Asia Science Letter

Information Bulletin of the Asian Office of Aerospace Research and Development Tokyo, Japan

ASL Volume 31 **May-Jun 01**

The Asia Science Letter is a bi-monthly publication of the Asian Office of Aerospace Research and Development (AOARD), Detachment 2 of the US Air Force Office of Scientific Research (AFOSR), the basic research manager of the Air Force Research Laboratory (AFRL). Its purpose is to inform the Air Force S&T community on the research and development activities in Asia and Pacific Rim countries including India and Australia. The assessments in this periodical are solely those of the authors and do not necessarily reflect official US Government, US Air Force, or AFOSR positions.

Highlights

Asia's science and technology investment continues to be strong in areas of Air force interest. Japan's total FY99 research investment was 16 trillion yen (or about $130 billion) which is 3.24% of Japan's GDP. The 24 trillion-yen 5-year plan for 2001-2005 emphasizes the four areas:

1. Information Technology/Telecommunications
2. Nanotechnology
3. Environment
4. Life Sciences/Biotechnology

In AOARD's March-April Newsletter Professor Feigenbaum discussed "Information Technology in Japan." In 2001 Japan's Basic Law on Information Technology (IT) came into effect and the 2001 budget request included almost a $1 billion investment in IT.

Japan has been investing in Micromachines for over a decade and leads in many aspects of this technology. In the current issue, Dr. Brett Pokines discusses advances in Micro & Nanotechnology in Japan and elsewhere in Asia.

Interest in Environmental research is increasing across Asia. Dr. Mark Goltz, an AFOSR-supported visiting scientist at Ehwa University in Korea, discusses the increased Korean interest in environmental issues.

Japan's increased activity in the area of Biotechnology will be addressed in the next ASL.

A human factors area of AFRL interest in Asia is 3D-display technology. Dr. Darrel Hopper (AFRL/HE) visited the Opto-Electronics & Systems Laboratories of the Industrial Technology Research Institute, Taiwan and gave an invited presentation at the "3D Vision & Display Workshop". Dr. Miyazaki (AOARD) has also contributed an article describing 3D holographic techniques.

Dr. Tae-Woo Park, from the Space & Missile Propulsion Division at Edwards Air Force Base (AFRL/PRST), visited AOARD from 11 March to 2 April 2001. He was part of the AFRL team at the annual meeting between OSD/ATL (Office of Secretary of Defense/Acquisition, Technology & Logistics) and Korea Agency of Defense Development. While in Korea, he also visited several academic institutions in Korea including Seoul National University, Korea Advanced Institute of Science & Technology, and the Korea Aerospace Research Institute. Several of these visits are described in articles in this newsletter.

Terence Lyons, Director

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Feature

Micro- & Nano-Technology in Japan

Economic pressure to realize successful "killer" commercial microsystem applications and the completion of the Ministry of International Trade and Industry's (MITI) (MITI was reorganized on 6 Jan, 01 and renamed "Ministry of Economy, Trade and Industry (METI)") ten year Micromachine Project has created a crossroad in Japanese microsystem and micro-electro-mechanical system (MEMS) research. Recently, nano-technology and nano-electro-mechanical systems (NEMS) have become catch phrases in Japan as a result of U.S.A. national nano-technology initiatives.

The Japanese government implemented the first large-scale and long-term government commitment to the development of microsystem technology. The term "micromachine" was coined to express the plan to capitalize on Japan's history of miniaturizing systems and to define a unique Japanese technology. The focus of the project was the development of scaled systems fabricated initially using conventional machining methods. The MITI Project established the early characteristics and some current misconceptions of microsystem research in Japan: conventional (e.g. milling and lathe processes) fabrication of functional systems (e.g. pipe inspection and tabletop micro-factory) incorporating scaled macroscopic devices (e.g. CCD cameras and milling machines). Other early characteristics included less reliance on analytical modeling and design resulting in an emphasis on an iterative "fabricate & test" development process - particularly in Si lithographic based research. Pockets of excellence spanning the gamut of micro-technology research have long existed in Japan. These pockets have expanded through the implementation of less restrictive funding rules, government encouragement to form industry & academic partnerships, and the broadening of the research scope to parallel research within the U.S.A and Europe. World class laboratories focussing on diverse topics such as modular bio/fluidic systems at Nagoya University, biomimetic research and nano-technology at the University of Tokyo, Si based lithography at Tohoku University, and high-aspect-micro-structures at Ristumeikan University have existed for several years.

Industrial efforts have largely been linked to the MITI project. This link has restricted industrial research to emerging areas such as Si lithographic based MEMS, and optical, bio & fluidic systems. Although the MITI project has resulted in some remarkable technology advances (particularly in system integration) commercial success has eluded the national project. Currently the Micromachine Center, which administered the MITI Project, is developing a new long-term development strategy that may place greater emphasis on nano-technology and bio & fluidic systems. Industrial micro-technology developers are now seeking new partnerships and attempting to leverage their basic research investments through the development of commercial applications. Commercialization is evident through the focus of several domestic conferences and symposiums and the discussion of foundry service development to facilitate venture company formation.

While a micromachine approach is still evident in Japan and the U.S.A. is currently ahead in MEMS system modeling software, Japanese research today is broad-based with new emphasis on commercialization. Japan also has the advantage of established microelectronics distribution methods and existing MEMS product platforms such as the personal telephone. (Pokines)

Application of Innovative Contaminated Groundwater Remediation Technologies in Korea

Research by graduate students at the Air Force Institute of Technology (AFIT) has documented that the Korean government and public are rapidly changing their attitudes with regard to the value they place on environmental quality. The citizens of Korea view groundwater contamination and remediation as important. It is remediation which has played such a significant role in the American public's perception of DoD as a steward of public lands.

Not unexpectedly, there are many similarities between the groundwater contamination problems in the CONUS and in Korea. Chlorinated solvents such as tetrachloroethylene (PCE) and trichloroethylene (TCE) are prevalent contaminants. These chlorinated contaminants migrate via groundwater to human and environmental receptors. Unfortunately, currently available strategies for managing chlorinated contaminants in the subsurface are plagued by various shortcomings. The drawbacks of conventional technologies have driven research to find innovative technologies to manage chlorinated contaminants in-situ (that is, without having to remove contaminants from the ground). These innovative in-situ technologies have the potential of remediating contaminated groundwater more cheaply, safely, and effectively than conventional technologies.

