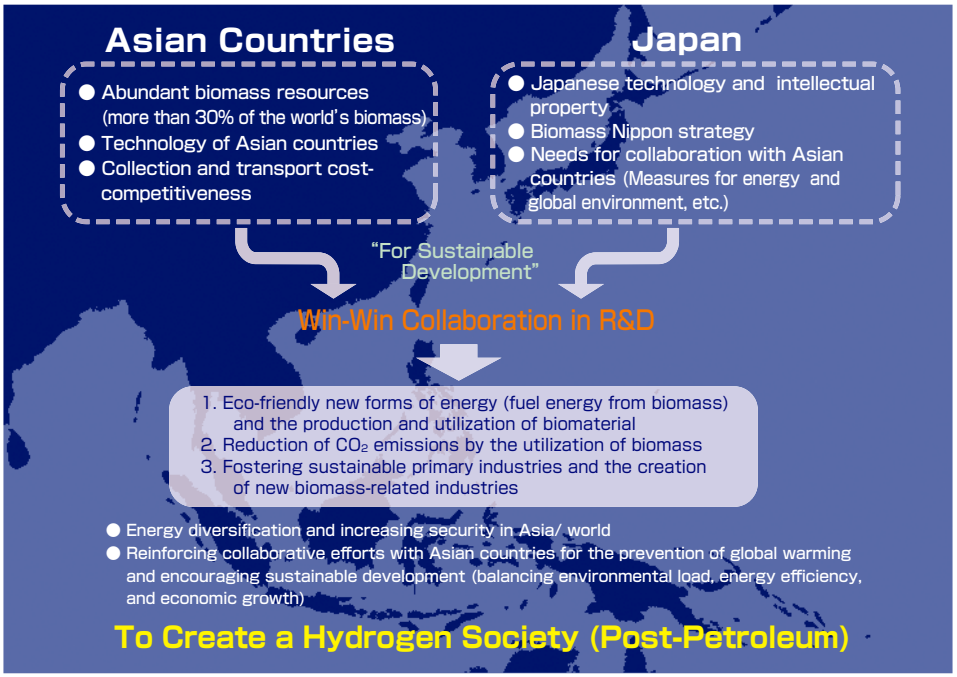


Fig.1 : Diagram of Biomass-Asia Outline

consumption and greenhouse gas emissions. The destruction of land in some parts of Asia is accelerated by desertification and deforestation. Therefore, there is a growing need to create a biomass production system aimed to prevent desertification and to help in the regeneration of forests. The establishment of biomass utilization techniques, the creation of a well-grounded recycling-based and sustainable eco-friendly society, and designing sustainable agriculture, forestry, and fishing industries in the Asian region are essential.

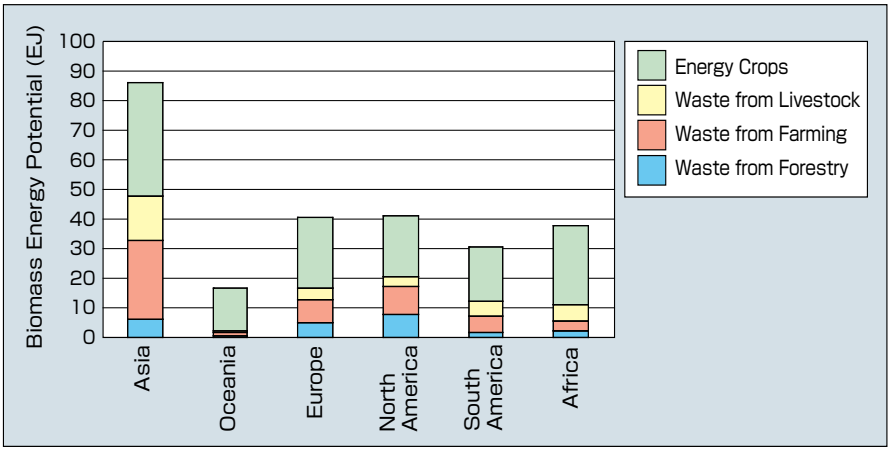


Fig.2 : World Biomass Energy Resources by Region
EJ (Exajoule) = 10^{18} Joule. 1 EJ is equivalent to 26,200,000 kL of crude petroleum.

As a concrete solution to the issues, with the initiative of AIST, the "Biomass-Asia Workshop 2005" was held in Japan in January, 2005. It was a large-scale project attended by administrators and researchers related to biomass utilization in Asian countries and Japanese related organizations, e.g. Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Economy, Trade and Industry (METI), Ministry of Education, Culture, Sports, Science and Technology (MEXT), AIST, 5 MAFF related institutes, University of Tokyo, Research Institute of Innovative Technology for the Earth (RITE), and Japanese organizations from the industrial sector. For detailed information, please refer to http://unit.aist.go.jp/internat/biomassws/01workshop/. In the workshop, the establishment of a network with each country was discussed and the course of industrial and agricultural policies as well as future research and development in the biomass field were clarified through an exchange of opinions and technical expertise. For the first time in Asian countries, this workshop made possible the establishment of a network between government bodies and research institutes in the biomass field. It revealed the actual progress of activities related to biomass and the technical issues facing each country and organization.

The second workshop (Photo. For detailed information please refer to http://unit.aist.go.jp/internat/biomassws) was held in Thailand in December, 2005. Under the initiative of the Minister for Science and Technology in Thailand, the structure to promote the development of Biomass Asia was established with collaboration between related Thai ministries. Each country's governmental representatives presented their political course in the area of biomass and their best trial cases of biomass utilization, with the exchange of opinions concerning R&D (research and development) on specific issues.

The third workshop to expand on the topics will be held in Japan in November, 2006.

Photo : The Second Biomass-Asia Workshop (held in Thailand, December, 2005)
Prof. Nakajima, Vice-President of AIST is the third from the right.

Further Network Reinforcement

In the future AIST will initiate the creation of a network and the establishment of a partnership for "Biomass-Asia", promote the planning of international joint projects which are mutually complementary and benefit both Japan and Asian countries, contribute to the sustainable development of our country through energy diversification and security stabilization in Asia and the world, contribute to the prevention of global warming and forge collaborative reinforcement activities with Asian countries.

Especially in the creation of a network, we regard as important a highly skilled personnel network and will promote the exchange of qualified human resources in Asia by using the AIST fellowship program begun in 2005 and JICA's new group training course "Research on Biomass Technology" which will begin in 2006.

Research Hot Line

UPDATE FROM THE CUTTING EDGE

Apr.-Jun. 2006

The abstracts of the recent research information appeared on the Vol.6 No.4–No.6 of "AIST TODAY" are introduced and classified by research area. For inquiry about the full article, please contact the author directly.

Life Science & Technology

Novel reporter assay system using color differences luciferases reveals multiple gene expression in the mammalian cells

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AIST TODAY Vol.6, No.4 (2006)
p.20-21

We developed a revolutionary tricolor reporter *in vitro* assay system, in which three gene expressions are monitored simultaneously using green-, orange- and red-emitting beetle luciferases. The technique was used to analyze biological clock mechanisms, which are generated by complicated transcription-translation feedback loops of clock genes, and two clock gene transcriptions were monitored simultaneously. This technique, furthermore, could be utilized for fine analysis in new field of transcriptome and promoterome, as well as pharmacological or toxicological technologies.

