

W National Institute of Advanced Industrial Science and Technology

New Year's Greetings

Hiroyuki Yoshikawa, President

The passage of time

We greet another new year. A great deal of water has flowed under the bridge in 2001. What will the new year bring in? We all hope that the year 2002 will be full of joy and happiness. We may become rather sentimental when entering the new year. The turn of the year makes you realize that time marches on and that the passage of time is an absolute that is beyond human control. I think this may be the reason.

On the other hand, we also feel that we are too busy catching up with too many novelties as well as a rapid change of the conventional environment. There may be no time to be emotional. Looking at the situation outside the country, the current international order lies not necessarily in security. Hardships lie ahead in solving many issues such as poverty, environmental deterioration and so on, due to conflicting interests amongst the nations. In Japan, there seems to be no sign of recovery from a prolonged economic stagnation and values unique to our country are crumbling. Worse still, we lack in vision for the future.

We chase matters that rapidly change with time. And this does not leave any room for quibbling. Things are changing rapidly as the time goes by.

Why don't we just choose one thing and go with the flow along the stream of time? Then the world may be quieter so that we have time to look around and greet other people.

However, things are developing in a complex way. Such calm state may be superficial.

Vehicle called the New Field

I define a researcher as a man who remains motionless in the current. He is standing still and observing the rapid change of complex systems of the world on the firm ground of his own co-ordinates.

For instance, in this "Information Era", it is not only scientific knowledge but also diversified information that fills society. The advanced technology of communication and data processing makes it easier to access any information. We lead a convenient life taking advantage of the benefit of information technology. If this is the norm to you, you are on the vehicle called "Information". Then, anything associated with information technology including the rapid progress of the field are accepted as the natural order of things. However, if you are not on the vehicle and look at the present situation of information technology based on your values, can you really be sure that this is the only possible way for the field to progress?

In fact, we have come through the age in which the size of a computing machine had increased as performance improved. Our dream of developing a computer comparable to human intelligence was seen as an extension. We did try to realize the dream. However, computer development did not actually follow the path of "upsizing". Instead, it needed a turn toward downsizing and networking, which has become the new buzzword in this field.

Although the technologies, which did not take this turn, have also achieved much progress and have been put into practice, we should note that this very turn broadened the unexpected horizon of computers, enabling penetration of the technology into society. I assume the people who aimed at the miniaturization of a computer device despite the trend toward "jumbo-sizing" of computers are those who did not get on the vehicle of the time.

In the field of technology and perhaps that of basic science, those who have made great achievements in directing the path of progress and pioneered new scientific frontiers often stand still at their co-ordinates and let go of the vehicles flowing with the mainstream. The notable examples in the 20th century include the physicist who opened the field of molecular biology and researcher in material processing who finally laid the foundation of nanotechnology by pursuing the concept of controlling individual atomic elements. These people do not follow after the development of the traditional scientific disciplines they have acquired. Alternatively, they set up their coordinations of values with a different point of view. Ultimately, they opened a new field of science; established a new track of development of the existing technologies.

Common Language

Having said that, I must admit that the researchers also take a vehicle. A unique idea or a good academic essay is not enough to gain recognition as an innovation of science/ technology. The novel field must create the current of the time. A number of researchers are to start researches in this area. And at least such studies must earn recognition of the academia. If it is a new technology, it has to be utilized in the society. It is not easy for the researchers to wait and see until such conditions are met. Their efforts can be ignored or even defamed. They have to develop endurance and persistence to struggle with adversity.

In this context, the researchers belonging to a research unit of AIST may or may not be on a vehicle. Some are seeking after a subject, which has not been recognized as a scientific/technical field. They continue with such publicly unrecognized studies. On the other hand, some researchers get social credit for their research achievements. Furthermore, there are those who embark on an enterprise by setting up an industry-academia joint research project, establishing their own venture businesses and so on.

And these researchers who belong to one unit of AIST need a commonality in their goals and standards i.e. a common language amongst the researchers. A group of such researchers can be called "the coherent researchers". In this coherent group, some are the explorers of the field of basic research, some are the designers who integrate the results to accomplish a set goal and some break through various obstacles and ultimately translate such inventions into practical application. The roles are not fixed. The researchers may play a double role. They may exchange their parts. In any case, they will press on toward the same goal in co-operation.

I hope the AIST will provide the best opportunity for all the member researchers, on vehicles or not, to exert themselves. Wishing that our unity would bring solutions to the challenges of this world in the new year, 2002.

AIST International Symposium

Nanotechnology

okyo International

November 13-14, 2001 kchange Center in Tokyo Academic Park

It was intended to target the industrial application of nanotechnology as well as basic and pioneering R & D. This symposium was composed of three sessions; the opening session, plenary session, and theme session.

Opening Session

Japan's Science and Technology Basic Plan and AIST's Research and Development Strategy



Hiroyuki Yoshikawa (AIST)

In the opening session, Dr. Hiroyuki Yoshikawa, President of AIST, presented "Japan's Science and Technology Basic Plan and AIST's Research and Development Strategy," where nanotechnology, one of four national prioritizations of Science & Technology, was mentioned as follows:

"AIST is one of the most experienced institutes for R & D on nanotechnology in Japan. AIST, in cooperation with Angstrom Technology Partnership, has been conducting a ten-year project called 'Atom Technology Project' since 1992, when it was Agency of Industrial Science and Technology (former AIST).

Our priorities are to make nano-science as a new academic discipline and proceed using the best approach of each specialist in various research areas in AIST. With the collaboration of academia, private sector and government, we expect to be contributable for maximum results to establish nano-industry."

Plenary Session |

Five researchers leading nanotechnology gave presentations. In this session, Dr. Kazunobu Tanaka, one of AIST trustees and the project leader of "Atom technology project," introduced the fruitage of the project.

Atom technology project is pioneering research for nanotechnology in the world, and carried out by "Joint Research Center for Atom Technology (JRCAT)", unique concentrated joint research system, comprising industrial, governmental and academic sectors. In this presentation, two topics, "silicon nanotechnology" and "spin electronics", were picked up as recent R & D activities.

Atom technology project will terminate in March 2002. Some plantlets of human resources and research outputs developed in JRCAT have been transferred to AIST and will grow up to forest of new science and technology.