Investigators at the AFIT are currently involved in evaluating innovative groundwater remediation technologies at USAF installations in the U.S. The research is focused on using models to develop and apply in-situ remediation technologies to manage chlorinated solvent groundwater contamination. Based on the discussion above, it is apparent that U.S. installations in Korea, where groundwater contamination problems are currently being managed using inefficient and costly conventional technologies, need access to the latest technologies to manage their subsurface contamination problems. Application of these new technologies to deal with contamination under the hydrogeological conditions encountered on the Korean peninsula requires use of contaminant fate and transport modeling.

As part of the Window on Asia program an AFIT investigator, Dr Mark Goltz, who has been involved with the research, development, and deployment of innovative groundwater remediation technologies at U.S. installations, will team with scientists from the recently established Korean National Subsurface Environmental Research Laboratory, in order to investigate how innovative in-situ technologies that have been evaluated in CONUS demonstrations may be modeled and applied to manage the groundwater contamination problems encountered at our installations in Korea. (Goltz) (Lyons)

Aerospace

Site Visit: Department of Applied Mathematics, Korea Advanced Institute of Science & Technology (KAIST) (Professor Hong Oh Kim, Department Chair), Taejon, Korea, 28 March 2001. The department, with 6 permanent and 5 visiting faculty members, focuses on three disciplinary areas: Applied Analysis, Scientific Computations and Mathematical Mechanics, and Applied Probability and Statistics. The research activities in these disciplines encompass such application areas as: image and signal processing, artificial intelligence, voice recognition, artificial vision, pattern recognition, algorithms for computational fluid dynamics, electromagnetism, and stochastic optimization. (Park) (Nowack)

Conference: 21st Asian Conference on Remote Sensing (ACRS 2000), Taipei, Taiwan: All substances have the properties of reflection and absorption of electromagnetic radiation and also radiate waves characteristically according to their material properties. With this as the basis of their science, over 400 international researchers and technologists met for the 21st ACRS. The meeting provided comprehensive coverage of this interdisciplinary Earth-observation science -- its applications, sensors, systems, and satellite platforms for ground resolution by remote sensors. Focus was on the collection, analysis, and dissemination of remotely sensed data, and the development of conceptual and numerical models to provide a comprehensive understanding of historical events and future trends of given phenomena. Techniques included those for laser, radar and laser-radar, propagation optics, atmospheric and oceanic sensing, and image analysis including rectification and object extraction. Important topics were space and aerial systems, next-generation satellites, and earth-science applications, especially for the emerging worldwide geospatial information markets. The meeting included a workshop on the use of RADARSAT (microwave satellite data) for disaster management applications. ACRS 2000 was organized by several Taiwan national institutes, including the Center for Space & Remote Sensing Research (see topic on CSRSR in this ASL), and was AOARD-supported. (Maurice)

Site Visit: Center for Space and Remote Sensing Research (CSRSR), National Central University (NCU), Chung-Li, Taiwan, 6-8 December 2000: CSRSR was established in 1984 at NCU and is the only center of its type in Taiwan. CSRSR has developed VHF radar technology and the integration of photogrammetry, atmospheric radiation, and remote-sensing techniques. Two national facilities have been installed -- the NCU Instrument Center for VHF radar and the Satellite Remote Sensing Lab, an earth resource satellite receiving station -- and are continually being upgraded to interface with current and future resource satellites (SPOT, Landsat, ERS, RADARSAT, EROS, & IRSI-C). Though VHF radar continues to serve as the Center's platform for development of new radar techniques, new equipment's such as digitsonde are also being implemented.

CSRSR is committed to space and remote sensing research, service and education. The interdisciplinary staff of about 70, including 15 faculty members, has a range of expertise from radar remote sensing, GPS/GIS, space and plasma physics, atmospheric physics and radiation, to orbital mechanics and photogrammetry. Though a Taiwan national center the majority of its funding comes from grants and contracts. With its reception coverage area of about 3,000-km radius, CSRSR expects to play an active role internationally in remote sensing, participating in campaigns for global environment monitoring and sharing its archives. http://www.csrsr.ncu.edu.tw/(Maurice)

Conference: 7th GNSS Workshop, Seoul National University, Seoul, Korea, 30 November – 2 December 2000: The 7th GNSS Workshop was an international symposium with discussion covering global navigation satellite system (GNSS) modernization and aerospace applications, geodesy and differential GPS (DGPS), GNSS Interoperability, and Asian wide-area DGPS (WADGPS). Topics involving navigation solutions included networking, acquisition algorithms, data processing, communication signal format, and anti-jam technologies. Implementation of satellite navigation technology by GPS and related systems is the most important technological breakthrough in aviation since radar. Its implementation is especially important in developing countries where ground-based navigation aids are limited or non-existent. Over 300 researchers participated in the Workshop sponsored by the Korean Ministry of Information and Communication, AOARD, and the US Institute of Navigation (ION), the world's leading professional GPS/GNSS society. US representation was heavy

and featured presentations by FAA's Dennis Beres, AFRL/SNAR's Denise Jacobs and Joung C. Ha, and many industrial colleagues. http://gnss.or.kr (Maurice)

Electronics and Physics

Window-on-Science: Drs. K. Sugioka, T. Akane, K. Obata (RIKEN Institute of Physical & Chemical Research, Japan), and Sano (Osaka Univ.), 22-26 January 2001: Laser material processing is a fast-growing field with direct applications to USAF needs. Four laser researchers traveled with Window-on-Science support to the recent LAMON-VI, LASE 2001, SPIE Symposium to chair sessions and present varied topics on laser material processing and laser material interaction physics -- particularly, etching, surface flattening, and growth of thin films. Dr. Sano presented results on a laser-induced forward transfer (LIFT) process to remove and prepare thin-films. In the technique, a target film is vaporized by laser irradiation on the backside of a substrate. Then, by reaction with the expanding gas, the film is reformed on various substrates positioned opposite. Dr. Sano showed that the film is removed – peeled away -- by the recoil force of the evaporation and plasma expansion generated between the film and the substrate. Beyond their conference topics and in direct support of their AOARD R&D project to establish advanced laser processing for GaN microdevice manufacture, Drs. Sugioka and Akane also traveled to Aerospace Corporation (El Segunda, CA). The RIKEN group holds unique technology for the microfabrication and micromachining of hard materials by a novel multi-wavelength excitation process. The hybrid technique, based on VUV-UV laser excitation, is applicable to a range of hard materials such as GaN and fused silica. The group has achieved very sharp and smooth GaN sidewalls. (Related topics are in ASL 26 & 30.) POC: Dr. Henry Helvajian, Aerospace Corporation (Maurice)