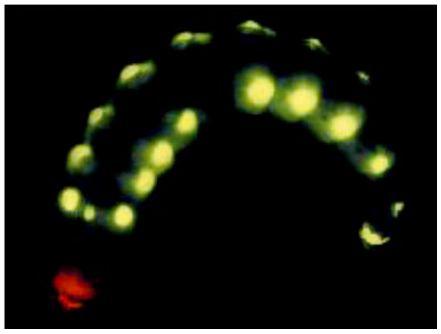

Figure 1: Railroad-worm, *Phrixothrix hirtus* larviform female by its own bioluminescence.

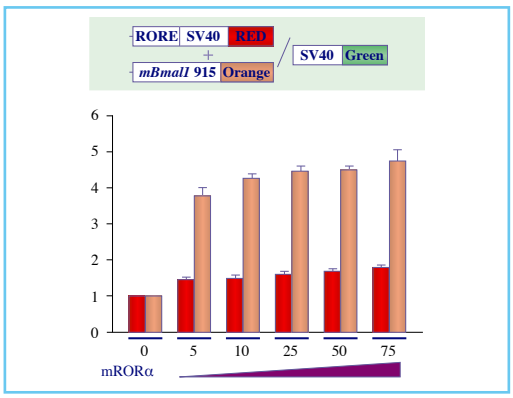

Figure 2: Simultaneous monitoring of mRORa4-dose-dependent induction of RORE-mediated (red bars) and *mBmal1* promoter fragment-driven (orange bars) transcription.

Development of a rapid and easy-to-use tool for stress measurement using microchip capillary electrophoresis

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AIST TODAY Vol.6, No.4 (2006)
p.24-25

A rapid and easy-to-use tool for stress measurement based on microchip technology and electrophoretic separation technique was developed. Cortisol and secretory immunoglobulin A (s-IgA) in saliva were measured as stress-related compounds. Advantages of microchip system over conventional immunoassay methods include short analysis times, high separation efficiency, reduced cost and disposability. The detection sensitivity was improved by the development of laser-induced fluorescence detection system, microchip devices and optimal analytical conditions. We expect our research will provide self-care products for stress diagnosis in future.

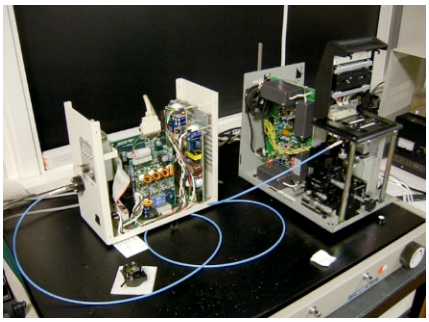

Figure 1: A highly sensitive measurement system based on microchip capillary electrophoresis and laser-induced fluorescence detection.

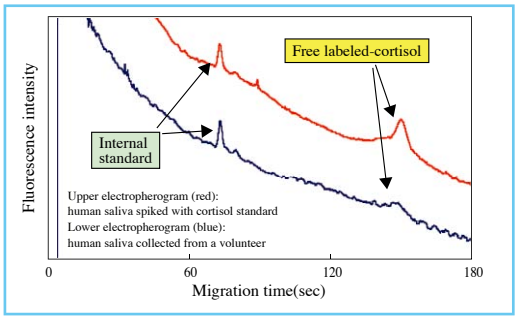

Figure 2: Analysis of salivary cortisol using competitive immunoassay and electrophoretic separation.

True 3D Display using Laser Plasma in the air

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AIST TODAY Vol.6, No.4 (2006)
p.16-19

Most of the 3D displays reported until now draw pseudo-3D images on 2D planes by utilizing the human binocular disparity. However, many problems occur, e.g., the limitation of the visual field, and the physiological displeasure due to the misidentification of virtual images.

We have developed a 3D display, which utilizes the plasma emission phenomenon near a focal point of focused laser light. By controlling positions of the focal points in three directions of X-, Y-, and Z-axes, real 3D-images constructed by dot arrays were displayed in the air (3D-space).

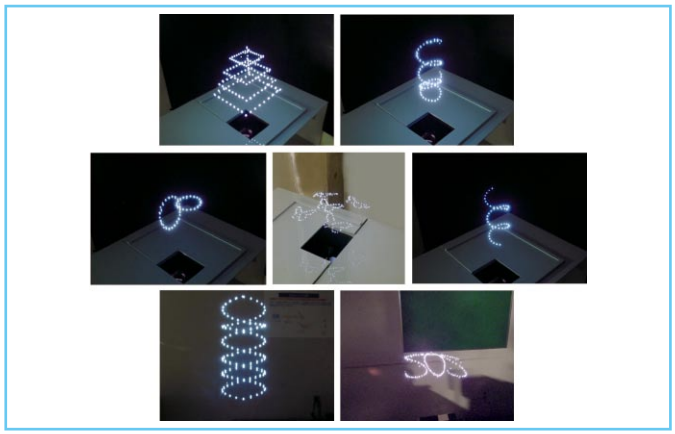

Figure : Various 2D and 3D objects drawn by the display device we have developed.

Flexible Organic Memory Device Fabricated with Printing Method

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AIST TODAY Vol.6, No.4 (2006)
p.26-27

We have developed novel ferroelectric materials with helical biopolymers such as polypeptides and DNA. Using the materials, a memory device of ferroelectric field-effect transistor was fabricated with a printing method. This technology will accelerate the development of all-printed fabrication of ubiquitous information terminal such as a flexible display.

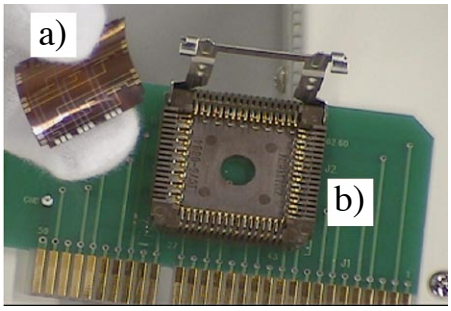

Figure 1: a) 3x3 memory devices fabricated with printing process on flexible substrate and b) measuring socket.

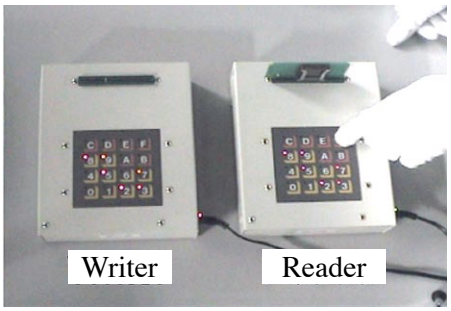

Figure 2: Checking of operations of printed memory devices. Each memory device corresponds to numbered LED. Writer (right): LED light when the device is applied gate bias. Reader (left): LED light when drain current is increased.

A double-gate MOSFET with an ultrafine upstanding Si-fin

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AIST TODAY Vol.6, No.4 (2006)
p.28-29

We have developed a damage-free neutral-beam etching technology for the fabrication of Si-MOSFETs. A double-gate MOSFET with an upstanding Si-fin was fabricated using the technology. The MOSFET showed improved performance. We expect that this technology will be widely used in the 32nm technology node.

