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MMC Activities

“MicroNano 2006” Micromachine Exposition

Overview

“MicroNano 2006,” a micromachine exposition organized by the Micromachine Center, will be held in Tokyo November 6-9, 2006. Each year the Micromachine Center holds the Exhibition MICROMACHINE and International Micromachine-Nanotech Symposium in Tokyo. This year, in order to promote industry interchange in micro-nano fields (micromachines, MEMS etc.) in a more effective manner, a variety of events will be held under the title “MicroNano 2006.” Additional events will include a MEMS Forum and a briefing to present the achievements of the Project for Development of a Design and Analysis Support System for MEMS (MEMS-ONE Project).

An overview of MicroNano 2006 is presented below. We encourage all interested parties to attend.

Date : Monday, November 6 - Thursday, November 9, 2006

Venue : Tokyo International Forum (Yurakucho, Tokyo)*

* Note: the MEMS International Standardization Workshop will be held in the Conference Square of the Mitsubishi Building (Marunouchi, Tokyo).

Events :

1. Exhibition MICROMACHINE : The 17th International Trade Show for Micro/MEMS & Nanotechnologies
(International exhibition of superfine/fine processing, MEMS, nanotechnology and biotechnology)

Tuesday, November 7 - Thursday, November 9, 2006 10:00 a. m. - 5:00 p. m.

Venue : Tokyo International Forum Entrance fee : 500 yen / person

2. MEMS International Standardization Workshop
(Exploring the frontiers of MicroNano material evaluation technologies)

Monday, November 6, 2006 10:00 a. m. - 4:25 p. m.

Venue : Conference Square, Mitsubishi Building (Marunouchi, Tokyo) Entrance fee : Free

3. MEMS Forum
(Aiming for growth in MEMS-related industries)

Tuesday, November 7, 2006 10:00 a. m. - 4:35 p. m.

Venue :Tokyo International Forum, Hall D7 Entrance fee : Free

4. 12th International Micromachine / Nanotech Symposium
(Exploring the frontiers of nanotechnology and integrated MEMS innovation and business)

Wednesday, November 8, 2006 9:00 a. m. - 5:55 p. m.

Venue : Tokyo International Forum, Hall D7

Entrance fee : 20,000 yen / person (MMC - MEMS Industry Forum members 16,000 yen / person)

5. MEMS-ONE Project Achievements
(Introduction to MEMS-ONE functions & features and demonstration of use / information on alpha and beta release)

Thursday, November 9, 2006 1:00 p. m. - 4:15 p. m.

Venue : Tokyo International Forum, Hall D7 Entrance fee : Free

In addition, the 10th International Conference on Miniaturized Systems for Chemistry and Life Sciences (μ TAS2006) will be held concurrently (November 5-9, 2006 at Tokyo International Forum, Hall C, Hall B5 and Hall B7).

Largest ever Exhibition MICROMACHINE to be held in Tokyo

Exhibition MICROMACHINE (The 17th International Trade Show for Micro/MEMS & Nanotechnologies), an international exhibition of superfine / fine processing, MEMS, nanotechnology and biotechnology, will be held in Tokyo for three days from Tuesday, November 7 through Thursday, November 9, 2006.

In the past, the exhibition has been held at the Science Museum near the Imperial Palace, but this year the venue will change to Tokyo International Forum in Yurakuchō. The rapid increase in exhibitors resulting from the recent growth in the micromachine, MEMS and nanotechnology fields meant that a more spacious venue was needed.

Last year's exhibition featured 256 companies and organizations presenting exhibitions in 362 booths. This year's exhibition is expected to host approximately 280 companies and organizations at approximately 430 booths, making this the largest exhibition yet.

Exhibition MICROMACHINE will showcase new technologies and new products in the fields of superfine and fine processing, MEMS (microelectromechanical systems) and nanotechnology. It is the largest exhibition of its kind in Japan. We invite all interested parties to attend.

The exhibition office is distributing complimentary tickets to the exhibition. For more information, call Mesago Messe Frankfurt at (+81) 3-3262-8456. You may also pre-register at the exhibition's website (<http://www.micromachine.jp>).