Site Visit: Asian Center for Research on Remote Sensing (ACRoRS), Asian Institute of Technology (AIT), Bangkok, Thailand: ACRoRS was established in 1997 and is dedicated to advancing geoinformatics technologies through research in remote sensing, geographic information systems (GIS) and geographic positioning systems (GPS). In response to environmental issues, including the threat of degradation, this mission has become important to researchers, managers, planners and legislators in the Asia-Pacific region in order to monitor and understand the inter-related Earth systems and to sustain social and economic growth. Research activities at ACRoRS actively promote geoinformatics in collaboration with Thai national and international organizations and are focused on:

- the development of methods and their integration in real-world application
- environmental monitoring and natural resource assessment
- NOAA AVHRR data processing techniques and near-time data distribution
- automated mapping from remotely-sensed data
- installation of regional remote sensing research networks

NOAA AVHRR data is particularly important at ACRoRS for study of the earth environment on regional and global scales. The benefit of the data lies in its high temporal frequency, large coverage, and spectral response from visual to thermal electromagnetic spectrums. ACRoRS has been receiving such data since its establishment, all of which is archived and being distributed to the scientific community in near real-time via Internet lines. ACRoRS analyzes the data for various research topics, including land classification and monitoring, disaster mitigation, oceanography, topography, climatology, sea-surface temperature analysis, and day/night analysis of land-use classification.

ACRoRS currently produces 10-day NDVI and SST composites of 2-km resolution, with 4-km resolution 10-day color composites available free of charge in the near future. Geometric and radiometric corrections are performed using PaNDA software under the collaboration with many Japanese universities. The center also participates in international projects such as the world fire web project for forest fire monitoring.

ACRoRS is directed by Dr. Kiyoshi Honda of Japan. Further information on its several joint research projects, consulting services, cooperative and training programs may be found at: http://www.acrors.ait.ac.th; http://www.star.ait.ac.th (Maurice)

Human Systems

Site Visit: Nara Institute of Science and Technology (NAIST), Graduate School of Information Science, Information Technology Center, Nara, Japan (Dr. Yoshio Matsumoto), 21 March 2001. Among the research programs at the School of Information Science is a Program on Vision Based Robotics. Areas of interest include stereo vision for obstacle detection, and studies of gaze control. The use of such modalities as voice and facial expression evaluation to determine operator state are also being evaluated. Diverse research applications are being studied including unmanned helicopters, human-computer interface, driving applications, soccer robots, industrial robots, and wheelchair applications. The use of gaze control as a modality to allow paralyzed individuals to control speed and direction of wheelchair movement was demonstrated. In addition some of the Japan's leading experts on Internet issues and computer system security are part of the NAIST Information Technology Center. (Lyons)

Workshop / Site Visit by AFRL/HE Scientist: 3D Vision and Advanced Displays, Hsinchu, Taiwan, 19-20 March 2001. From 19-23 March 2001, Dr. Hopper AFRL/HE attended the 3D Vision and Advanced Displays Workshop hosted 19-20 March 2001 by the Industry Technology Research Institute in Hsinchu,

Taiwan and visited research facilities in Hsinchu, Taiwan. On 19 March 2001, Dr. Hopper presented an invited two-hour seminar entitled "Five Revolutions in Display Technology: Sharpness, Digital, Resolution, True-3D, Intelligence" at the Workshop.

Dr. Wen Jean Hsueh, Program Director for Imaging Technology at the Industrial Technology Research Institute (ITRI), hosted Dr. Hopper's visit. Other key ITRI personnel included Dr. Li Sheng Shen, Director of Electro-Optics System Division and Dr. Gang-Chuan Ho, Director of the Optical Sciences Division. Dr. Sheng's division is involved in autosteroscopic 3-D research and 3-D laser scanning of human bodies. Dr. Ho's division works with various projection technologies, optics fabrication research, and organic light emitting diode displays (OLED). ITRI employs some 6000 scientists and engineers with about 100 doing research related to displays. ITRI is addressing significant human factors obstacles in the development of 3D Displays.

Professors Han-Ping D. Shieh and Ken Y. Hsu of the National Chiao Tung University (NCTU) provided Dr. Hopper a tour and discussion of liquid crystal on silicon (LCOS) reflective miniature active matrix liquid crystal display (AMLCD) technology and optical storage materials.

A visit to Dr. Fang Lau, Vice President of UNIPAC was made for a discussion of the practicality of meeting avionics cockpit performance requirements using improved, current large area consumer notebook AMLCDs. Dr. Lau designed some of the first avionics AMLCDs, including those that flew in the YF-22 and current F-22A developmental aircraft.

Dr. J.J. Lih, Manager of the New Technology Development Department at Acer Display Technology Inc. has just formed a research group in OLED technology. Acer and UNIPAC announced their agreement to merge into a new company with the symbol of gold, Au, for its name, during Dr. Hopper's visit. The combined company becomes the second largest world manufacturer of large AMLCDs for computers after Samsung of Korea. (Hopper) (Lyons)

Window-on-Science Visit: Richard C. Goris, Ph.D., Yokohama City University School of Medicine, 1-10 March, 2001. Dr. Goris presented a series of lectures on the role of capillary blood flow in regulating afterimage in pit vipers. Lecture sites included the AFOSR Program Review in Philadelphia, as well as Eglin AFB, Florida, The University of of Florida, and AFRL/ML at Wright-Patterson AFB, Ohio. Dr. Goris has studied the array of receptors called terminal nerve masses in the pit-membrane of vipers which produces coded nerve impulses in response to the strength and quality of infrared rays impinging on the receptors. The amount of heating needed to produce a response is infinitesimal, but the impulses continue to be emitted as long as the receptors remain heated above a basal state. Unless quenched, this "afterimage" would blur any new information arriving as a mouse moves in the field of "sight". To combat this phenomenon, the pit organ uses a heat exchange mechanism based on a dense capillary network within the pit membrane. (Lyons)