Program •

Carbon Nanotubes, Bismuth Nanowires, and Low-Dimensional Thermoelectric Materials Mildred S. Dresselhaus ; Massachusetts Institute of Technology	
Industrial Polymer Research ; W Play?	/hat Role could Nanotechnology Joseph Put ; DSM Research
Atom Technology Project	Kazunobu Tanaka ; AIST
R&D on Nanomaterial in National Institute for Materials Science Kazuhiro Yoshihara ; National Institute for Materials Science	
Application of Nanotechnology to Electronics Junichi Sone : NEC, Fundamental Research Laboratory	







Dr.K.Tanaka





Dr.K.Yoshihara

Dr.J.Sone



Theme Session

Nanotechnology is integrated and comprehensive technological area, covering a wide range of fields such as information technology, machine, life science and materials.

In this session, we focused on four themes corresponding to sequential stages of nanotechnology (to produce, to observe, to functionalize, and to utilize nanostructure) to have more intensive discussions regardless of one's research field. Fourteen researchers at home and abroad participated in the sessions as lecturers, including the AIST researchers who presented his achievement in the four themes.

Besides these, we have more research works on nanotechnology, which are introduced briefly in AIST homepage (http://www.aist.go.jp/index_en.html).



We will hold an international symposium annually, focusing on hot topics of scientific and technological progress.



Be a "good trouper" to society

Masayuki Kamimoto Deputy Director of Planning Headquarters

Upon launching the AIST, one of the major emphasis was placed on "the tie with society". As the new year starts, I would like to look back on the 9 month course of our activities focusing on several key topics: International co-operation, Industry-academia-government collaboration, Technological information, Dissemination of research achievement, and Public relations.

Common goal: Contribution to society's sustainable development

The first and foremost goal of AIST is the contribution to society's sustainable development by means of research and development activities in the field of industrial technology. R&D of earthfriendly industrial technologies is vital to restoration of the green planet, which has been long neglected since the era of the Industrial Revolution.



Hosting International Symposiums

The International Affairs Department is in charge of international co-operative activities. In 2001, several international symposiums were held including "AIST Waterfront Symposium" commemorating the opening of AIST Tokyo Waterfront and "AIST International Symposium on Nanotechnology -Potential Industrial Technology in 21 Century-". In addition to the AIST symposiums, a number of researchers of AIST attended various bilateral international meetings such as the 3rd Japan-Korea Science and Technology Forum, Workshop on Italy-Japan Interdisciplinary Materials Science and Technology, Japan-Australia joint Symposium on Nanotechnology.

Conclusion of the co-operation agreements with NIST, CNRS and other research institutes

Following the conclusion of the co-operation agreement with NIST (US National Institute of Standard and Technology) upon cer-

tification issue of a product's compliance with standards, we effected General Agreement on Comprehensive Research Co-operation with CNRS (Centre National de la Recherche



Scientifique). We are aiming at establishing a close partnership with major research institutes of different countries.

AIST Mr. Sakuraba, Senior Researcher, appointed as an Antarctic wintering team member

Many AIST researchers went abroad to attend various international meetings in 2001 although the number shrank slightly since the September 2001 terrorist attacks in the USA. Eighteen researchers were sent to various international organizations including UNIDO (United Nations Industrial Development Organization) and

International Bureau of Weights and Measures. Toshiaki Sakuraba, senior researcher set off to the South Pole as a member of the 43rd Antarctic Wintering Team on the November 28.



Entrepreneurial Boom

Seven venture businesses have been set up based on the research results at AIST. We encourage the new businesses in terms of technology transfer, patent acquisition to break new ground for the researchers who have an interest in creating new business fields. The department of industry-academia-government collaboration is assigned to the supporting activities in this area.

Firstly, TLO, "AIST Innovations" was established to facilitate technology transfer. This is the first authorized organizations under the Technology Licensing Organization Law. The mission of AIST Innovations is to transfer the technologies based on the AIST's intellectual properties. Coordinators of Collaboration Department and Collaboration Centers are providing assistance to the technical guidance, co-operative researches and so on together with Manufacturing Technical Support Office established at each Collaboration Center.



The 3rd Japan-Korea joint Forum on Science and Technology



More Funded Research Projects and Increase in Number of visiting professors of Affiliated Postgraduate Institutes

The number of research projects funded by the organizations outside AIST has increased from 5 in 2000 to 41 at the point of September 2001. As for partnerships with academia, the number of the visiting professors at the related postgraduate schools are 198 (as of September 2001), a significant increase compared to that in 2000.



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Expansions of research exchanges in Tsukuba city

The research institutes affiliated to the former Agency of Industrial Science and Technology had kept various research partnerships with research organizations which are in a close tie with them, including Central Research Institute of Electric Power Industry, Communications Research Laboratory and so on. The AIST initiated a new research workshop together with National Institute for Materials Science which was also re-established as one of the independent administrative institutions in April 2001. In August, the AIST co-hosted a seminar on industrial development with Tsukuba city, entitled "Local Industry in Tsukuba city and Partnership with the AIST".

AIST• Technology Information Seminar

It is essential to set a course to realize the industrial technology which contributes to our society's sustainable development. AIST set up the Technology Information Department and Planning Headquarters to enforce the strategic planning of the organization. Technology Information Department is in charge of organizing "AIST Technology Information Seminar" which is intended to offer latest information of R&D projects, systems etc. of national institutes which may be useful in promotion of R&D activities.



Geological Museum Opens on Holidays

The AIST research centres throughout Japan were opened to public for the first time since the AIST was established. As the open house day in Tsukuba coincided with a public holiday, over 3000 people visited the institute to see the achievements of the research activities. In addition, Information Technology Research Institute and Intelligent System Institute had a separate open house respectively. Geological Museum which boasts a large collection of valuable specimens has been open on holidays since June. High school students from Miyake Island were invited to a lecture upon volcanoes by a researcher who specializes in the research of volcanoes on the island.

AIST AIST Series to be published in March 2002

The AIST series of educational books upon industrial technology are to be published by Maruzen Co., Ltd. from March 2002. Information & Publication Division takes charge of public relations / publication including AIST hosting lectures, press conferences and so on.

As AIST is a consolidated organization of 15 research institutes, the general understanding of our activities is not necessarily sufficient. Now we have set up a new research organization. We aim at introducing a number of influential research achievements which may have an impact in the field of industrial technology based on our elaborated strategy. It is a first step forward for us to become a solid support for society. AIST RESEARCH HOT LINE

Abstracts (August - November 2001)

The abstracts of the recent research information appeared on the Vol.1 No.7-No.10 of " AIST today " are introduced, classified by research area. For inquiry about the full article, please contact the author directly.