Fiscal 2006 MEMS International Standardization Workshop & Program

A MEMS International Standardization Workshop will be held as one of the events of MicroNano 2006 with the aim of strategic deployment of international standardization in the MEMS field. The Workshop will invite researchers from around the world who are working on the front lines of this field and have produced outstanding cutting-edge achievements. These researchers will talk about MEMS-related microtechnology and nanotechnology and about their experiences on the front lines of evaluating these technologies. Another objective of the workshop will be to deepen mutual understanding on the part of researchers in different countries.

Date : Monday, November 6, 2006 10:00 a. m. - 4:25 p. m.

Venue : Conference Square M+

(Mitsubishi Bldg. 10F, 2-5-2 Marunouchi, Chiyoda-ku, Tokyo)
(<http://www.emplus.jp/access/>)

Language : English

Entrance fee : Free

Sponsored by : Micromachine Center

MEMS International Standardization Workshop Executive Committee

Cosponsored by : New Energy and Industrial Technology Development Organization (NEDO)

Support provided by : Ministry of Economy, Trade and Industry

Session 1	Opening Ceremony	
10 : 00-	Opening remarks	Yakichi Higo (Professor, Tokyo Institute of Technology and Chair, Workshop Executive Committee)
10 : 05-	Words of welcome from sponsors	Sumio Kozawa (General Manager, New Energy and Industrial Technology Development Organization [NEDO])
Session 2	Frontiers of MEMS Devices	
10 : 10-	"Glass Properties for Electrostatic Bonding in Process of the Packaging of MEMS Devices"	Prof. Dr. Sekwang Park (Kyunpook National University, Korea)
10 : 40-	"CNT Nano Electromechanical Transducers"	Prof. Dr. Christofer Hierold (ETH Zurich, Switzerland)
11 : 10-	"MEMS-based Nanopatterning : New Challenges and Opportunities for Materials Science"	Prof. Juergen Brugger (EPFL, Switzerland)
11 : 40-	- lunch -	
Session 3	MEMS Evaluation Techniques and Standardization	
13 : 00-	"MEMS Standardization Project at NIST"	Dr. Michael Gaitan (National Institute of Standards and Technology, U.S.A.)
13 : 30-	"Measurement of Micro-Tensile Properties for Gold Thin Film Using Micro-ESPI Technology"	Dr. Yong-Hak Huh (Korea Research Institute of Standards and Science, Korea)
14 : 00-	"Mechanical Material Characterization at the MEMS Materials Laboratory of IMTEK"	Prof. Dr. Oliver Paul (University of Freiburg, Germany)
14 : 30-	- Break -	
14 : 50-	"Deformation and Fatigue Mechanisms of Structural Films"	Prof. Christopher L. Muhlstein (The Pennsylvania State University, U.S.A.)
15 : 20-	"Round-Robin Test on Fatigue of Thin Films for MEMS Applications in Japan"	Prof. Kazuki Takashima (Kumamoto University, Japan)
15 : 50-	"A Comprehensive Assessment of Fatigue Failure in Micron-Scale Polycrystalline Silicon Structural Films for MEMS"	Prof. Robert O. Ritchie (University of California at Berkeley, U.S.A.)
Session 4	Closing Ceremony	
16 : 20-	Closing remarks	Naotake Oyama (Chair, MMC Standardization Project Committee)

MEMS Forum

- Aiming for growth in MEMS-related industries -

Tuesday, November 7, 2006 10:00 a.m. - 4:35 p.m. Tokyo International Forum Hall D7

Sponsored by : MEMS Industry Forum

Cosponsored by : Ministry of Economy, Trade and Industry, The New Energy and Industrial Technology Development Organization (NEDO)

Support provided by : Kitakyushu Foundation for the Advancement of Industry, Science and Technology; MEMS Park Consortium