Window-on-Science Visit: Dr. Soo-Young Lee, Director of the Brain Science Research Center, KAIST, Taejon, Korea; 6 February, 2001. Dr. Lee visited AFRL/HE and AFRL/SN to give a seminar on the interdisciplinary research project by the Korean Braintech Research Program on Artificial Vision and Auditory Systems, including a presentation of recent results of speech enhancement based on independent component analysis, auditory models for robust feature extraction, and a selective attention model for improved recognition in noisy environments. He also described KAIST's 3T fMRI system which will be operational in August for non-invasive measurements of human brain activities. We believe future collaboration will be beneficial to both sides. (Lyons)

Material Science

Contract awarded: "Studies of the interface between nitride semiconductors and a solution," Dr. Kazuhiro Ohkawa, Department of Applied Physics, Science University of Tokyo, Tokyo, Japan, February 2001: Nitride semiconductors are attracting special attention in many applications due to astounding achievements of one of the collaborators on this project, Professor Shuji Nakamura, now of UCSB. While the means for growing high quality GaN heteroepitaxial layers had been successfully established by Dr. Nakamura while in Japan, the chemical characteristics of nitrides remain unclear. How nitrides behave in chemical reactions, in particular, is not well understood. Suitable techniques for wet etching thus remain undeveloped. Because defects in the material (imperfections in crystallinity) create dangling chemical bonds that react chemically, an improved understanding of their role and the interfacial physics involved will be valuable for developing wet-etching techniques. Preferable to dry etching in order to realize atomically flat surfaces, wet etching is fundamental for realizing precisely controlled structures and to subsequently yield efficient devices. Such techniques are lacking due to the same chemically stable feature of nitrides that makes them so attractive and ideally suited for many applications. That is, the stability of nitrides obstructs etching by chemical solution.

This project investigates 1) the growth of GaN and AlInGaN alloys and heterostructures with p- and n-type doping grown by metal organic vapor phase epitaxy (MOVPE) and, additionally, 2) the role of light on nitride-solution reaction rates, an area in which no work has been done to date. In advancing an understanding of surface states and passivation of GaN, surface states can be reduced, in turn cutting the background leakage current and thus allowing increased sensitivity in, e.g., UV photodetectors.

Dr. Ohkawa's expertise starts in MBE II-VI compounds. He invented not only p-type doping by nitrogen plasma source but

also n-type doping for ZnSe-system by using Cl donors. These remain, to date, the only way to realize II-VI blue-green laser diodes. Besides extensive state-of-the-art characterization equipment, Dr. Ohkawa's lab has an unusual capability: both a new NIPPON SENSO MOVPE reactor and the software ability to simulate the complex 2-flow MOVPE process and reactions. These (the MOVPE growth process and the reactions involved) are very geometry dependent. An understanding of the reactor and its boundaries is required in order to optimize the growth conditions and is accomplished by computational fluid dynamics. Using this combination and their ample experience in materials growth and characterization, Dr. Ohkawa and co-investigator Dr. Karasawa (USHIO Inc. R&D Center, formerly of Matsushita and ATR), can perform 1-, 2-, and 3-flow MOVPE with varying concentrations. Together they have achieved high-quality growth of nitrides with and without the use of a low-temperature buffer layer. (See related article in ASL 30.) POC: Dr. Dan Johnstone, AFOSR/NE. (Maurice)

Site Visit: Department of Materials Science & Engineering, Korea Advanced Institute of Science & Technology (KAIST), Taejon, Korea, 28 March 2001. Dr. Tae-Woo Park (AFRL/PRST), Mr. James Fillerup (AFRL/IO), and Lt. Col. Paul Yamaguchi (JUSMAG-K, International Program Manager) visited the Department of Materials Science & Engineering to review the current research activities in the Composite Materials Lab. Professor Soon Hyung Hong described several on going projects in:

- Fabrication Process and Characterization of Composite Materials
- Brazing and Diffusion Bonding of Dissimilar Metals and Alloys

The department's work on "Mechanical Alloying Process and Mechanical Behavior of Oxide Dispersion Strengthened (ODS) Tungsten Heavy Alloys" is of particular interest to AFRL. (Park)

Workshop: Research Facility Joint Symposium 2000, Tokyo, Japan, 28-29 November 2000. The New Energy and Industrial Technology Development Organization (NEDO) established five research facilities within the framework of Research Facility Development Program in 1992. The workshop was run to promote recent results to industry prior to the program's reorganization next year. The results are expected to open new industrial fields.
Reported highlights included:

? **Marine Biotechnology Institute (Dr. Sugi).** Oligosaccharide sulfate based on carrageenan was successfully and efficiently synthesized using marine bacteria. It exhibits prominent effects against the influenza virus.

? **Japan Ultra-high Temperature Materials Research Center (Dr. Tanaka)** A novel Melt Growth Composite (MGC) of Al2O3/YAG was successfully synthesized. The material exhibits excellent heat resistance above 2073 deg-K as well as strong oxidation resistance and high shear strength at 2073 K. A Ceramic Material Composite (CMC) of SiC(fiber)/SiC based on Tyranno registered by Ube Industries was applied to a ceramic gas turbine. It achieved a thermal efficiency of over 42% with a turbine inlet temperature of 1350 deg-C.

? **Ion Engineering Center (Mr. Sasabe)** A photocatalyst thin film of TiO2 was fabricated. The film showed distinguishing sensitivity to visible light and exhibited prominent decomposition characteristics with NO, water and stearic acid.

? **Applied Laser Engineering Research Institute (Dr. Fukazu)** Formation of complex coating films of Fe, Mo and cast iron were made possible by high energy pulse laser decomposition (HPLD). Promising sliding test results were obtained, a total sliding length 240,000 mm for 98N load. Welding technology for high performance magnesium alloys was developed with CO2 and YAG lasers.

? **Japan Space Utilization Promotion Center, and Japan Microgravity Center (Mr. Sumigame)** A single crystal silicon ball with 5.5 mm diameter was grown by an electro-magnetic levitation (EML) method. The specific liquid flow pattern under microgravity was fully analyzed and applied to material processing.