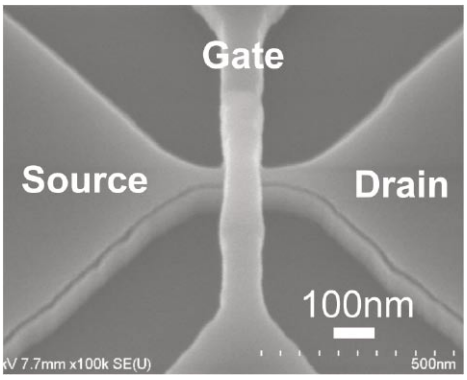

Figure 1: SEM image of the fabricated double-gate MOSFET.

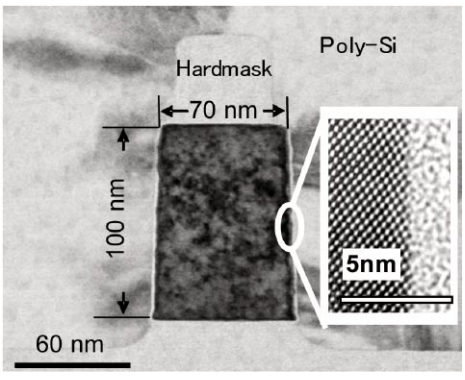

Figure 2: TEM cross-sectional image of the upstanding Si-Fin.

The Data Repository System for The Shake Test

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AIST TODAY Vol.6, No.5 (2006)
p.22-23

"E-Defense" is a 3-D full-scale earthquake testing facility. Shake tests at the facility can observe and investigate strength of various types of buildings against earthquakes. "EDgrid Central" system supports storing and publishing experimental data of the shake tests, by the IT technology. The system enables civil engineering researchers to access the experimental data securely through the Internet. The researchers can share results and reports of analyses of the experiments with researchers of various fields, and would promote their collaboration.

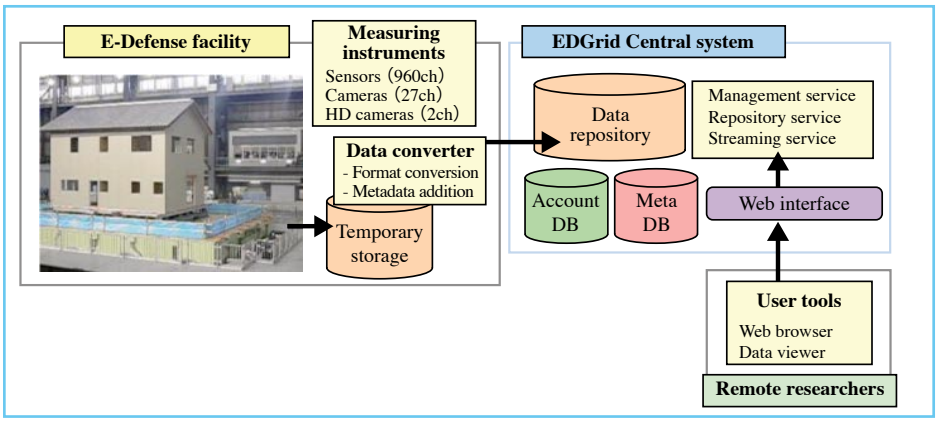

Figure : Overview of EDgrid Central system

Overlay Weaver : An Overlay Construction Toolkit

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

We have been developing an overlay construction toolkit called "Overlay Weaver".Algorithm designers can implement structured overlay algorithms in just hundreds of lines of code with the toolkit and improve them rapidly by iterative tests on a single computer. The toolkit enables designers to make fair and large-scale comparisons between new and existing algorithms. Furthermore, the implemented algorithms can work on a real network in addition to the emulator. The toolkit enables algorithms developed through research to be used in applications directly.

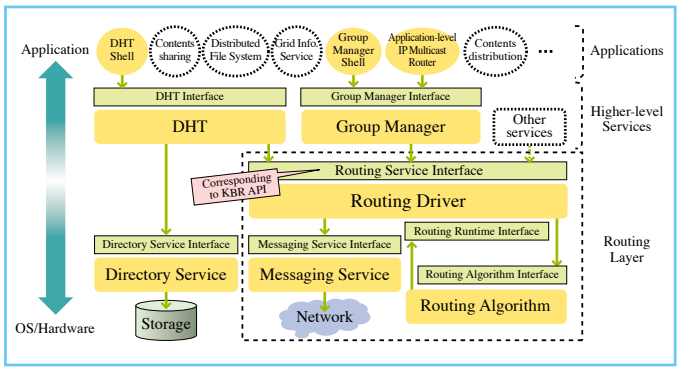

Figure 1: Components of runtime in Overlay Weaver

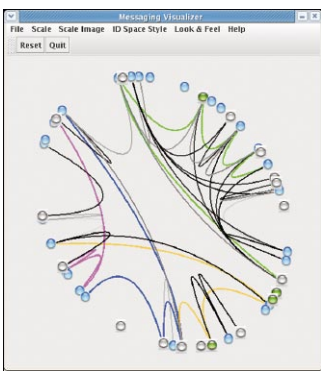

Figure 2: Messaging visualizer

Successful Development of a Desktop Apparatus Enabling Nanometer-scale Fabrication

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

We have developed a new thermal lithography technique that utilizes the thermal decomposition of platinum oxide. This technique enables lithography of high resolution, high speed and wide writing area (96 cm^2). The smallest reproduced feature was 50 nm in diameter, using an optical system consisting of a 405 nm laser and an objective lens with numerical aperture (NA) of 0.65. Size of this feature is one eighth of that achievable by conventional photolithographic techniques. High-speed writing of over 6 m/s was achieved, with 3 million nano-dots fabricated per second. With the technique, nano-scale devices will be produced at lowcost.

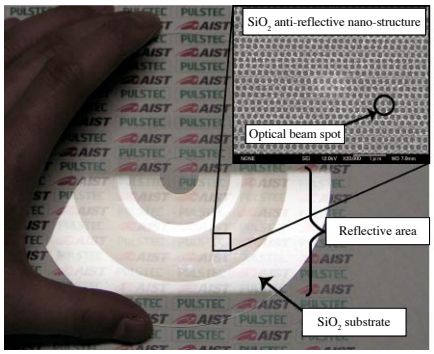

Figure 1: A photo image of an antireflective nano-structure formed on a SiO_2 disc substrate of 12 cm in diameter.

Figure 2: The jointly-developed desktop nano-fabrication apparatus.

Uniform dispersion of carbon nanotubes into polyimide

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AIST TODAY Vol.6, No.6 (2006)
p.30-31

We developed a new method for dispersing carbon nanotubes in polyimide with nano-meter-scale uniformity. This material is a new promising nonlinear optical material with transparency, thermal durability, robustness and processibility. A fiber laser using this material generated a very short light pulse with 165 femto second width. With a fine microfabrication technology, a waveguide device was fabricated using this material.