Entrance fee : Free

Program

MC : Keiichi Aoyagi, Secretary-general, Secretariat, MEMS Industry Forum

Session 1	Opening	
10:00 – 10:05	Opening address	Tamotsu Nomakuchi, Chairman, MEMS Industry Forum
10:05 – 10:10	Greetings from guest of honor	Taizo Takahashi, Director, Industrial Machinery Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry
10:10 – 10:20	Introduction of MEMS Industry Forum activities	Keiichi Aoyagi, Secretary-general, Secretariat, MEMS Industry Forum
Session 2	MEMS Industrial Policy	
10:20 – 10:50	MEMS Industry Policy in Japan with a view to International Competitiveness (tentative title)	Taizo Takahashi, Director, Industrial Machinery Division, Manufacturing Industries Bureau, Ministry of Economy, Trade and Industry
10:50 – 11:20	MEMS Industry Policy and Business Development in the U.S.	Micro and Nanotechnology Commercialization Education Foundation (MANCEF) , Vice President Jane Niall
11:20 – 11:50	MEMS Business : What Determines Success or Failure ?	Associate editor, Tsuneyuki Miyake, Nikkei Business Publications Inc.
11:50 – 13:00	Lunch	
Session 3	Reinforcement of MEMS Industry Infrastructure	
13:00 – 13:30	Developing a Standard Menu for Functional Enhancement of MEMS Foundries (tentative title)	Kazushi Tomii, Chair, Foundry Service Industry Committee, MEMS Industry Forum (General Manager, MEMS Foundry Services, Micro Fabrication Process Development Center, Matsushita Electric Works Ltd.)
13:30 – 14:00	Activities of the MEMS / MS Applied Research Forum	Nagao Miyashita, Chief-executive, Industry-Academia Cooperation Center, Kitakyushu Foundation for the Advancement of Industry, Science and Technology
14:00 – 14:30	Efforts to Develop MEMS Technology through Liaison with the Manufacturing Industry: Local Publicly-Run Trials	Yoshiyuki Watanabe, Senior researcher, Electronics Information Technology Department, Yamagata Research Institute of Technology
Session 4	MEMS Technology Establishment and Industry - Academia Cooperation	
14:30 – 15:00	Road Map to MEMS Technology Strategies	Sumio Kozawa, Director general, Machinery System Technology Development Department, The New Energy and Industrial Technology Development Organization (NEDO)
15:00 – 16:00	Information From MEMS Industry Forum/Academia Affiliates	Organizer: Professor Kazuo Sato, Nagoya University
	• Seed Technologies Contributing to Optical-Integrated Devices	Minoru Sasaki, Assistant professor, Hane-Sasaki Laboratory, Tohoku University
	• Fundamental Problems with MEMS Accelerometers and Potential for Solutions Provided by Venture Business	Akira Umeda, Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology (AIST)
	• Research at Kyoto University Nano-Microsystem Engineering Laboratory	Professor Osamu Tabata, Nano-Microsystem Engineering Laboratory, Kyoto University
16:00 – 16:30	• Reports on Industry-Academia Liaison Activities by The Japan Society for Precision Engineering Expert Committee on Micro-Nanosystems Research and the Tokyo Institute of Technology Precision and Intelligence Laboratory (Horie Group)	Professor Mikio Horie, Precision and Intelligence Laboratory, Tokyo Institute of Technology
	Establishment of Core Technology to Strengthen the Infrastructure of the MEMS Industry	Professor Hiroyuki Fujita, Institute of Industrial Science, University of Tokyo
Closing		
16:30 – 16:35	Closing address	Koichi Karaki, Vice-chairman, MEMS Industry Forum

The 12th International Micromachine / Nanotech Symposium
- Innovations on Nanotech / Integrated MEMS and Forerunners of MEMS Business -
November 8, 2006, The Tokyo International Forum, Tokyo

Sponsored by : Micromachine Center

Cosponsored by : Ministry of Economy, Trade and Industry, The New Energy and Industrial Technology Development Organization (NEDO)

Entrance fee : 20,000yen / person (MMC-MEMS Industry Forum members 16,000yen / person)