Professor Sawaoka (President of Daido University) chaired a panel discussion on Material research strategy in the 21st century. Emphasis was on research for ceramics, metals, superconducting materials and chemical materials. (Miyazaki)

Micro Systems

Conference: 2001 National Convention of the Institute of Electrical Engineers of Japan, Nagoya, Japan, 21-23 March 2001. Over 2000 participants attended the convention from academic and industrial organizations across Japan. The Special speech "Venture Industry and Changes of University in Korea, Technology Strategy" by Prof. Wook-Hyun Kwon of Seoul University highlighted changes in Korean commercial development. The International Monetary Fund crisis that occurred between 1997-1998 resulted in social and economic change that has motivated Korean universities and government agencies to promote venture business as a means of reinvigorating the economy. Venture business government support was quite limited before 1985 when legislation to promote small business was enacted. In 1996 this legislation was significantly strengthened and the KOSDAQ market started. Universities and government-funded institutes (e.g. Seoul National University, Han Yang University, Korean Advanced Institute of Science and Technology) have become important elements in venture business development. University professors and new graduates as well as the university infrastructure comprise the backbone of many venture formations. Incentives to professors include a three-year leave of absence and facilities support. The impact of the venture business promotion is the apparent shift in new graduate attitudes. Instead of only considering employment with large companies, venture company are now considered an option. Yearly venture company starts number about 12,000 and the current total is about 43,000 according to Dr. Kwon.

A symposium "Micromachine Technology and its Future" addressed current micromachine topics including fabrication process methods, the Ministry of International Trade and Industry's (MITI) micromachine project, current industrial work, specific device case studies such as a micro-encoder, and the success story of the microtechnology based digital-light-projection system. The symposium chairman was Dr. Kazuo Sato of Nagoya University. Dr. Hiroyuki Fujita of the University of Tokyo provided an overview of the origins of micromachine research and indicated that Transducers'87 held in Japan was an important event to focus micromachine research in Japan. Dr. Fujita discussed his work developing a three-dimensional tunneling probe array. In addition, he defined micro-optical-electro-mechanical systems (MOEMS), bio-microsystems and nano-technology as key current and future focus areas. Dr. Kazuhiro Homma of the MITI Micromachine Center summarized the 10 year micromachine project that concluded in 2001. He indicated the Micromachine Center was currently primarily engaged in planning future projects. Dr. Kazumasa Yanagisawa from Olympus, a participant in the Micromachine project, presented an integrated control & shape memory alloy actuator system, demonstrating the state-of-the-art in system development vs. component development. Dr. Renshi Sawada from NTT presented the result of NTT's development of a monolithically integrated micro-encoder. The system contains a laser diode based integrated micro-doppler velocity measurement system. A representative from Texas Instruments Dr. Toshiyuki Kaeriyama chronicled the development of the digital-light-projection system. Development began in 1977 and a commercial imaging projection product was realized in 1996. The device is designed to have an operation life of 115,000 hours and a total of 500,000 devices have been sold. The Texas Instrument system was presented as a micro-technology commercial success story. (Pokines)

Conference: The International Society for Optical Engineering (SPIE), Smart Structures and Materials, 8th International Symposium held jointly with Nondestructive Evaluation (NDE) for Health Monitoring and Diagnostics, Newport Beach, U.S.A., 4-8 March 2001. Researchers from Asia presented 21% of the conference papers and poster sessions at the Smart Structures and Materials Conference with Japanese researchers presenting the highest number of papers from Asia followed by Korea, China/Hong Kong and Singapore. The smart structures and micro-electro-mechanical systems (MEMS) research areas have several focus areas in common such as actuator/sensor development, and active materials development. MEMS papers from Asia covered subjects such as wireless transmission methods, particle assembly methods, and biomimetic devices for object avoidance based on insect vision. A Plenary Presentation by Dr. Norio Shinya of the National Research Institute for Metals focused on "The State-of-the-Art of Intelligent Materials Research in Japan". Dr. Shinya's presentation covered nano-particle assembly of microstructures or powder particle assembly, a research area in Japan since 1994, and structural materials that are able to self-heal hard to detect micro-cracks. Future intelligent materials should have three elements - software, and customized material properties and functions according to Dr. Shinya. He also outlined the different characteristics of smart structures (SS) and the Japanese definition of intelligent materials (IM). The two disciplines were defined using examples from four categories: Primitive Functions, Intelligence, Manifestation of Function, and Applications. Primitive Functions for both IM & SS include sensor/actuators operations. Intelligence or Smart Functions for IM include self-replication & healing while SS functions include health monitoring and active control. The manifestation of these functions in IM is the formation of integrated material composites, while SS contain three distinct elements; sensors, actuators, and microprocessors. Finally, Applications were left undefined for the IM but include structure control for SS. (Pokines)

Workshop: International Symposium on Nano-Manufacturing, TEPIA, Tokyo, Japan, 16 February 2001. The symposium was jointly sponsored by the Manufacturing Science and Technology Center (MSTC), the Micromachine Center and the New Energy and Industrial technology Development Organization (NEDO). MSTC has engaged in incorporating nanotechnology into manufacturing since 1999. One workshop objective was to confirm the impact Nano-Manufacturing could have on manufacturing technology and identify what technological issues had to be overcome. Workshop highlights included:

? **Micro-Machine and Nano-Manufacturing (Prof. Shimoyama, University of Tokyo)** The transition from micro-machine and MEMS technology to nano-manufacturing involves difficult technological issues such as nano-manipulation, nano-material growth, and nano-position control.

? **Micro-Machine and Nano-Technology for Biotechnology (Prof. Fujimasa, National Graduate Institute for Policy Studies)** Prof. Fujimasa is famous for his pioneering work in medical nano-electronics and he emphasized unsolved problems for nano-machines; energy conversion mechanisms, self-assembly technology like biotechnology, fear of Nanobots (from the standpoint of ethics), and proper application fields.

? **National Initiatives in Nanoscience and Technology (Prof. Moore, The Office of Science and Technology Policy)** Prof. Moore exhibited examples of nano-technology business which would be realized in the near future - storage system, nano-robot (Nanobot), and micro-satellite and ultra small sensors related to NASA business. He also stressed the significance of education.