Life Science & Technology

Production of Therapeutic Glycoprotein in Yeast for Lysosomal Disease

Yasunori CHIBA Institute of Molecular and Cell Biology e-mail:y-chiba@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 10

In order to produce the more economic therapeutics for replacement therapy of Fabry disease, we introduced human α -galactosidase $(\alpha$ -GalA) gene into S. cerevisiae mutant that disrupted the outer chains, and expressed. The recombinant α -GalA had both neutral and also acidic oligosaccharides. Because mannose-6phosphate (Man-6-P) residue is needed to incorporate the α -GalA into the lysosome, we trimmed down the oligosaccharides of the enzyme by a new bacterial α -mannosidase. The α -GalA treated with the α -mannosidase had Man-6-P residues on non-reduced end of oligosaccharide chains. Incorporated α-GalA was targeted to the lysosome and degraded ceramide trihexoside in the fibroblast of the Fabry cells.



Strategy for the production of α -GalA with Man-6-P residues from yeast

Development of "Frightened/Startled" (Near-Miss Accident) Sensor

We developed a technique to detect occurrences of "frightened/startled" situation, in which a worker feels the strain, fright or surprise at dangerous working conditions, such as construction site. The situation is detected as characteristic changes of workers physiological states, measured continuously by wearable sensors. To estimate the tendency of physiological responses in "frightened/startled" situation, we performed experiments using virtual reality system.



Virtual Reality System

Masaki TANIGUCHI Human Stress Signal Research Center e-mail: m-taniguchi@aist.go.jp AIST Today;

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Research and Development of Artificial Muscles

The purpose of our research is to develop soft and wet-actuator as a candidate of artificial muscle. In 1991, ion-exchange membranes plated with noble metal have been found to bend in response to low voltage by our group. The response is quick and durable. The mechanism for electro-responsive bending motion has been analyzed. Based on the mechanism, the performance of the bending has been largely improved. In order to prepare multi-direction bending actuator, a tubular io-exchange membrane was used. The surface of the tube was repeatedly chemically plated with gold and was cut four grooves by laser beam to form electrodes, which become to bend all the desired direction. By using the tubular actuator, a moving catheter for brain surgery is developing.



Photograph of the bending motion of the perfluorocarboxylic acid membrane / Au composite in response to 2V voltage in distilled water, and the response model in which the bending motion is attributed to the water flow associated with the ionic current.

Kinji ASAKA

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OR in the 21st Century; MRI and Surgical Assist Robot

Kiyoyuki CHINZEI Institute for Human Science and Biomedical Engineering e-mail:k.chinzei@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 16

Surgical assist robot systems that cooperatively work with magnetic resonance imaging (MRI) are under development for clinical applications. We proved that robot motion and imaging could be done simultaneously without any adverse effects. This work is a collaboration with Brigham and Women's Hospital (Boston, MA). We also cooperate with Tokyo Women's Medical University on their 'intelligent' operating theatre that equips an open MRI in the operating room (OR). An MR compatible surgical endoscope was developed and the prototype model demonstrated excellent low noise images compared to ordinary endoscopes. By integrating robotics and endoscopic technology into intraoperative MRI, we aim to illustrate the ORs in the 21st century.



MR compatible surgical robot attached to an intraoperative MR scanner. It was the world's first fully MR compatible surgical robot.

Thermal Conversion of Biomass Resources by New Microwave Method

Masakatsu MIURA

Research Institute of Biological Resources e-mail:m.miura@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 20 A new pyrolysis method, namely microwave pyrolysis, for biomass resources has been developed by National Institute of Advanced Industrial Science and Technology (AIST) Hokkaido. The materials were found to be pyrolyzed within a short irradiation time and transformed into useful materials such as anhydro-sugars (levoglucosan), pyrolysis liquid and charcoal.



Outline thermochemical biomass conversion technology

A Facile Detection of Verotoxins by Quartz Crystal Microbalance

An artificial glycolipid was designed and applied to quartz crystal microbalance technique for the detection of verotoxins produced by highly toxic bacteria: Escherichia coli O-157. We have successfully detected both types of verotoxins (type-1 and 2) within 30 - 40 min in crude sample solutions and to determine the binding constants, associate and dissociate constants.



The QCM system for the detection of verotoxins produced by pathogenic bacteria: O-157.

Hirotaka UZAWA Nanoarchitectonics Research Center e-mail: h.uzawa@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 8

Naoki MORITA

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Gene Clusters Responsible for DHA and EPA Biosynthesis

- New Genetic Resources Found in Marine Bacteria -

Some marine bacteria have the ability to synthesize DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid). The fatty acid biosyn-

thetic (fab) gene cluster encoding a part of fatty acid synthetase (FAS) and the gene cluster responsible for biosynthesis of polyunsaturated fatty acid (PUFA) such as DHA or EPA have been cloned from DHA -producing and EPA-producing bacteria. The isolated gene clusters responsible for DHA and EPA biosynthesis from marine bacteria would be significant genetic resources for considering the origin of DHA and EPA in living organisms and for utilization



AIST Today; EPA-producing bacterium Vol. 1, No. 9 (2001) 9 (Shewanella sp. strain IK-1) plsX fabH fabD fabG acpP fabF (h) Gene cluster encoding FAS Gene cluster responsible for EPA biosynthesis (fab gene cluster) (The genes shown by the black arrow are indispensable for EPA biosynthesis) DHA-producing bacterium (Moritella marina strain MP-1) - plsX fabD fabG acpP fabF Gene cluster encoding FAS Gene cluster responsible for DHA biosynthesis (fab gene cluster) (The genes shown by the black arrow are indispensable for DHA biosynthesis) One arrow indicates one gene and the direction of transcription Bacterium which cannot synthesize PUFA plsX; PlsX protein, fabH; β-ketoacyl-ACP synthase III, fabD; malonyl-CoA, ACP (Escherichia coli) transacylase, fabG; β-ketoacy-l ACP reductase, acpP; acyl carrier protein (ACP), plsX fabH fabD fabG acpP fabF fabF; β-ketoacyl-ACP synthase II. The gene cluster responsible for EPA or DHA biosynthesis: The area shown by the color indicates the homologous region of fatty Gene cluster encoding FAS acid synthetase. Yellow: FabF, Pink: FabD, Blue: AcpP, Green: FabG, Orange: β -(fab gene cluster) hydroxydecanoyl-ACP dehydratase.

Gene clusters responsible for fatty acid biosynthesis found in bacteria. The bacterium that can synthesize DHA or EPA has the two gene clusters responsible for fatty acid biosynthesis. One is the gene cluster involved in DHA or EPA biosynthesis, and the other is the *fab* gene cluster encoding a part of FAS found in bacteria that cannot synthesize any PUFAs. Therefore PUFA-producing bacteria would have two fatty acid biosynthetic systems, the synthesis of fatty acids with up to 16- or 18-carbon atoms and the synthesis of DHA or EPA.