Contact : Micromachine Center, Industry Department

MBR99Bldg.6F, 67 KandaSakumagashi, Chiyoda-ku, Tokyo 101-0026, Japan

Tel : 03-5835-1870 Fax : 03-5835-1873

E-mail:front@mmc.or.jp

Program

Opening		Chairperson : Keiichi Aoyagi, Micromachine Center
9:00 – 9:05	Opening Remarks	Tamotsu Nomakuchi, Micromachine Center
9:05 – 9:10	Guest Speech	Taizo Takahashi, Industrial Machinery Division, Manufacturing Industries Bureau, METI
Keynote Session	Towards the Next Generation of MEMS	Chairperson : Keiichi Aoyagi, Micromachine Center
9:15 – 10:00	Advances in Research and Applications of Integrated MEMS in Japan	Isao Shimoyama, The University of Tokyo
10:00 – 10:45	Advances in MEMS Integration : MEMS First or MEMS Last ?	Thomas W. Kenny, Stanford University
Session 1	Cutting Edge of MicroNano Science and Technology	Chairperson : Osamu Tabata, Kyoto University
10:45 – 11:15	Fusion of Top-down and Bottom-up Processing Using Neutral Beam	Seiji Samukawa, Tohoku University
11:15 – 11:45	Preparation and Properties of Multicomponent Nanocrystal Superlattices	Christopher B. Murray, IBM, The T.J. Watson Reserch Center
11:45 – 12:15	Organic and Organic-Inorganic Hybrid Molecular Devices	Cherie R. Kagan, IBM, The T.J. Watson Reserch Center
12:15 – 13:30	Lunch	
Session 2	Forefront of MEMS Business	Chairperson : Isao Shimoyama, The University of Tokyo
13:30 – 14:00	CMOS/ MEMS integration is a key to success of Silicon Resonator	Emmanuel Quevy, Silicon Clocks Inc.
14:00 – 14:30	Reconfigurable RF Circuits for Future Mobile Terminals	Shoichi NARAHASHI, NTT DoCoMo, Inc.
14:30 – 15:00	Development of Medical Devices for Minimally Invasive Diagnostics and Treatment Using Micro/nano Technology	Yoichi Haga, Tohoku University
15:00 – 15:30	MEMS@Bosch - Automotive Applications and beyond	Peter Ernst, Robert BOSCH GmbH
15:30 – 15:50	Break	
Session 3	CMOS / MEMS & MEMS/MEMS Integration	Chairperson : Takashi Usuda, AIST
15:50 – 16:20	CMOS/ MEMS Integration by Poly Si Ge	Kris Baert, IMEC
16:20 – 16:50	Carbon Nanotube-based Machine Elements for Nano-scale Mechanisms and Technologies Required to Transition Them From the Lab to Products	Martin Culpepper, Massachusetts Institute of Technology
16:50 – 17:20	Advanced Packaging is the Breakthrough Technology of MEMS Commercialization	Joerg Froemel, Fraunhofer IZM
17:20 – 17:50	Optical MEMS towards Integration and Large Scale	Hiroshi Toshiyoshi, The University of Tokyo
Closing		
17:50 – 17:55	Closing Remarks	Keiichi Aoyagi, Micromachine Center

MEMS-ONE Project Achievements

This will be the final year of the Project for Development of a Design and Analysis Support System for MEMS (MEMS-ONE Project). The MEMS-ONE Project was established with the aim of setting up an infrastructure to provide systems support for the growth and development of the Micro Electro Mechanical Systems (MEMS) industry. MEMS-ONE development is entering the final stages; even last year, only fragments were visible, but beginning with this fiscal year, verification after combining elements has been conducted, enabling the overall picture to be glimpsed.

When the MEMS-ONE system is launched, the graphical user interface (GUI) function that serves as the basic framework for the system appears. This function allows users to perform analysis in an interactive manner, and the results of analysis can be easily checked by means of figures, graphs and animations. Steady progress is also being made with regard to novice support features such as the acquisition of a knowledge database and data on material properties.

In the future, integrated verification of the overall MEMS-ONE system will be conducted to increase the overall completeness of the system. In addition, a vigorous effort is being made to increase the volume of data acquisition in anticipation of the issue of alpha and beta (final) releases.