? **Trends in Micro-Optics and its Future (Prof. Herzig, University of Neuchatel)** What's next in micro-optics might be large micro-optics, deep3D surface profiling with nm accuracy, nano-structures with artificial index structures, photonic crystals, Scanning Near-field Optical Microscopy (SNOM), High Resolution Interference Microscopy (HRIM) and optical memory.

? **Nano-Manufacturing for Manufacturing Fields (Dr. Kataoka, Japan Aviation Electronics Ltd.)** and **Nano-Manufacturing for Optical Devices (Prof. Kamiya, National Institution for Academic Degrees)** Both speakers presented recent nano-manufacturing trends in Japan. Prof. Kamiya categorized one-, two- and three-dimensional optical devices and their conspicuous features. NEDO has directed the

commission for surveying nano-manufacturing since 1999 and a new national project in this field will be set up next year. For further information, contact AOARD or MSTC directly (e-mail: nano@honbu.mstc.or.jp) (Miyazaki)

Upcoming Conferences In Asia

These upcoming conferences may be of interest to you. Contact us for more details or check our homepage at http://www.nmjc.org/aoard/ Conferences in **BoldFace** are AFOSR/AOARD Supported.

Date	Name	Place
May 6-11, 01	11th Asia Pacific Military Medical Conference	Auckland, New Zealand
May 14-18, 01	**13th International Conference on Indium Phosphide and Related Materials 2001 (IPRM'01)**	**Nara, Japan**
May 16-18, 01	**Laser Precision Microfabrication (LPM 2001)**	**Singapore**
May 16-18, 01	2001 International Workshop on Distributed Shared Memory on Clusters (DSM2001)	Brisbane, Australia
May 20-23, 01	IFAC Workshop on Mobile Robot Technology	Jejudo, Korea
May 20-24, 01	Sub Optic 2001	Kyoto, Japan
May 21-26, 01	ICRA2001	Seoul, Korea
May 21-26, 01	International Symposia on Materials Science for the 21st Century (ISMS-21)	Osaka, Japan
May 27-30, 01	Congress on Evolutionary Computation (CEC2001)	Seoul, Korea
May 27-31, 01	Scanning Probe Microscopy, Sensors and Nanostructures	Chiba, Japan
May 27-31, 01	The 10th International Conference on Narrow Gap Semiconductors and Related Small Energy Phenomena, Physics and Applications (NGS 10)	Kanazawa, Japan
May 28-30, 01	4th International Symposium on Assembly and Task Planning (ISATP2001)	Fukuoka, Japan
May 28-31, 01	The Second Asian Conference on Chemical Vapor Deposition	Kyongju, Korea
May 29-31, 01	12th International Conference on New Information Technology (NIT 2001)	Beijing, China
Jun 3-8, 01	Seventh International Symposium on Solid Oxide Fuel Cells (SOFC- VII)	Tsukuba, Japan
Jun 4-5, 01	Microarrays and Microchips Japan	Tokyo, Japan
Jun 4-8, 01	The 13th International Symposium on Power Semiconductor Devices & ICs	Osaka, Japan
Jun 6-8, 01	5th International Conference on Mechatronics Technology	Singapore
Jun 6-8, 01	4th Asian Conference on Robotics and its Applications	Singapore
Jun 6-8, 01	International Conference on Optical Engineering for Sensing and Nanotechnology (ICOSN2001)	Yokohama, Japan
Jun 10, 01	2001 International Workshop on Statistical Methodology for VLSI Design and Fabrication	Kyoto, Japan
Jun 10-11, 01	2001 Silicon Nanoelectronics Workshop	Kyoto, Japan
Jun 10-15, 01	8th International Conference on the Formation of Semiconductor Interfaces (ICFSI-8)	Sapporo, Japan
Jun 11-14, 01	2001 Symposium on VLSI Technology	Kyoto, Japan
Jun 12-16, 01	IEEE International Symposium on Industrial Electronics (ISIE 2001)	Pusan, Korea
Jun 13-16, 01	2001 Symposium on VLSI Circuits	Kyoto, Japan
Jun 19-22, 01	8th International Superconductive Electronics Conference (ISEC '01)	Osaka, Japan
Jun 20-22, 01	FPD Expo Taiwan 2001	Hsinchu, Taiwan
Jun 25-27, 01	The JST International Symposium on Superconducting Device Physics (SDP 2001)	Tokyo, Japan
Jun 25-29, 01	13th International Conference on Composite Materials	Beijing, China
Jun 27-29, 01	International Conference on Affective Human Factors Design	Singapore
Jun 28-29, 01	The 8th International Workshop on Femtosecond Technology (FST 2001)	Tsukuba, Japan
Jul 1-5, 01	Integrated Optics & Optical Communications Conference (IOOC) Opto-Electronics Communications Conference (OECC) Australian Conference on Optical Fibre Technology (ACOFT)	Darling Harbour Convention Centre, Sydney, Australia
Jul 1-6, 01	**5th International Symposium on Advances in Polymers and Composites**	**Singapore**
Jul 1-6, 01	International Conference on Materials for Advanced Technologies (ICMAT)	Singapore