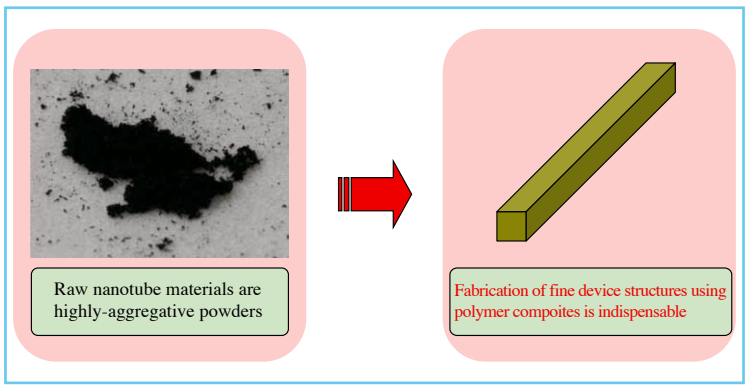

Figure : Necessity to develop a nanotube-polymer composite material

Development of High Performance Micro Tubular SOFCs

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AIST TODAY Vol.6, No.5 (2006)
p.24-25

Micro tubular SOFCs of ceria based electrolyte with 0.8-1.6 mm diameter have been fabricated using an advanced ceramic processing technology. SOFC stacks of high volumetric power density at 500 - 600 °C can be built with the micro tubes. The single tubular SOFC showed cell performance of 1W/cm^2 at 570°C with H_2 fuel. The tubular SOFCs will be applied to a compact power device which can endure repeated rapid changes of electrical load and operating temperatures.

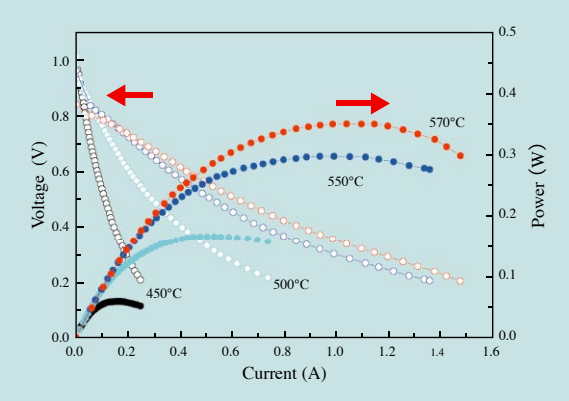

Figure : Cell performance of the single micro tubular SOFC -- 1.6 mm diam. 1 cm length (0.7 mm cathode length)

Highly Stabilized β-carotene in Single-walled Carbon Nanotubes

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AIST TODAY Vol.6, No.5 (2006)
p.26-27

An effective stabilizing method for organic molecules is a bottleneck preventing their industrial application. For example, β-carotene has the following remarkable features; ultrafast optical response, third-order optical nonlinearity, and so on. However, it has not been used as photonic-devices because it easily degrades by oxidation and isomerization. We have succeeded in encapsulating β-carotene inside of single wall carbon nanotubes. The stability of β-carotene is highly improved by the encapsulation.

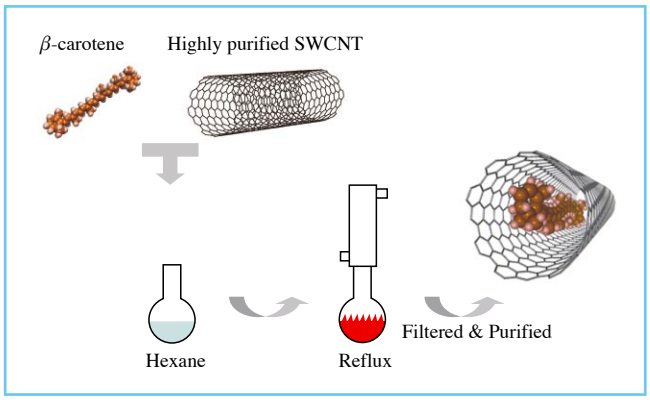

Figure : Encapsulation procedure of β-carotene in SWCNT.

Stable Operation of Carbon Nanotube Transistor

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AIST TODAY Vol.6, No.6 (2006)
p.20-21

Carbon nanotube transistors, so far reported, had major problems such as a large time fluctuation of drain current and a large hysteresis characteristic. A cause of these fluctuations was found to be a photo-resist adhered to the surface of carbon nanotubes, as well as oxygen and water. New fabrication process for a carbon nanotube transistor was established in which the residue of the photo-resist as well as the water and oxygen never adhere to the carbon nanotubes. The new carbon nanotube transistor shows almost no fluctuation of the current and no hysteresis characteristic.

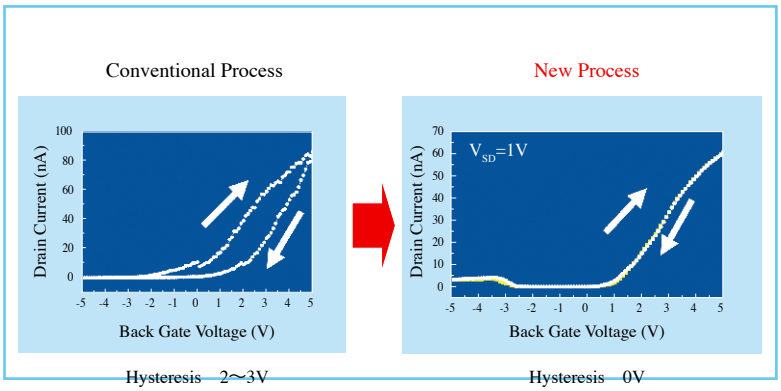

Figure : Carbon nanotube FET fabricated by the conventional process shows the large hysteresis characteristics of a few Volts. On the other hand, the carbon nanotube FET fabricated by our new process shows almost no hysteresis characteristic.

Highly Conductive Single-Wall Carbon Nanotubes

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p.32-33

Enrichment of metallic single-wall carbon nanotubes (SWCNTs) up to 80 % has been achieved by preferable oxidation of semiconducting SWCNTs simply by keeping HiPco® SWCNTs in hydrogen peroxide at 90 ºC for 47 min. The higher chemical reactivity of semiconducting SWCNTs was probably caused by a metallization of semiconductors due to a charge transfer to the hydrogen peroxide. This reaction could be applied to more precise selection that is crucial to transparent electrodes and the other electronic devices in near future.

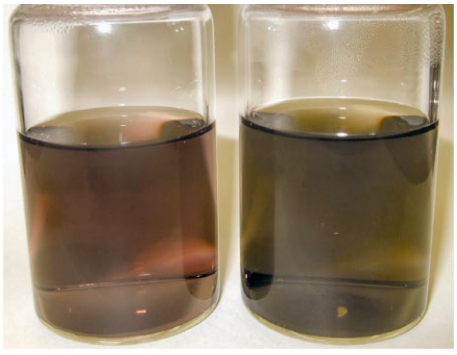

Figure 1: Optical photographs of SWCNT suspension before (right) and after (left) the heat treatment in hydrogen peroxide. "Red" seen in the left bottle is the color of metallic SWCNTs.