This autumn a briefing will be held to announce the achievements of the MEMS-ONE Project. This briefing will feature up-to-date information on such topics as an overview of the functions that will ultimately be provided in MEMS-ONE and their characteristics, a demonstration showing how to use the program, anticipated dates for the issue of alpha and beta releases and so on. This briefing will differ from the one held last year in that it will feature enhanced content based on the actual software currently being developed. In addition, the venue has been changed to the Tokyo International Forum. A video presentation on MEMS-ONE will be presented at Exhibition MICROMACHINE as well, in addition to a demonstration featuring sample analyses, panel exhibits and pamphlet distribution.

The program for the briefing is shown below. We invite all interested parties to attend.

Date/Time : Thursday, November 9, 2006
1:00 - 4:15 p.m.

Venue : Tokyo International Forum, Hall D7

Entrance fee : Free

Sponsored by : Micromachine Center
MEMS-ONE Project Promotion Committee

Cosponsored by : New Energy and Industrial Technology Development Organization (NEDO)

Support provided by : Ministry of Economy, Trade and Industry

Program :

Session 1 : Opening

- 1:00 - 1:15 Sponsor's greetings
- 1:15 - 1:30 Greetings from guest of honor
- 1:30 - 2:00 Keynote address:
"Expectations for MEMS-ONE based on Fine-MEMS"
- 2:00 - 2:15 Break

Session 2 : Overview of MEMS-ONE functions & demonstration

- 2:15 - 2:35 Overview and characteristics of functions
- 2:35 - 3:20 From design conceptualization to process mask design and operational testing
- 3:20 - 3:25 Q & A session

Session 3 : MEMS-ONE alpha release

- 3:25 - 3:35 Future release plans
- 3:35 - 3:50 Alpha release
- 3:50 - 4:00 Q & A session

Session 4 : Closing

- 4:00 - 4:15 MEMS-ONE Support Center concept

Registration :

-To register for the briefing, please send an email with your name, company name, department, position, address, email address, telephone number and fax number to the following email address : mems1@mmc.or.jp

When your registration has been confirmed, a confirmation email will be sent. On the day of the briefing, please bring a copy of the confirmation email and present it to the receptionist. If you have not pre-registered but would like to register on the day of the event, please see the receptionist prior to the start of the briefing. However, same-day registration will be permitted only on a space-available basis, so we encourage you to register in advance.

-Deadline for registration : **Wednesday, November 1, 2006**

For more information :

If you have any questions regarding the briefing, please call the MEMS-ONE Project Office at (+81) 3-5835-1870.

Copies of the alpha release and beta release will be distributed in accordance with the following schedule.

- 1) The purpose of distributing the alpha release is to enable users to evaluate the current state of execution of the program. The results of the evaluation will be reflected in the beta release to the greatest degree possible in order to make the program more complete. The alpha release is scheduled for mid-November 2006. You will be able to register to receive a copy of the alpha release beginning in early October.
- 2) The beta release will be the final version representing the ultimate achievement of the MEMS-ONE Project. It is tentatively scheduled for release in May 2007.

Current State of Nanobiotechnology Research and MEMS

Yoshinobu Baba, Professor, Nagoya University, Director of Nanobio Research, Health Technology Research Center, National Institute of Advanced Industrial Science and Technology (AIST)

Nano-bio research is currently attracting a great deal of attention in fields ranging from basic science and key technology fields (such as electricity, electronics, machine, physics, chemistry and life sciences) to biotechnology, medicine and pharmaceutical research.^{1) - 4)} Nano-bio research falls into two broad research categories: nanobiology (also known as nano-bioscience), a research field of life science using nanotechnology, and nano-biotechnology, a research field created through the integration of biotechnology with nanobiotechnology. (Fig. 1)

Nanobiology involves research to determine the properties and structure of biological molecules at the single molecule level, as well as research into primarily molecular motors and biomachines and other molecular assemblies and intracellular bioreaction imaging and so on. Nanobiotechnology is rapidly expanding from basic technologies such as gene expression and protein measurement technologies using chips, sensors and MEMS to application fields such as medical diagnosis technologies, nanomaterial-based drug delivery systems, gene therapy, systems engineering, regenerative medicine and nanomedicine. (Fig. 2) Moreover, with the recent progress in MEMS and nanotechnology, research is expanding in the domain that fuses nanobiotechnology with nanobiology.