Jul 4-6, 01	**International MEMS (Micro Systems) Workshop 2001**	**Singapore**
Jul 5-7, 01	6th Asia-Pacific Regional Conference of International Telecommunications Society (ITS 2001)	Hong Kong, China
Jul 9-13, 01	8th IFIP TC 13 Conference on Human-Computer Interaction (INTERACT 2001)	Tokyo, Japan
Jul 11-13, 01	The 8th International Workshop on Active-Matrix Liquid-Crystal Displays-TFT Technologies and Related Materials (AM-LCD '01)	Tokyo, Japan
Jul 15-18, 01	International Conference on Tropical Ecosystems: Structure, Diversity and Human Welfare	Bangalore, India
Jul 15-19, 01	The 4th Pacific Rim Conference on Lasers and Electro-Optics (CLEO/Pacific Rim 2001)	Chiba, Japan
Jul 15-19, 01	International Meeting of the Psychometric Society (IMPS-2001)	Osaka, Japan
Jul 15-20, 01	7th International Symposium on Magnetic Field and Spin Effects in Chemistry and Related Phenomena	Tokyo, Japan
Jul 16-18, 01	Fourth International Symposium on Impact Engineering (ISIE/4)	Kumamoto, Japan
Jul 16-19, 01	CLEO Pacific Rim 2001 and InterOpto 2001	Chiba, Japan
Jul 17-22, 01	International Conference on Phenomena of Ionized Gases (XXV ICPIG)	Nagoya, Japan
Jul 23-27, 01	The 10th International EISCAT Workshop	Tokyo, Japan
Jul 24-27, 01	**2001 International Symposium on Signals, Systems, and Electronics**	**Tokyo, Japan**
Jul 25-27, 01	The 40th Society of Instrument and Control Engineers Annual Conference (SICE2001)	Nagoya, Japan
Jul 30-31, 01	**First Asian Conference on Vision**	**Kanagawa, Japan**
Jul 30-Aug 3, 01	4th International Conference on Biological Physics (ICBP 2001)	Kyoto, Japan
Jul 30-Aug 4, 01	The 13th International Conference on Crystal Growth (ICCG-13)	Kyoto, Japan
Aug 1-4, 01	2001 Asia-Pacific Radio Science Conference	Tokyo, Japan
Aug 6-8, 01	11th IEEE Workshop on Statistical Signal Processing	Singapore
Aug 6-10, 01	ICAS 2001	Tokyo, Japan
Aug 6-10, 01	IUPAC International Congress on Analytical Science 2001	Tokyo, Japan
Aug 13-16, 01	Sixth International Symposium on Signal Processing and its Applications (ISSPA 2001)	Kuala Lumpur, Malaysia
Aug 18-30, 01	International Association of Geomagnetism and Aeronomy (IAGA) and International Association of Seismology and Physics of the Earth's Interior (IASPEI) – Joing Scientific Assembly	Hanoi, Vietnam
Aug 19-25, 01	**International Conference on Photoresponsive Organics and Polymers 2001 (ICPOP2001)**	**Cheju Island, Korea**
Aug 21-24, 01	International Conference on Integrated Logistics	Singapore
Aug 27-30, 01	7th International Conference on Foundation of Quantum Physics and Advanced Technology	Hatoyama, Saitama
Sep 2-5, 01	4th International Conference on Non-contact Atomic Force Microscopy (NC-AFM2001)	Kyoto, Japan
Sep 2-7, 01	Fifteenth International Symposium on Air Breathing Engines	Bangalore, India
Sep 3-5, 01	9th International Symposium on Integrated Circuits, Devices Systems (ISIC 2001)	Singapore
Sep 6-9, 01	Fifth International Conference on Knowledge-Based Intelligent Information Engineering Systems & Allied Technologies	Osaka and Nara, Japan
Sep 10-12, 01	International Symposium on Micromechatronics and Human Science (MHS 2001)	Nagoya, Japan
Sep 10-12, 01	Solar Terrestrial Magnetic Activity & Space Environment	Beijing, China
Sep 10-14, 01	Second International Conference on Inertial Fusion Science and Applications	Kyoto, Japan
Sep 16-20, 01	**Third US/Australia Joint Workshop on Defense Applications of Signal Processing**	**Adelaide, Australia**
Sep 21-23, 01	The First International Symposium on Measurement, Analysis, and Modeling of Human Functions (ISHF2001)	Sapporo, Japan
Sep 24-28, 01	5th International Conference and Exhibition on High-Performance Computing in the Asia-Pacific Region	Gold Coast, Australia
Sep 25-28, 01	International Conference on Optical MEMS and their Applications	Okinawa, Japan
Sep 26-28, 01	2001 International Conference on Solid State Devices and Materials	Tokyo, Japan
Oct 2001	EMF Biological Effects and Standards Harmonization	South Korea
Oct 2-6, 01	**The 6th International Conference on Laser Ablation (COLA '01)**	**Tsukuba, Japan**
Oct 4-5, 01	The 1st International Symposium on Advanced Fluid Information (AFI-2001)	Sendai, Japan