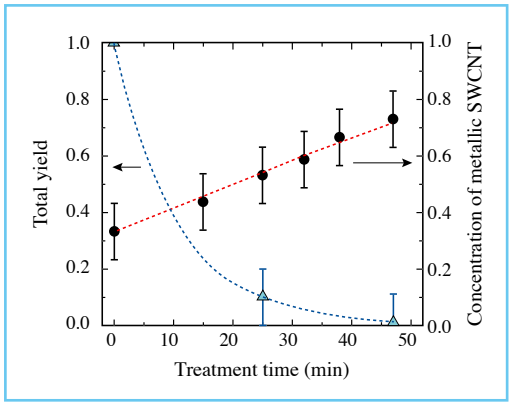

Figure 2: Treatment time dependence of the total yield and the concentration of metallic SWCNTs.

Novel Mass Spectrometric Technology for Biological and Environmental Fields

We have successfully developed a novel matrix-free soft ionization mass spectrometry technique. In this technique, by irradiating laser shots on the sample simply deposited on germanium quantum dots, mass spectra can be easily observed without obstructive peaks. So far, highly sensitive analysis at 10^{-16} mol level for peptides and analysis of brominated flame-retardants have been demonstrated. This technique is further applicable for wide range of samples not only biomaterials such as proteins, peptides and oligosaccharaides, but also industrial materials such as synthetic polymers and additives.

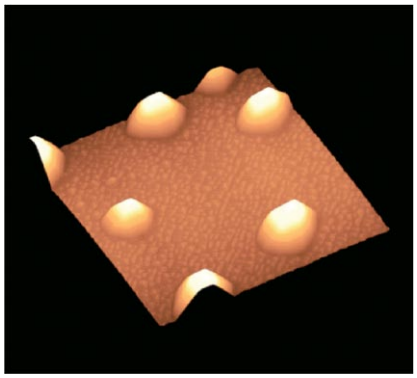

Figure : Photograph of germanium nanodot structure.

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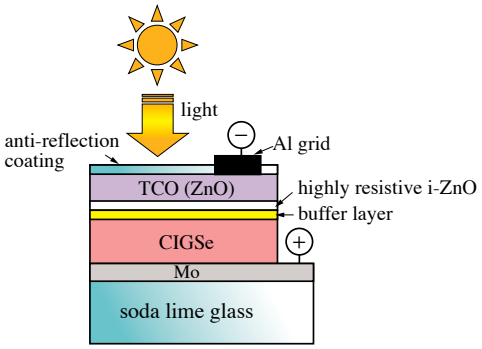
p.16-19

Development of high V_{oc} $Cu(In,Ga)Se_2$ solar cells

A novel technique to improve CIGSe solar cell performance was developed. Introduction of water vapor to a vacuum-deposition chamber reduces defects in CIGSe thin films. Open circuit voltage (V_{oc}) and short circuit current density (J_{sc}) of the films increased as a result. A solar cell with a wide-gap (1.3 eV) CIGSe film gave 18.1% efficiency, V_{oc} of 0.744V, J_{sc} of 32.4 mA/cm^2 and fill factor of 0.752. The novel technique would lead to development of practical large area and/or flexible CIGSe solar cells.



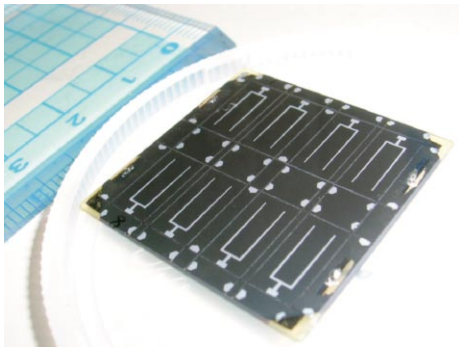


Figure : Schematic illustration of the CIGSe solar cell structure and a device sample.

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p.22-23

Decomposition of Environmentally Persistent Perfluorooctanesulfonate (PFOS) in Subcritical Water

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p.28-29

Perfluorooctanesulfonate (PFOS) and related chemicals have been widely used as surface treatment agents, emulsifying agents and so on. Their high stability consequently results in environmental persistence and bioaccumulation. Techniques to decompose them to harmless species at stationary sources are desired. The method should involve cleavage of the C-F bonds to form F^- ions, because a waste-treatment process for F^- was already established. PFOS and other related chemicals can be efficiently decomposed to F^- ions using iron and subcritical water. This method was also effective to PFOS contained in a coating agent used in a real manufacturing process.

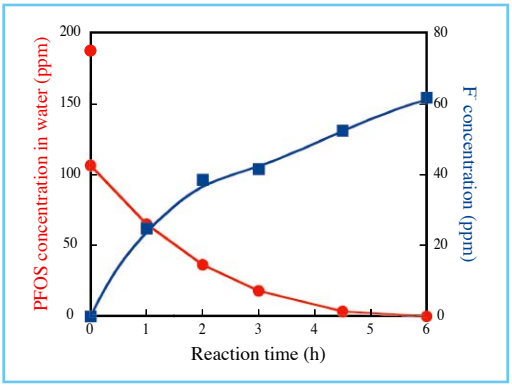

Figure : Reaction-time dependence of the concentrations of PFOS and F^-. Initial concentration of PFOS: 186 ppm, Reaction temperature: 350°C, Reaction pressure: 23.3 MPa [Reprinted with permission from Environmental Science & Technology, 2006, 40, 1049-1054. Copyright 2006. American Chemical Society].

Concealed Median Tectonic Line in the Kanto Plain, Central Japan

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p.20-21

Concealed Median Tectonic Line (MTL), the largest fault in Japan, was confirmed in the Kanto Plain. Geologic analyses for core samples obtained from 3500m deep bore hole of the Iwatsuki Observation Well show that MTL runs within 500m south of the lwatsuki well. As MTL partially reactivates as active faults especially in Southwest Japan, the relation between MTL and surface Ayasegawa Active Fault should be clarified, and earthquake disaster prevention should be planned based on the relation.

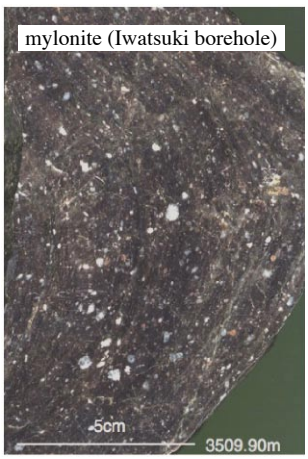

Figure : Photograph of polished slab of the mylonitic rock obtained from 3500m-deep Iwatsuki borehole.

Proteome analysis for oxidative stress

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AIST TODAY Vol.6, No.5 (2006)
p.28-29

"Oxidative stress" is defined as a disturbance in the oxidant-antioxidant balance in favor of the former, and is involved in a numerous number of diseases. We identified the structure of oxidatively modified peroxiredoxin (Prx) and DJ-1 under the oxidative stress condition using mass spectrometry. The ratios of the oxidatively modified Prx 2 and Prx 6 to the reduced form in erythrocytes of Alzheimer's disease (AD) patients were elevated compared to those of the healthy control, respectively. These modified proteins are promising candidate markers for diagnosis of AD.