Effective use of MEMS technology is becoming an important key to successful nano-bio research, particularly in the currently active research domain that fuses nanobiology and nanobiotechnology. Up to now, molecules and molecular assemblies were the principal target of nano-bio research. However, MEMS is also coming to play an extremely important role in research into more complex systems such as cells and structures. For example, with MEMS it is possible to analyze the single-molecule gene expression information inside a single cell, something heretofore thought to be impossible. It is also now possible to study techniques for producing chemical

energy by applying mechanical energy to a single-molecule motor. Moreover, it is also becoming possible to use MEMS to conduct research into cell patterning (used in cell manipulation and regenerative medicine) and so on.

There has been considerable progress in nano-bio research in recent years, particularly in terms of the creation of research domains in which research would be impossible without nanobiotechnology. Achievements in nano-bio research are currently having a tremendous impact on the life sciences, to the extent of rewriting what we know as common knowledge about the life sciences. Moreover, most of this new research has been created as a result of the deployment of MEMS in nanobiotechnological research. However, the use of MEMS in nanobiotechnological research has just begun, and most of the technologies produced through MEMS are not yet being applied in nanobiotechnological research. In the future, the deployment of various MEMS technologies in nanobiotechnological research will bring about a technological revolution in the life sciences, as well as in medical treatment and pharmaceutical research. These technologies are expected to help us solve the mysteries of life and aid in further progress in medical treatment and pharmaceutical research.

- 1) Baba, Yoshinobu ed. "Nanotechnology and medical treatment" Nippon Rinsho, February 2006)
- 2) Baba, Yoshinobu ed. "Isolation and measurement technologies in the nanotechnology and biotechnology MEMS era" (CMC Publishing Co., Ltd., 2006)
- 3) Baba, Yoshinobu ed. "Nanobiology: Using nanotechnology to transform biology" (Cellular Engineering, August 2006)
- 4) Baba, Yoshinobu ed. "New directions in nanobiotechnological research made possible by chemistry" (Modern Chemistry, November 2006)