Computational Biology Research Center

Makiko SUWA Computational Biology Research Center e-mail: m-suwa@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 8 We developed an automated system for discovering GPCR sequences in the whole human genome using algorithms of gene finding, sequence search, motif and domain assignment, transmembrane helix prediction and the gene quality refinement. This system is intended to detect sequences of multiple exon or remote homologues that can not be detected by using conventional sequence search alone. With careful assessment of the analyzing components, we obtained candidate gene datasets of various confidence levels, among which we found at least 888 and at most 2,298 candidate GPCR genes from human genome.



Topographical Analysis of a Membrane Protein by a Photoactivatable Probe

Yoshikatsu OGAWA Institute of Molecular and Cell Biology e-mail:ogawa.y@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 10 Studies of the topographical arrangement of proteins are important for understanding the structural and functional properties of biological membranes. We have studied the topography of a membrane protein, glycophorin A (GPA), by a bola-amphiphilic photoactivatable probe in collaboration with Dr. Nakatani in Université Louis Pasteur, CNRS. The photosensitive group of this probe is localized at the center of lipid bilayers including physiological amount of cholesterol and cross-links regioselectively with neighboring atoms by UV irradiation. We have revealed with this probe that valine 80 and methionine-81 of GPA exist in the middle of the bilayer membrane. The present method is expected to open a new way to the development of nano-biotechnology.



Chemical structure of photoactivatable probe.

Separation of Leukemic Cells by Lectin

-Utility of Technique by Column and Magnetic Bead-

For the development of the system for a new leukemia cell separation, we are attempting to make two kinds of separation materials, which can identify a leukemia cell and a normal lymphocyte.

We clarified that the column, which covalently united the jequirity seed lectin with the CNBr-activatred-Sepharose 6MB, was able to separate a leukemia cell and a normal lymphocyte.

We also made clear that the magnetic beads, which were covalently united the plant seed lectin, were clearly able to separate a leukemia cell and a normal lymphocyte.

Aiming at the practical use of these

separation materials, we plan to accumulate the data using the lymphocyte, which separates from those who contract disease leukemia, in addition to another cultured cells derived from leukemia in the future.



Preparation of Lectin Affinity Column

Information and Communication Technology

Improvement of Channel Mobility for 4H-SiC MOSFET using Hydrogen Annealing

Significant improvement of inversion channel mobility for 4H-SiC metal-oxidesemiconductor field-effect transistor (MOSFET) on (11 20) face using high temperature hydrogen post oxidation annealing (H₂ POA) has been achieved. The channel mobility of 110 cm²/Vs for the MOSFET with the H₂ POA is much higher than that without the H₂ POA. This result is attributed to reducing interface trap density at SiO₂/4H-SiC interface. To our knowledge, this value is the highest for lateral n-channel 4H-SiC MOSFETs with a thermal gate oxide reported until now.



Typical I_D -V_D characteristics of 4H-SiC MOSFET, with gate oxide prepared by wet oxidation followed by H₂ POA, fabricated on the (1120) face.

Hideki OOBA

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Carrier-phase Locking among Subharmonic Pulses

Yohei KOBAYASHI Photonics Research Institute e-mail: y.kobayashi@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 17

We have developed a subharmonic generator based on a femtosecond parametric oscillator (OPO) in order to realize a sub-femtosecond pulse train generation by Fourier synthesis. We have developed a method to measure the optical-phase relation among the pump, signal and the idler pulses in OPO. The carrier-envelope phase of the signal and the idler pulses were locked to that of the pump pulse by an electronic feedback system every six pulses. This technique will open the way to generate an attosecond pulse train and an optical synthesizer.



Experimental setup for carrier-phase-lock among the pump, signal, and idler pulses. PM; photomultiplier tube, LPF; low-pass filter, BPF; band-pass filter, PZT; piezo-electric transducer, OC; output coupler, PD; photodiode.

Supercomputer ensamble enabled by Grid technology over Tsukuba WAN

Satoshi SEKIGUCHI Information Technology Research Institute e-mail: s.sekiguchi@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 19

The Information Technology Research Institute at the National Institute of Advanced Industrial Science and Technology (AIST) has used an improved version of GLOBUS software, developed through joint research with NEC Corporation, and achieved the first ever operation of a supercomputer via a high-speed network. The GLOBUS is a highly rated grid middleware originally having developed by USC's Information Science Institute (ISI) and Argonne National Laboratory. In the research, the supercomputer at the Telecommunications Advancement Organization of Japan Tsukuba Gigabit Laboratory and an AIST computer were connected via the Tsukuba WAN high-speed network. The Gigabit Laboratory supercomputer was then successfully operated by the AIST computer.



Tsukuba WAN AIST NODE (located at TACC)

Tele-assistant System for Visually Impaired People

Tele-assistant system for visually impaired people has been developed. The system comprises a wearable video camera (including microphone and earpiece) that can be worn inconspicuously by the visually impaired. It enables information on surroundings, as well as requests from the visually impaired user, to be transmitted to remotely located support helper via a PHS. It enables the visually impaired user to receive audio help whenever and wherever it is needed.



Visually impaired user with an earphone-shaped video camera.

Iwao SEKITA Advanced Semiconductor Research Center e-mail: i-sekita@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 8

Speech Completion

- On-demand Completion Assistance Using Filled Pause for Speech Input Interface -

We propose a novel speech interface function, called speech completion, which helps a user enter a word or phrase by completing (filling in the rest of) a phrase fragment uttered by the user. We enable a user to invoke the speechcompletion function intentionally and effortlessly by building an interface that displays completion candidates when a filled pause is uttered (a vowel is lengthened) during a phrase. In our experience with a system that includes a filled-pause detector and a speech recognizer capable of listing completion candidates, the effectiveness of speech completion was confirmed. Speech completion can be applied to various speech applications and is expected to become indispensable in speech interfaces.

Research Institute e-mail:m.goto@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 9



Screen snapshots of speech completion for a phrase whose last part is uncertain.

Masataka GOTO Information Technology

Data Compression wit Security Capability

Hidenori

SAKANASHI Advanced Semiconductor Research Center e-mail: h.sakanashi@aist.go.jp AIST Today; Vol. 1. No. 10 (2001) 10 Dispersed Reference Method for print image data compression, which is expected to be included in an ISO standard, has been improved to incorporate the security functions(cryptograph and water mark). The data compression will commercialized in the on-demand distribution of measured maps used for public enterprise constructions and so on.