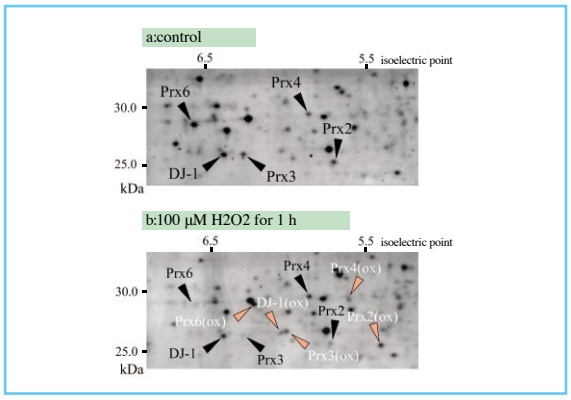

Figure : Two-dimensional gel electrophoresis of endothelial cells (a, normal culture condition; b, cells cultured in medium containing 100 μM H_2O_2 for1 hour).

Temperature measurement of microscale specimen by simultaneous measurements of thermoreflectance and electric resistance

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A temperature measuring system based on the thermoreflectance method has been developed. This system can measure the temperature of sub-microscale specimen with non-contact, high temperature resolution, high speed, and high spatial resolution. Simultaneous measurements of a specimen in the relative intensity of reflected light and in the electric resistance allow us to determine its surface temperature. High spatial resolution of 0.7μm is achieved by employing laser irradiation and detection through confocal microscope optics. The minimum detectable temperature change of 0.2 °C at around 100°C is obtained for a molybdenum thin strip.

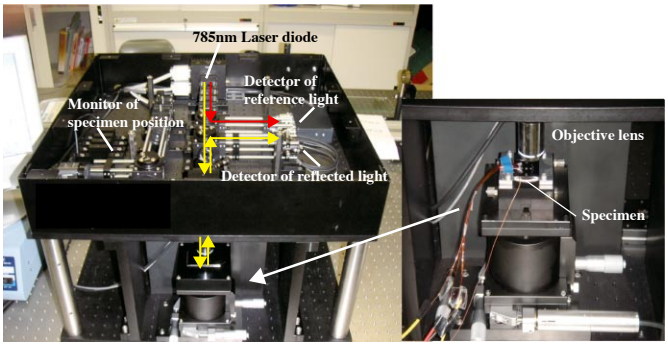

Figure : Thermoreflectance thermometer using a confocal microscope system.

Synthesis of Unique High Quality Fluorescence Quantum Dots for the Biochemical Measurements

We have succeeded in the synthesis of unique high quality fluorescent quantum dots, and nano-biohybrid materials for protein and DNA/RNA measurements are developed using the quantum dots. The nano-hybrid materials can be applied for detection of trace amounts of proteins using antibodies (immunoblotting). The sensitivity of the method was drastically improved.

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Figure 1: Fluorescence emitted from quantum dots.
Blue fluorescence can be emitted from small particles of approximately 2 nm in diameter, green from ~3 nm particles, yellow from ~4 nm particles, and red from large particles of ~5 nm.
The wavelength of the excitation light is 365 nm.

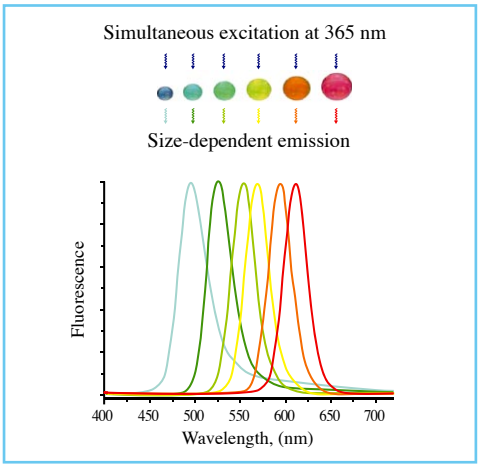


Figure 2: Fluorescence spectra depending on the size of quantum dots.

Technical Research Centre of Finland (VTT) and AIST Signed an Agreement of Research Cooperation

On February 15th, AIST and the Technical Research Centre of Finland (VTT) signed a comprehensive agreement of research cooperation. VTT conducts research and development in a wide range of fields as the largest public research institution in Northern Europe, with over 3,000 staff members. With many shared research projects with VTT, AIST has historically continued research exchange of research unit level, such as the coordination of Electrotechnical Laboratory, when AIST was still the Agency of Industrial Science and Technology, with VTT Electronics in Oulu City. In the future it is likely that several more research units will conclude agreements of research cooperation and joint research contracts. In light of this, based on discussion with VTT headquarters, the two institutions agreed to conclude a comprehensive agreement of cooperation including guidelines on handling intellectual property rights and provisions for conflict resolution procedures.

VTT President Dr. Erkki KM Leppävuori came to Japan for the signing of the agreement of cooperation, meeting with Senior Vice-President Kodama and associates at AIST Tsukuba and visiting laboratories there. Afterward, he went to Tokyo Headquarters where he met with AIST President Yoshikawa and signed the agreement.

Vietnam-Japan Scientific Cooperation Workshop on Geo-Grid

A workshop aiming to integrate grid technologies with the geological information field was held over a two-day period commencing on March 6th in Hanoi, Vietnam. Two workshops have already been held in a mutually complementary tie-up between AIST and the Vietnamese Academy of Science and Technology (VAST), an institution with which AIST has concluded a comprehensive agreement.

The opening ceremony.
AIST Vice President Nakajima on stage.

This latest workshop focuses on the field-integrating project Geo-Grid. AIST called on a wide array or future users: in addition to researchers at the two institutions, researchers in fields like IT, geosciences, agriculture, and forestry gathered from the Vietnam Ministry of Natural Resources and Environment, and the Ministry of Agriculture and Rural Development, Ho Chi Minh City University of Technology, Forestry and Forest Products Research Institute in Japan, Nagoya University, Tohoku University, and the Earth Remote Sensing Data Analysis Center (ERSDAC).

Following greetings from VAST Vice President Nguyen Khoa Son, AIST Vice President Naomasa Nakajima, Dr. Nguyen Cong Thanh, Deputy Minister of the Vietnam Ministry of Natural Resources and Environment, and representatives from the Coordinating Committee for Geoscience Programs in East and Southeast Asia (CCOP), various discussions were held. Topics included making use of geological data in earth observation and environment with an eye toward expansion to Southeast Asia with remote sensing via satellite, disaster prevention technologies, resource exploration, biomass distribution, environmental protection, and CO_2 flux. The topics of the future coordination between geosciences and IT, as well as cooperation between Japan and Vietnam were also brought up.

AIST President Yoshikawa Visits the Chinese Academy of Sciences and Hosts Joint Symposium on Innovation

In May 2004, AIST concluded a comprehensive agreement of research cooperation with the Chinese Academy of Sciences (CAS). Then CAS President Lu Yongxiang visited Japan. In November 2005, AIST, NEDO and CAS held a general conference in Beijing and a workshop on biomass and other renewable energy sources in Guangzhou as specific actions taken in light of the agreement. These events highlighted the environmental and energy fields, areas that will benefit from mutually complementary coordination between Japan and China. This time AIST President Yoshikawa visited CAS and exchanged views with President Lu, holding a symposium on innovation ("chuangxin" in Chinese) with the academy on March 24th, 2006. President Yoshikawa's visit came directly following the National People's Congress in March 2006, matching the timing of the beginning of China's 11th 5-Year Plan in 2006, which had been officially approved at the congress.