Oct 8-11, 01	Narrow Band-Gap Nitride Workshop	Guilin, China
Oct 10-12, 01	International Conference on Sensing Units and Sensor Technology	Wuhan, China
Oct 11-13, 01	6th Annual Conference on Liquid Atomization and Spray Systems-Asia (ILASS-ASIA 2001)	Busan, Korea
Oct 15-17, 01	3rd International Conference on Experimental Mechanics	Beijing, China
Oct 15-18, 01	The Third International Conference on Information, Communications and Signal Processing (ICICS 2001)	Singapore
Oct 15-19, 01	6th International Conference on Mercury as a Global Pollutant	Minamata, Japan
Oct 16-19, 01	21st International Display Research Conference (Asia Display)	Nagoya, Japan
Oct 16-19, 01	International Conference on Computer Networks and Mobile Computing	Beijing, China
Oct 16-19, 01	International Symposium on Optical Memory (ISOM2001)	Taipei, Taiwan
Oct 17-21, 01	2001 International Conference on Control, Automation and Systems (ICASE)	Cheju, Korea
Oct 21-26, 01	8th International Conference on Environmental Mutagens	Shizuoka, Japan
Oct 22-24, 01	**WHO EMF Biological Effects and Standards Harmonization Asian Regional Meeting**	**Seoul, Korea**
Oct 22-24, 01	2nd International Symposium on Multispectral Image Processing and Pattern Recognition	Wuhan, China
Oct 23-26, 01	**The 2nd Asia-Pacific Conference on Intelligent Agent Technology (IAT-2001)**	**Gunma, Japan**
Oct 23-26, 01	**The 1st Asia-Pacific Conference on Web Intelligence (WI-2001)**	**Gunma, Japan**
Oct 24-26, 01	**8th Microoptics Conference (MOC'01)**	**Osaka, Japan**
Oct 25-26, 01	The 2nd International Workshop on Telecommunications (ITST2001)	Kanagawa, Japan
Oct 28-30, 01	IEEE-NANO 2001	Hawaii
Oct 28–Nov 2, 01	**International Conference on Silicon Carbide and Related Materials 2001 (ICSCRM2001)**	**Tsukuba, Japan**
Oct 29-31, 01	JSASS 15th International Sessions in 39th Aircraft Symposium	Gifu, Japan
Oct 29-Nov 3, 01	IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2001)	Maui, Hawaii
Oct 31-Nov 1, 01	The 7th International Micromachine Symposium	Tokyo, Japan
Oct 31-Nov 2, 01	2001 International Microprocesses and Nanotechnology Conference	Shimane, Japan
Nov 5-9, 01	22nd Asian Conference on Remote Sensing (ACRS2001)	Singapore
Nov 6-9, 01	**5th International Conference on Durability Analysis of Composite Systems (DURACOSYS 2001)**	**Tokyo, Japan**
Nov 7-9, 01	2001 International Symposium on GPS/GNSS	Cheju Island, Korea
Nov 7-10, 01	International Symposium on Optoelectronics and Microelectronics	Nanjing, China
Nov 11-14, 01	3rd International Symposium on Atomic Level Characterizations for New Materials and Devices '01	Nara, Japan
Nov 11-16, 01	9th International Conference on the Conservation and Management of Lakes	Shiga, Japan
Nov 12-16, 01	Asia-Pacific Optical and Wireless Communications Conference and Exhibit (APOC 2001)	Beijing, China
Nov 13-16, 01	**7th Japan International SAMPE Symposium and Exhibition (JISSE-7)**	**Tokyo, Japan**
Nov 14-18, 01	The 8th International Conference on Neural Information Processing (ICONIP 2001)	Shanghai, China
Nov 19-21, 01	**11th International Conference on Composite Structures**	**Monash, Australia**
Nov 20-22, 01	China-Japan-Korea Joint Workshop on Neurobiology and Neuroinformatics (NBNI 2001)	Hangzhou, China
Nov 22-24, 01	Artificial Neural Networks and Expert Systems (ANNES'2001)	Dunedin, New Zealand
Nov 26-30, 01	International Symposium on Photonics and Applications (ISPA)	Singapore
Nov 27-30, 01	**7th International Conference on Education and Training in Optics and Photonics**	**Singapore**
Dec 2-5, 01	The 10th IEEE International Conference on Fuzzy Systems	Melbourne, Australia
Dec 3-6, 01	**Asia Pacific Symposium on Multi-Dimensional Microscopy 2001**	**Melbourne, Australia**
Dec 4-7, 01	5th East Asian Conference on Chemical Sensors (EACCS 01)	Nagasaki, Japan
Dec 5-7, 01	The Eighth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-8)	Singapore
Dec 11-15, 01	XI International Workshop on the Physics of Semiconductor Devices	Delhi, India
Dec 17-19, 01	**International Symposium on Microelectronics and MEMS**	**Adelaide, Australia**
Dec 18-20, 01	ISAI 2001 International Symposium on Artificial Intelligence	Kolhapur, India

Feb 20-22, 02	**Third Australasian Congress on Applied Mechanics**	**Sydney, Australia**
May 15-17, 02	The Seventh World Congress on Biosensors	Kyoto, Japan
May 26-Jun 2, 02	23rd International Symposium on Space Technology and Science	Matsue, Japan
May 28-Jun 1, 02	International Joint Conference on the Applications of Ferroelectrics 2002	Nara, Japan
Jun 25-27, 02	International Symposium on Distributed Autonomous Robotic Systems	Fukuoka, Japan
Jul, 02	**Topical Workshop in Heterostructure Materials (TWHM'02)**	**Japan**
Jul 15-19, 02	The International Congress on Plasma Physics, ICPP 2002	Sydney, Australia

Upcoming Window-on-Science Visitors

Contact us for more details if you are interested in the following WOS visitors.

Dates	Visitor Name	Affiliation and Country	Topic	Visit Location
29 May-5 Jun, 01	Dr. Shuichi Emura	Osaka University, Japan	Isomer	2nd Isomer Workshop Telluride, CO University of Texas, Dallas, TX
17-22 Jun, 01	Dr. Yusuke Teramoto	Kumamoto University, Japan	Observation of Plasma Motion in a Coaxial Plasma Opening Switch with a Chordal Laser Interferometer.	AFRL/DEHE PPPS 2001, Las Vegas, NV
17-29 Jun, 01	Dr. Weihua Jiang	Nagaoka University of Technology, Japan	High-Power Pulsed Power Generator Applications	AFRL/DEHE PPPS 2001, Las Vegas, NV University of New Mexico Texas Tech University
16-27 Jul, 01	Dr. Shigefusa F. Chichibu	University of Tsukuba, Japan	Laser Diodes, Nitrides, Nitrides Characterization, Nitrides Growth & Optoelectronic Materials	4th International Congress on Nitride Semiconductors, ICNS-4 AFRL/MLPS UCSB, Gfoleta, CA
16-27 Jul, 01	Prof. Kazuhiro Ohkawa	Science Technology of Tokyo, Japan	Laser Diodes, Nitrides, Nitrides Characterization, Nitrides Growth & Optoelectronic Materials	4th International Congress on Nitride Semiconductors, ICNS-4 AFRL/MLPS UCSB, Gfoleta, CA
16-26 Jul, 01	Dr. Ikai Lo	National Sun Yat-sen University, Taiwan	Nitrides, Nitrides Characterization, Nitrides Growth & Optoelectronic Materials	AFRL/MLPO
27-30 Aug, 01	Dr. Takashi Ishikawa	Nihon University, Japan	Cryogenic Composite Tank for the Future Japanese Spaceplane Effort	AFRL/VSDV
27-30 Aug, 01	Prof. Chang-Sun Hong	Korea Advanced Institute of Science & Technology	The Improved FBG Sensor System using a Wavelength-Swept Fiber Laser (WSFL)	AFRL/VSDV
28-30 Aug, 01	Dr. Dong-Whan Choi	Korea Aerospace Research Institute, South Korea	Current Status & Prospect of the Korean Aerospace Industry	AFRL/VSDV
28-30 Aug, 01 9-12 Sep, 01	Prof. O-Il Byon	Nihon University, Japan	Fabrication Method of the Unidirectional Polymeric Composite Material	AFRL/VSDV American Society for Composites
9-12 Sep, 01	Prof. Hiroshi Fukuda	Science University of Tokyo	Compression Bending Test Method to a CFRP Pipe	AFOSR/NL

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