Femtosecond Laser System based on Genetic Algorithum

Tetsuya HIGUCHI*,

Taro ITATANI Advanced Semiconductor Research Center e-mail: t-higuchi@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 11 We have proposed and demonstrated femtosecond lasers with an auto-aligned system based on genetic algorithm. The system includes compact sensors and actuators with position accuracy less than 1 mm. These components are inevitable for achieving fast alignment to reduce error signals in the feed-back system. The system has succeeded to optimize the cavity alignment for femtosecond lasers in 30 minutes, which is more than 100 times faster than manual alignment.





Thermal Lithography for 100 nm Fabrication Pattern

We have succeeded in patterning narrow lines and dots with 100 nm dimensions in a photoresist film by a "Thermal Lithography" technique using a semiconductor laser with 635 nm wavelength. We utilized a focused laser spot to produce a spatially confined hot spot in a phase change recording layer on a polycarbonate optical disk substrate. This hot spot induced a thermal cross-linking reaction in an adjacent photoresist film. By optimizing the sample rotation speed and the laser power, we were able to reduce the spot size where the thermal cross-linking reaction in the photoresist occurred and patterned extremely fine structures.



Masashi KUWAHARA Laboratory for Advanced Optical Technology e-mail: kuwacokuwahara@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 13

Quantum-size Effects in Magnetic Tunnel Junctions

We prepared the magnetic tunnel junctions which have single-crystal ultrathin Fe electrode, and measured the tunnel spectra and magnetoresistance. As a result, the MTJs with ultrathin Fe electrode showed the oscillatory behavior in the positive bias field, and the magnetoresistance showed the oscillations also. These results indicate the existence of the quantum-well states in the ultrathin Fe electrodes. This is the first observation of the quantum-well effect in the bias dependence of TMR. This new effect provides us with a possibility to create new spintronics devices.



Oscillatory components of the differential conductance of MTJs with ultrathin Fe (100) electrode for various thickness Fe (100) electrodes;Cr(100)(30nm)/ Fe(100)(nML)/AI-O(1.7nm)/FeCo(20nm).

Taro NAGAHAMA

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Environmental Science & Technology

Advanced Durable Materials for Severe Environment

- New Type metal Matrix Composite Materials -

Michiru SAKAMOTO Institute for Structure and Engineering Materials e-mail: michiru-sakamoto@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 12 The material innovation is one of the key-technologies to operate the thermal power plant and the advanced waste treatment plant at higher temperatures for increasing the thermal efficiency, and for decreasing the environmental injurant such as dioxins.

We have found that the new type composite materials (Fe-Cr-Ni-MX-C) have excellent durability at high temperatures in comparison with conventional alloys. Now the demonstration experiment of the materials developed in our laboratory is carried out in a commercial coal burning power plant and in an advanced waste treatment plant.



Specific wear rates of the newly developed alloy and the composite reinforced with alumina short fibers

Development of a Method to Determine Polymer Density

Kazutoshi TANABE

Research Institute for Computational Sciences email: k-tanabe@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 13

A rapid and intact method has been developed for predicting polyethylene density by near-infrared spectroscopy combined with neural network analysis. Near-infrared spectra in the 1.1-2.2 µm wavelength region have been measured for pellets or powders of twenty-three kinds of polyethylene with different densities $(0.898-0.962 \text{ g/cm}^3)$. The spectra were trained for back-propagation neural network after normalized and second-derivative treatments to predict polyethylene density. Although only a small number of spectral data were used for training, a leave-one-out test of neural network analysis has demonstrated good result, with a root mean square error of prediction of 0.0003. It is found that near-infrared spectroscopy combined with neural network analysis is useful for recycling plastics efficiently and accurately.



Near-infrared spectra of high density (red) and low density (green) polyethylene samples

Energy Science & Technology

Development of New Organic Dye Sensitized Solar Cells

The new efficient organic dye sensitized solar cell was developed. In order to harvest light widely in a visible region and to obtain an efficient electron injection form dy e to oxide semiconductor photoelectrode, newly designed coumarin derivatives were synthesized. It was found that a newly designed coumarin derivative dye shown in Fig.1 works as an efficient photosensitizer for TiO2 nanocrystalline solar cells. The highest solar light to electricity conversion efficiency such as 6.0% with 14.0 mA/cm2 (Jsc), 0.60V (Voc) and fill factor of 0.71 was obtained under standard AM1.5 irradiation (100mW/cm2).



Hironori ARAKAWA Photoreaction Control Research Center e-mail: h.arakawa@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 11

Incident photon to current conversion efficiency (IPCE) of newly designed coumarine derivative dyeand Ru dye(N3 dye)-sensitized solar cells

Hysteresis Losses of Superconducting Tape Conductors in Nearly Parallel Magnetic Fields

In order to elucidate the hysteresis loss behavior of the next-generation superconducting wire, we investigated magnetization hysteresis loops of micron-thick YBa₂Cu₃O₇ films deposited on Ni-based alloy tapes in magnetic fields applied nearly parallel to the film surface. We measured the magnetization perpendicular to the film, and confirmed that it is the dominant contributor to the hysteresis loss (area of the hysteresis loops), unless the field is oriented very close to the film surface. We found that its effect on the hysteresis loss is more significant at higher temperatures (T \geq 77 K) at which the critical current density becomes lower.



Angular dependence of magnetization of a YBCO tape, measured every 1° near the H II film at T = 60 K. Solid lines denote the measured magnetization data and markers denote the contribution of the perpendicular magnetization. The hysteresis loss increased remarkably with angle at 77 K (inset).

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Development of Dislocation Constraint Technique for SiC Sublimation Growth

Tomohisa KATO Power Electronics Research Center e-mail: t-kato@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 17

Dislocation constraint in the growth of SiC crystal by the sublimation method (modified Lely method) was studied. In SiC single crystal growth, the dislocations and defects generally propagate from the seed crystal surface. However, when the etch back on the seed crystal surface in the sublimation process was performed prior to growth, defects and dislocations propagation in the interface between the seed crystal and the grown crystal were suppressed reasonably. The switchover from the etch back to the growth could be performed without changing heating condition during the initial process. We noticed that the density of the hollow defects called as micropipes in the grown crystal were decreased to 1/10 compared to that of the seed crystal used. We consider the etch back process of the seed crystal is an effective method for constraining the defects in the SiC crystal growth.



Optical micrograph showing several micropipes in the interface region between the seed crystal and the grown crystal. Some micropipes terminated just below the boundary are seen.