CAS–AIST Innovation Forum 2006, featuring speeches by President Yoshikawa and CAS President Lu, filled the venue to near capacity with a total of over 300 people, including researchers and administrators from CAS, the Chinese Academy of Social Sciences, Tsinghua University, and Peking University, as well as local Japanese staff from the Japanese Embassy, NEDO, and JETRO. Lively discussion took place after the speeches, including questions from young Chinese researchers on issues such as how international cooperation should be (the outlines for the speeches are given below).

On the same day, President Yoshikawa visited Tsinghua University, thanking its president, Gu Binglin, who is a member of the AIST Advisory Board, for his presence on the board in February. They also exchanged views on such issues as innovation management and future strengthening of ties between AIST and the university. President Gu spoke about the history of Tsinghua University, its output of many key people in the Chinese government –including Chinese President Hu Jintao, its establishment of a medical school and other development of top-level research in China, its emphasis on networking with many US-based and other overseas universities and research organizations, and its reinforcement of coordination with business (including those in the West and Japan, Hong Kong, and Taiwan). President Gu also expressed his expectations for the university's coordination with AIST.

CAS – AIST Innovation Forum 2006

Date: March 24th, 2006

Place: Library of the Chinese Academy of Sciences (Zhongguancun, Beijing)

• Contents of President Yoshikawa's speech

"National Commitment for Innovation in Japan - The Role of AIST"

Topics included: Japanese innovation, promotion of AIST as an innovation hub, AIST's second period research strategy to accommodate the Third Science and Technology Basic Plan, AIST's philosophy on Full Research with case examples, and bringing Full Research to society.

• Contents of CAS President Lu's speech

"A Future-Oriented CAS"

Topics included: The historical role of CAS, reform of the structure of research fields and priority areas, systems for human resources development, reforming structural frameworks for innovation, and international cooperation.

President Yoshikawa giving a speech at the symposium

CAS President Lu (left) and AIST President Yoshikawa

Hannover Messe 2006

Hannover Messe 2006 was held at Hannover Exhibition Grounds in Germany over a five-day period from April 24th to 28th. This event gathers a wide range of industries in the world's largest exclusively industrial-related exhibition. The exhibition is held each April in Hannover, Germany, with this past event being the 60th in its history. This year the event featured 5,175 companies from 66 countries, logging over 155,000 visitors. This particular year coincided with 2005/2006 Deutschland in Japan, a campaign to introduce a broad range of German culture, economy, and science to Japan, and at the urging of concerned parties in both countries the event saw over 800 Japanese attendees, with AIST making a more influential showing than ever before.

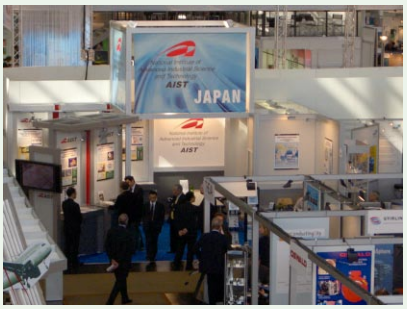
Among the ten fields exhibited at Hannover Messe 2006, AIST was featured in the R&D and Technology field, displaying a total of seven technological exhibitions: thermoelectric generation modules, ceramic films (Claist), ionic liquids, aerosol deposition (AD) methods, targeting drug delivery systems (DDS), ultrasonic echo probes, and Si/SiC filters. Due in part to our display of devices and prototypes this year our booth was visited by a great many business, university, and research institution representatives.

In addition to the AIST booth, this year the institute also hosted a joint seminar with Fraunhofer Gesellschaft of Germany on the third day of the event (April 26th). Four AIST researchers participated as speakers introducing AIST technologies, and we had the opportunity to exchange views with Fraunhofer Gesellschaft.

The Japan-Germany Economic Forum, jointly hosted by the Japan External Trade Organization (JETRO) and the state of Niedersachsen, was held on the fourth day of the event April 27th. AIST Senior Vice-President Kodama delivered a keynote speech on Full Research to a many members of Japanese and German political and business circles in attendance.

In addition to all these programs, we were privileged to receive Japanese Ambassador to Germany Toshiyuki Takano at our booth on the last day of the Messe (April 28th), with whom we held enthusiastic discussions about the seven technologies we had on display.

AIST's latest showing at the Hannover Messe not only helped promote future technology transfer, but was also an event of great significance in the creation of high-level human networks and international cooperation.



Research Coordinator of the Geological Survey of Japan, AIST, Takes Over as CCOP Steering Committee Chairperson

The CCOP (Coordinating Committee for Geoscience Programs in East and Southeast Asia) is an international organization acting over 11 member nations to promote geoscience information and technology as well as mediate, coordinate, and carry out various projects. Japan's representative in the CCOP is the Minister of the Japanese Embassy in Thailand, with the resident sub-representative being the counselor at the embassy, and the permanent sub-representative being Research Coordinator of the AIST Geological Survey of Japan.

In the 46th Steering Committee Meeting held in Beijing in September 2005, Japan was nominated as the next presidency holder. AIST considers the dissemination of geoscience research and achievements in Asia as an important mission. Upon Japan's acceptance of its accession to the presidency, AIST held deliberations with the Ministry of Foreign Affairs on the appointment of a chairperson. Dr. Eikichi Tsukuda, Research Coordinator of AIST was selected to take over as chairperson, with a term of office lasting two years commencing on January 1st, 2006.

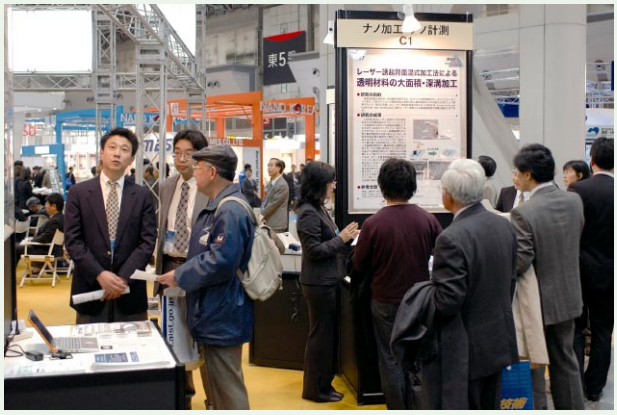
The first meeting presided over by Dr. Tsukuda was the 47th Steering Committee Meeting held in Krabi, Thailand from March 29th through 31st, 2006. With participation of representatives from the member countries of Japan, Cambodia, China, Indonesia, South Korea, Malaysia, the Philippines, and Thailand, as well as members of the CCOP secretariat and the USA acting as advisory group chair, intense discussion transpired on matters such as to what degree the CCOP could contribute to society using geosciences as well as the related structures, activities, future plans, and financial policies to bring those contributions to fruition. The next Steering Committee Meeting will be held in Daejeon, South Korea on November 4th and 5th, 2006.

Participating in " nano tech 2006 "

Nanotechnologies are manufacturing technologies that dramatically improve the functionality of substances and materials and form the foundation of many technological fields, including information technology & electronics, energy & environment, and biotechnology. Nanotechnology and materials are expected to be chosen as priority areas in Japan's Third Science and Technology Basic Plan as was the case in the Second Term Plan. International interest in nanotechnology is also extremely high, with many countries actively promoting development toward industrialization of the new technologies.