Hydrogen Gas Sensors for Fuel Cell-powered Vehicles

Norimitsu MURAYAMA Synergy Materials Research Center e-mail: n-murayama@aist.go.jp AIST Today; Vol. 1. No. 10 (2001) 16

A novel hydrogen gas sensor, consisting of a film of thermoelectric material coated with platinum catalyst on half of its top surface, has been developed. When this sensor was exposed to air mixed with hydrogen gas, the catalytic reaction resulted in temperature increment of the Pt-coated surface, and then thermoelectric voltage appeared across the hot and cold region of the oxide film. At room temperature, the platinum catalyst reacts only with hydrogen gas, so the sensor has high selectivity to hydrogen gas. Moreover, the sensor is energy efficient, as it operates at room temperature, and is suitable for integration into silicon substrates.



Schematic of the thermoelectric hydrogen sensor. Lower image is the temperature distribution of the sensor device surface monitored by the infraredcamera.

Nanotechnology and Materials Science & Technology

Development of High Thermal Conductivity Silicon Nitride

Silicon nitride (Si_3N_4) is a serious candidate for high performance ceramic substrates because of its excellent mechanical properties and high intrinsic thermal conductivity. Recently it has been revealed that lattice oxygen content in Si₃N₄ crystal is a crucial factor governing the thermal conductivity of silicon nitride ceramic as shown in the figure. Based on this result, silicon nitride with high thermal conductivity of about 150W/ (m•K) has been developed at the Synergy Materials Research Center. When used magnesium silicon nitride (MgSiN₂) as a part of sintering aids, extremely low level of lattice oxygen content can be achieved, which leads to the high thermal conductivity of 150W/(m•K). The value achieved in Si₃N₄ is equivalent to that of aluminum nitride (AlN) which has being used as heat-sinks for IC packages. Silicon nitride has about two times higher in mechanical strength and toughness than AlN, that might be expected a wide applications as a material having both superior mechanical properties and high-thermal conductivity.



Effect of lattice oxygen content on thermal resistivity and thermal conductivity for silicon nitrides fabricated by various methods.

Kiyoshi HIRAO Synergy Material Research Center e-mail: k-hirao@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 11

Development of Co-Ni-Al-based Ferromagnetic Shape Memory Alloys

A ferromagnetic shape memory alloys has been developed in Ni-Co-Al system. The alloys exhibit a paramagnetic/ferromagnetic transition besides a thermoelastic martesitic transformation from the B2 to $L1_0$ structure. The Curie and the martensitic start temperatures in the $L1_0$ phase can be individually controlled in a range from -150 to 150°C. Some of the specimens were found to undergo the martensitic transformation from the ferromagnetic B2 to the ferromagnetic $L1_0$, accompanied by a shape memory effect. The workability of the new alloys is quite better than other ferromagnetic shape memory alloys.



Demonstration of shape memory effect of Co-Ni-Al-based ferromagnetic shape memory alloy. (a) Alloy was deformed at 10°C and (b) heated over A, temperature

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Nano-composite from Natural Polysaccharide : Development of Mechano-chemical Polymer Alloy

Takashi ENDO Institute for Marine Resources and Environment e-mail: t-endo@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 19 Natural polysaccharide such as cellulose and chitin/chitosan are useful biomass polymers. However, their applications have been limited. To make extensive use of polysaccharide as new industrial materials, we have studied mechano-chemical preparation of a novel composite under a dry- and solid-state. A new type of polysaccharide composite was prepared by ball-milling a polysaccharide with synthetic polymer. The thermal behavior and molecular motion of synthetic polymer in the composite are distinct from those of original one. These results suggest strong interactions between a polysaccharides and synthetic polymer and thus compatibilization of the polysaccharides and synthetic polymer.



Molded product of the composite with 80wt% cellulose and 20wt% synthetic polymer

Synthesis of High Performance Magnetostrictive Materials in Microgravity and Magnetic Field

Hideki MINAGAWA

Microgravity Materials Laboratory e-mail: h-minagawa@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 9

Unidirectional solidification experiments of TbFe₂ alloy using a static magnetic field in microgravity were performed in the 10 seconds drop tower experiments. When the magnetic field strength was increased from 0 T to 4.5×10^{-10} ² T during unidirectional solidification in microgravity, a [111] crystallographic alignment of the grains grew dominantly, and the maximum magnetostriction constant increased from 1000 ppm to 4000 ppm. For unidirectional solidification in normal gravity, randomly aligned columnar structures were formed and the maximum magnetostriction constant showed at 2000 ppm. The structure and the value of maximum magnetostriction of the products solidified in normal gravity did not observed any change in spite of loading of magnetic field.



Microstructure of unidirectionally solidified TbFe2 in (a) normal gravity and (b) microgravity and magnetic field. (Etched by nital solution.)

Nano-scale Alignment of Metal Nano Particles within Block Copolymer Films Induced by Reduction of Metal Complex Vapor

We have developed a dry process to achieve nano-scale alignment of metal particles with narrow size distribution within block copolymer films. Vapor of palladium(II) acetylacetonato (Pd(II)AA) is exposed to PS-*b*-PMMA block copolymer film in a nitrogen atmosphere at 180°C for certain time up to 2hr. Pd(II)AA is decomposed and reduced to metallic state to be converted into nano particles. Due to the difference of reducing power between PS and PMMA, the metal particles are selectively assembled within the PS domains, and the periodical array of nano-sized particles is achieved.



Cross sectional view by TEM showing the nano-scale alignment of Pd particles in blockcopolymer films having lamellar (left) and sphere (right) microdomain structures.

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Molecular scale Flattening of Organic Optic Materials by AFM Nano-polishing Method

Organic electro-optic material surface tends to be covered with a degenerated rough layer, which may cause light scattering or unfavorable light transmission. We demonstrate a novel method to remove the layer and flatten the (001) and (001) parallel surfaces of 4dimethylamino-N-methyl-4-stilbazolium tosylate (DAST) crystal on a molecular scale by applying the optimum force on the tip of atomic force microscope (AFM). When the force is kept around 10 nN, the DAST molecules can be removed layer by layer, as shown in the figure. This method has provided a large flat terrace of 300,000 nm², and the molecular-scale flatness of this area was confirmed by their molecular image of DAST crystal.



Step-terrace structure of organic single crystal by nano-polishing layer by layer

Hiroshi NANJO Institute for Structural and Engineering Materials e-mail: hi-nanjo@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 14

Development of High Sensitive Pressure Sensor using Dielectric Thin Films

Morito AKIYAMA Institute for Structural and Engineering Materials e-mail: m.akiyama@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 15 We have developed new high sensitive pressure sensors using dielectric thin films for fuel cells or appliances such as an air-conditioner, utilizing new technology. Especially, we investigated preparation conditions of highly oriented dielectric thin films such as aluminum nitride (AlN), zinc oxide (ZnO) and LiNbO3 by using design of experiments (ANOVA) and theoretical analysis in order to improve the sensitivity and the reliability of the sensors. The new type sensors consist of electrodes and piezoelectric thin films, and their structures are very simple.