The "nano tech 2006 International Nanotechnology Exhibition and Conference" (organized by the nano tech executive committee with backing by AIST and others) focuses on nanotechnology as a central theme and was held at Tokyo Big Sight over a three-day period from February 21st through 23rd, 2006. This exhibition and technology conferences have been held every year since 2002, increasing in scale each year as societal and especially industrial expectations of nanotechnology continue to grow. It has become the world's largest venue at which to talk business on cutting-edge nanotechnologies and products.

Along with the exhibition many technology conferences are held, at which the latest research and development results are displayed and announced. The event is also a place for many concerned parties with interests in nanotechnology to promote industry through coordinated research and business partnerships, a place where business opportunities are created for venture enterprises, as well as a place for making international connections for promoting information exchange, cooperation, and other interaction. With 45,868 attendees over the three-day period (figure disclosed by the organizer), this year's "nano tech 2006" was a bigger success than ever before.



At "nano tech 2006", AIST introduced selected research achievements from research units in various fields, with emphasis on those belonging to the nanotechnology, materials, and manufacturing fields. AIST introduced these achievements not only at the AIST booth, but also at the NEDO booth and the joint symposium. The following is a brief report:

The AIST Booth

This year, as before, AIST set up an exhibition booth and displayed selected research achievements pioneered by the institute. The institute announced and exhibited a total of 23 research achievements in the public eye: three related to energy, one related to nano-optics, eight related to nano-engineering and nano-measurement, two related to nano-biotechnology, and nine related to nanomaterials. This year AIST paid particular attention to creating business opportunities, making efforts to display the new technologies in more prototyped form than it had in past.

In addition to the presentation of these achievements, the large number of participants involved in venture enterprises at this year's event prompted AIST to introduce its venture development strategy as well. The institute also gave a taste of its research achievements concerning the relationship between nanotechnology and society, which is likely to become a major issue for the nanotechnology industry in the near future.

Besides exhibiting research achievements, the AIST booth also had a screen with about 20 seats for viewing small technology presentations, which were held in the booth in the afternoons throughout the course of the event. We conducted seven or eight presentations a day for a total of 23 in all, but certain presentations ran out of time as we fielded enthusiastic questions from visitors. On one hand it was unfortunate that the presentations were cut short, but on the other hand we were very happy with the high level of interest in our research.

The AIST booth received a very large number of visitors, partly owing to its placement very near to the nano tech 2006 Main Theater. It seems that these visitors were surely able to

see AIST's achievements up to now in technology research as well as our future directions. Having also received many enquiries from people in business relating to setting up joint research projects and obtaining intellectual property rights, we felt this was a very worthwhile exhibition.

While we prepared 5,000 pamphlets (with English translations) summarizing the achievements exhibited at our booth, these ran out on the afternoon of the final day of the event. We offer our apologies for inconveniencing those who visited thereafter. Please feel free to view the pamphlet, available in both English and Japanese, at the web address below.

http://www.aist.go.jp/aist_j/event/ev2006/ev20060221/list.html

The NEDO Booth

AIST actively participates in and works to advance technology-related governmental projects promoted by government ministries like the Ministry of Economy, Trade and Industry (METI) and the Ministry of Education, Culture, Sports, Science and Technology. Achievements coming out of projects promoted by METI were introduced at the NEDO booth, and in addition to these, AIST also presented 17 other research achievements in areas such as nanotechnology research, measurement standards research, and advanced manufacturing research.

An overview of AIST-related research achievements presented at the NEDO booth may be viewed at the web address below.

http://www.aist.go.jp/aist_j/event/ev2006/ev20060221/nedo.html

nano week 2006

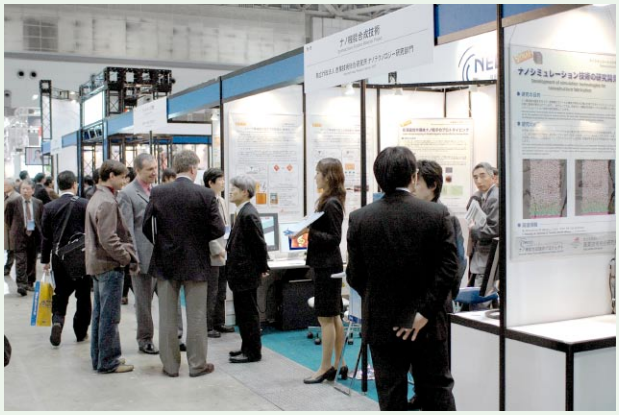
The period from February 20th to 23rd has been billed as "nano week 2006," and during this period 16 symposiums, workshops, and other events were held concurrently with the International Nanotechnology Exhibition at the same venue, in Tokyo Big Sight.

On the 21st, the Workshop on International Nanotechnologies Standardization was hosted by AIST and the Japanese National Nanotechnology Standardization Committee. With the aim of promoting industrialization and appropriate risk assessment of nanotechnology, the workshop saw introductions from those involved in nanotech standardization on trends in international standardization as well as nanotech standardization efforts in Japan and other Asian countries amid expectations of rapid expansion of standards creation efforts. Future orientation on nanotech standards was also set forth.

On the 22nd, AIST hosted the AIST Symposium: Japan Nanotech Venture Leadership Forum 2006. The symposium featured presentations and panel discussions by frontline analysts who are involved in nanotech ventures from various angles and who act as leaders in venture development. The idea came out of the recognition that industrialization of nanotechnology would require value systems and behavior models on a different dimension to any that have been used in the past, and was to illuminate the possibilities and potential issues in nanotech ventures in Japan.

In the Business Plan Contest that was part of Nanotechnology Business Forum 2006, held on the 23rd, a paper by Dr. Norio Murase, (at the time on loan as Director for Research and Development Survey, METI, from Photonics Research Institute, AIST) entitled "Fabrication and Sale of Biomarkers and Luminous Elements that Make Use of Glass-Coated Semiconductor Nanoparticles" received the special Entrepreneur Award.

http://www.ics-inc.co.jp/nanotech/nanoweek2006/nanoweek_06bj.html



Assistant Minister of Science, Education and Sports of Croatia Visits AIST

Dr. Radovan Fuchs, Assistant Minister for International Cooperation, Ministry of Science, Education and Sports of the Republic of Croatia, paid a visit to AIST Tsukuba, on March 9th. After exchanging greeting with Senior Vice-President Kodama and associates, Dr. Fuchs was given a general explanation of AIST. The explanation went well over the scheduled time, with Dr. Fuchs asking questions about AIST's various innovative changes in its transition from the Agency of Industrial Science and Technology to its current status as an independent administrative institution and the process of going from its first period to its second. In particular, Dr. Fuchs related reforms in his own country's research organizations with such issues of the Full Research concept, the autonomy of research units, proper research management, and the granting of incentives to researchers, which led to a frank exchange of opinions.

Dr. Fuchs's subsequent tour of the "Science Square Tsukuba" was rushed yet also exceeded the scheduled time as he and the staff discussed the positioning of the various research and development and Full Research, among other topics.

The Assistant Minister left AIST with these words: "I was deeply impressed with AIST's reforms and research achievements. My country's researchers have great potential in mathematics and other fundamental research, and I would be delighted if they were given a chance to come here & jointly conduct research with your staff."

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