Application of new pressure sensors

Oxidation of Propene by Molecular Oxygen over Ti-modified Silicalite Catalysts

Kazuhisa MURATA Research Institute for Green Technology email: kazu-murata@aist.go.jp AIST Today; Vol. 1, No. 9 (2001) 14 Ti-modified zeolite with a high silica content (Si/Al ratio=1900, HSZ(1900)) was found to catalyze the oxidation of propene by molecular oxygen at 573K to produce oxygenates, in particular, to propene oxide at a conversion of 20% with a selectivity of 26%. The catalytic performances are affected by Si/Al ratio of the HSZ supports as well as the presence of titanium cation or TiO₂. It is expected that fine controls of the cooperation between moderate acid properties of HSZ(1900) and titanium cation or TiO₂ may enhance the catalytic activity and selectivity for propene oxide formation.



Comparison of novel and conventional processes.

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Vol. 1, No. 9 (2001) 11

Polymer/Clay Nanocomposites

High modulus poly(ethylene terephthalate) (PET)/layered silicate nanocomposites were prepared by employing a novel reactive compatibilizer, 10-[3,5-bis(methoxycarbonyl) phenoxy]decyltriphenylphosphonium bromide, which was designed to link the layered silicate to the PET matrix through covalent and ionic bonds. The compatibilizer could be intercalated into the interlayer of the expandable fluorine mica. The PET/layered silicate nanocomposites were obtained through the polymerization of bis (2-hydroxyethyl) terephthalate in the presence of the intercalation compounds. The composites were characterized by X-ray diffraction, polarization microscopy, and flexural tests. The obtained nanocomposites showed a 70% higher flexural modulus than a raw PET at maximum.



Illustration of PET/Layered Silicate Nanocomposite

A Potential Ability of Flame Spraying

- The Successful Synthesis of Spherical Filler-sized Aluminum Nitride Powder -

The new rapid synthetic-route was investigated as a method for manufacturing powders of the aluminum nitride (AlN) & oxynitride (γ -AlON etc.) via flame spraying. Our targeted size of the AlN filler used to manufacture via direct-nitridation to date. However, the resultant had an angular shape mostly, which was against the high-density packing. The spherical filler-sized AlN was prepared via flame spraying. The synthetic mechanism was studied from the viewpoint of chemical reactions in the Al-O-N ternary systems. The current understanding of this new synthesis affirms its potential for providing a highyield processing rather than the previous gas-phase and solid-state reactions.



Scanning electron microphotograph of a synthesized AIN powder via flame pyrolysis.

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Laser Manipulation for Micro Particles and Droplets

Yoshio TANAKA Institute for Marine Resources and Environment e-mail: yo-tanaka@aist.go.jp AIST Today; Vol. 1, No. 10 (2001) 12

One of the non-contact micro manipulating techniques is optical tweezers, but this technique can not apply to metallic particles. We have developed a new non-contact micro manipulating method for particles with low refractive index or high reflectance such as metals. The method forms optical cages by synchronous scanning laser beams, and arrange the particles in the cages. This idea enlarges the ability of the conventional optical tweezers. We are aiming the sophisticated non-contact 3D micro manipulating technique for micro total analysis systems (μ -TAS).



Basic principle of arrangement method for metallic particles

Mechanical Engineering and Manufacturing Technology

Self-Reconfigurable Modular Robot

Haruhisa KUROKAWA Intelligent System Institute e-mail: kurokawa-h@aist.go.jp AIST Today; Vol. 1, No. 7 (2001) 15 A modular robot has been developed jointly with Tokyo Institute of Technology. It is composed of nine modules and is the first in the world to be able to reconfigure its shape without outside help. It is planned to install distributed intelligence in each module, which enables the modular robot to execute selfreconfiguration and self-repair. Possible applications are operation and exploration in unknown environments where adaptation is required to the surroundings, as well as continuous operation under extreme environments where autonomous repair is necessary.



A nine module robot reconfigures from a crowler robot to a four legged walking robot

Silicone Rubber Microvalve

Micro-TAS (Micro Total Analysis Systems) are miniaturized chemical analysis instruments, and have great promise for high throughput and portability. To realize highly integrated micro-TAS, microvalves are essential for handling of samples and reagents. We have developed a three-way microvalve system composed of three independent one-way valve units. Intervals between the valve units are smaller than 780 micrometers. All the parts were made of inexpensive silicone rubber, and rapidly fabricated with molding and spin-coating.



Optical micrograph of the microvalve

Kazuo HOSOKAWA Institute for Mechanical Systems Engineering e-mail: hosokawa.k@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 16

Standards and Measurement Technology

Development of a High-Accuracy Laser Tracking Interferometer System Used for Coordinate Measurement

A laser tracking interferometer system (LTS), which is capable of measuring 3-D coordinate, has been developed at AIST. The LTS makes use of the principle of laser trilateration i.e. the position of the target is determined by three lengths from three base points. Recently, we developed a compact and accurate laser tracker. The key component of the tracker is a hemispherical mirror; a hemisphere and a small sphere are connected with a rod. The plane surface of the hemisphere is mirror coated and the laser beam is reflected on the mirror. By moving the small sphere by an X-Y stage, the angle of the mirror can be changed; hence the direction of the laser beam is also changed. The hemisphere sits on three small balls, so that the center position of the hemisphere does not shift. In experiments, the mechanical error of the laser tracker is smaller than 0.5 μ m. The measurement accuracy of the LTS was assessed by comparing it to a high precision coordinate measuring machine (CMM). The accuracy of our LTS was about $2 \sim 3 \mu m$, which is much better than other commercial LTSs.

We will apply this system for calibrating CMMs (large scale or low cost) and evaluating dynamic characteristics of industrial robots.



Tracking system using a hemispherical mirror

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Development of Standard Vortex Shedding Flowmeter

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The design of a vortex shedding flowmeter has been optimized for its standardization. The optimization was achieved by evaluating the linearity of the flowmeters with various bluff bodies. The effect of the installation conditions of the flowmeter on the measurement error and the sensitivity of each flowmeter dimension to the flowmeter output of the flowmeter were also evaluated. A new design method based on theses experimental results has been published in Japan Industrial Standard Z 8766-2001, which will improve the measurement uncertainty significantly and also reduce the manufacturing cost.



Photo of standardized vortex shedding flowmeter

Determination of the Avogadro Constant

-development of a new atomic mass standard for replacing the kilogram-

Kenichi FUJII Metrology Institute of Japan e-mail: fujii.kenichi@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 12

In the field of basic standards, an accurate value of the Avogadro constant is of primary importance because fundamental physical constants, such as the Planck constant, Boltzman constant, elementary charge, and Josephson constant, are so closely related to the Avogadro constant that its accurate value is indispensable for finding a consistent set of fundamental physical constants used in physics and chemistry. In the field of metrology, kilogram is the only SI base unit still defined by a material artifact. For replacing the present definition of the kilogram with an atomic mass standard, a more accurate value of the Avogadro constant is needed. A determination of the Avogadro constant by the x-ray crystal density (XRCD) method has therefore been conducted at the National Metrology Institute of Japan (NMIJ) of AIST, where the lattice constant, density, and molar mass of a silicon crystal are measured in conformity with the definition of the SI units. The photograph shows an optical interferometer used to measure the diameter of a singlecrystal silicon sphere. This interferometer determines the volume of the 1 kg silicon sphere

with an uncertainty of 0.1 ppm. From the known value of the lattice constant, it determines the number of atoms in this sphere. These data then lead to an accurate value of the mass of a single Si atom. A research group led by K. FUJII is developing a more accurate density standard for further reduction in the uncertainty of the Avogadro constant. This research is now organized as an international cooperation program with the PTB (Germany), IMGC (Italy), IRMM (EU), CSIRO (Australia), NIST (USA), and BIPM (France) for replacing the kilogram.



Optical interferometer to measure the diameter of a 1 kg silicon sphere with an uncertainty of 1 nm.

Formation of Large Cationized Molecules in Gas Phase

Recently new ionization techniques for large molecules have been introduced into the field of mass spectrometry of solid samples. However, the mechanisms of ionization are not adequately understood for the establishment of quantitative analysis. In the investigation of cationization processes of fundamental nonionic surfactants in matrix-assisted laser desorption/ionization (MALDI) mass spectrometry, we have found that cationization efficiency of poly(ethylene glycol) oligomers depends on the kind of metal ions while poly(propylene glycol) oligomers show little dependence. This fact indicates that the chemical structure of chain is essential in the cationization process of linear molecules.



Mass spectrum of poly(ethylene glycol). Molecules of various size cationized by alkali ions (Li^+,Na^+,K^+) are observed. The symbol n denotes the number of repeating units (-CH₂CH₂O-)

Hisashi TOGASHI

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Geological Survey and Geoscience

An Application of Information Technology on Marine Geosciences

The history of the earth is recorded in the marine sediments. In order to decode the history of the earth, the research results from various directions have been expressed as maps. For example, that are geological maps, resources maps, sedimentlogical maps etc. Geological Survey of Japan published a database of the marine seismic profiles around Japan in 2001, that applied the latest GIS (geographic information system) technology and the Internet technology (Fig). It is important for future information technology on marine geosciences that results of an investigation are simply added to the database by users. It is sure that the new earth view will come from the multi-dimension information analyses. We are trying to find the best way to understand the earth's history.



An example window shows an index map of seismic profiles around Japanese Islands. Each seismic profile can be searched and perused easily. Moreover, it is linked with the marine geological map, interpretation sections, etc.

Shin'ichi

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Determination of Hydraulic Properties of Low-Permeability Geologic Materials

Ming ZHANG

Research Center for Deep Geological Environments e-mail: m.zhang@aist.go.jp AIST Today; Vol. 1, No. 8 (2001) 18 Low-permeability geologic materials are now being scrutinized in increasing detail because of their importance in retarding the transport of hazardous materials that are disposed or stored underground. To determine the permeability both rapidly and accurately in the laboratory, rigorous theoretical analytical method is used to evaluate three laboratory techniques: constant head, constant flow rate, and transient-pulse permeability tests. In addition, a new versatile laboratory system has also been developed. The efficiency and accuracy of these analyses and this new laboratory system are demonstrated through a series of experimental results derived from various types of rock.



Effects of confining pressure and anisotropy on the permeability of Inada Granite.

Geological Research for Utilization of Low-Temperature Geothermal Resources

Tomoyuki OHTANI Institute for Geo-Resources and Environment e-mail: tomo-ohtani@aist.go.jp http://staff.aist.go.jp/ tomo-ohtani/geoheat/ AIST Today; Vol. 1, No. 8 (2001) 19

For the low-temperature geothermal utilization such as geothermal heat pumps, understanding of geological and hydrological structures is as important as reduction of the drilling cost in Japan. Underground heat energy is unevenly distributed due to groundwater flow. The objective of our research is to develop a 3D resources assessment technique for low-temperature geothermal utilization. We will develop techniques for analyzing 3D thermal and hydrological structure based on the subsurface temperature distribution, groundwater chemistry, and geology. We will also establish a guideline for utilization of low-temperature geothermal resources based on numerical simulation results. Once the amount of utilizable low-temperature geothermal energy and environmental influence is evaluated through this research, installation of geothermal heat pumps may be promoted in Japan.



Flow of Research and Development

Flow of Research and Development

AIST concludes General Agreement with CNRS

On November 22, 2001, AIST concluded a General Agreement on Comprehensive Research Cooperation with the Centre National de la Recherche Scientifique (CNRS), France. Dr. Geneviève Berger, the President of CNRS, and Dr. Hiroyuki Yoshikawa, the President of AIST, attended the signing ceremony held in Tokyo and signed both Agreements written in French and Japanese.

The CNRS is one of the leading research and administrative organizations in Europe with about 26,000 employees and a Fr.13.8 billion annual budget.

It covers a wide spectrum of research fields such as mathematical physics, nuclear physics, basic engineering, space engineering, human and social sciences, chemistry, and life sciences.

The AIST is planning to develop an Institute Partnership Program with influential research organizations all over the world. Its objectives are continuing research cooperation, mutual exchange of researchers and joint symposiums. We are



currently preparing for the conclusion of general agreements with these organizations. The Agreement with CNRS is the first achievement in our efforts and we hope that this will enhance our partnership in research activities.

VISITOR'S BOOK



Dr.Tony Tan Singapore, Dupty Prime Minister September 9, 2001.





Mr. Young-Hwan Kim South Korean, Minister of Science & Technology November 28, 2001.

Dr.Vuko Domazetovic Yugoslavia, Federal Secretary for Development and Science November 1, 2001.



Mr.Oluf Ulseth Norway, State Secretary of the Norwegian Ministry of Trade and Industry January 17, 2002.





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