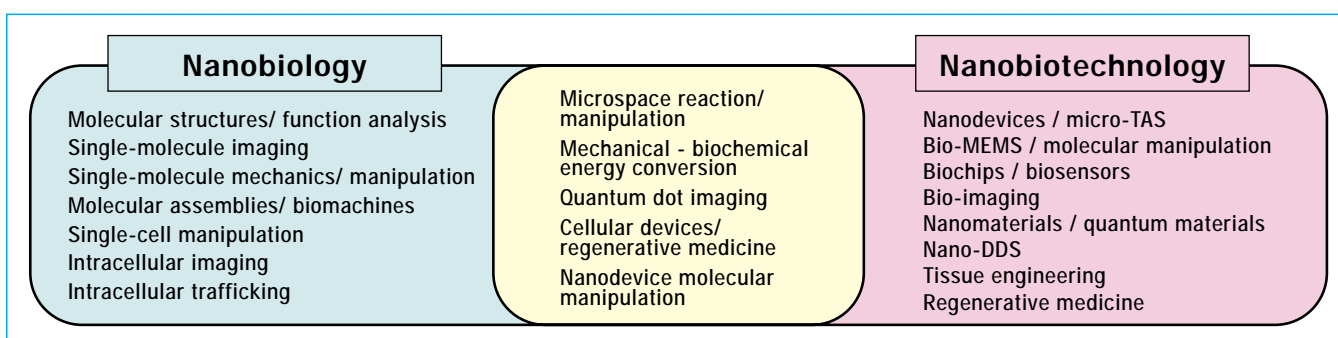


Fig. 1 Nano-bio research domains

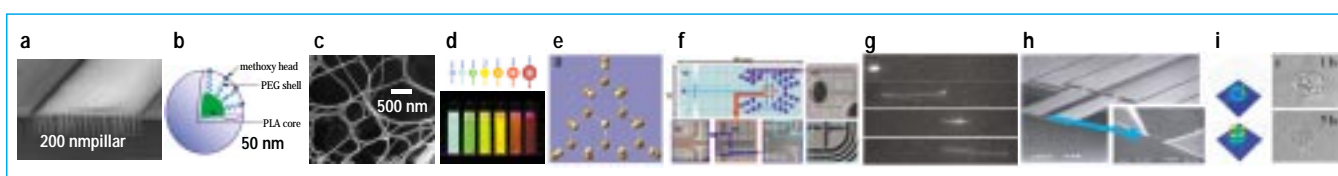


Fig. 2 Nanobiotechnologies studied by the Group
 a. Nanopillar, b. Nanobowl, c. Nanofiber, d. Quantum dot, e. Quantum dot cluster
 f. Biodevice, g. Monomolecular imaging, h. Nanotweezers, i. Intracellular molecular imaging

2nd Japan-Korea-China MEMS Standardization Workshop held in Gyeongju, South Korea (June 22 - 23, 2006)

The Micromachine Center is playing a leading role in MEMS international standardization activities. As a result of the Center's activities, Japan has led other countries in promoting such standardization activities as the publication of the "MEMS Glossary," "Tension test methods for thin film materials" and "Fatigue test methods for thin film materials".* In recent years, South Korea has also begun active efforts in this area.

Japan and South Korea in particular feel that it is important to exchange views regarding MEMS standardization and seek future cooperation. As a result, last year the first Japan-Korea-China MEMS Standardization Workshop was held. The Workshop provides a forum for discussions relating to standardization proposals and the possibility of conducting joint research relating to MEMS standardization. This year the second Workshop was held June 22 - 23, 2006 in Korea and at the Concord Hotel in Gyeongju, South Korea.

Gyeongju is a historic city that served as the capital during the Silla Era. It is also famous throughout the world for its many historical treasures.

Professor Sekwang Park of Kyungpook National University, the project leader for the International Electrotechnical Commission (IEC) TC/WG4, presided over the Workshop. Seven lectures were presented on the special theme of "Thin film testing of MEMS and NEMS."



Photo 1 Concord Hotel (Gyeongju)

Unfortunately there were no attendees from China. However, seven delegates from Japan, from such organizations as the International Standardization Engineering Laboratory, Kumamoto University, Kanazawa Institute of Technology, Kyoto University, New Energy and Industrial Technology Development Organization (NEDO) and so on, were in attendance, and approximately 20 persons from South Korea attended. The attendees listened to lectures and participated in a discussion of the latest research developments and standardization in this field.

Following words of welcome from Professor Park, there were four presentations from Korean researchers. Dr. Nak-Kyu Lee of the Korea Academy of Industrial Technology (KAITECH) gave a presentation entitled "Micro Material Property Measurement Technology of Micro Thin Film Materials." Professor Chung-Seog Oh of Kumoh National Institute of Technology gave a lecture entitled "Some Efforts in Improving the Mechanical Properties Measurement Accuracy for Thin Films." Dr. Yong-Hak Huh of the Korea Research Institute of Standards and Science (KRISS) gave a presentation entitled "Measurement of Micro-tensile Properties for Thin Film Materials using Micro-ESPI Technique." Finally, Professor Jun-Hyub Park of Tongmyong University gave a presentation entitled "Tensile and Fatigue Test of Thin Film by New Test Procedure."

Next, there were three presentations by Japanese researchers. First was Professor Iwaoka of Kanazawa Institute of Technology, who gave a presentation entitled "MEMS Technology Trends and Needs of MEMS Standardization for Industry." He spoke about overall technical trends relating to MEMS and, based on a comparison of the technical infrastructure for IC and MEMS, emphasized the need for a strategic standards program in the MEMS field. Next, Professor Takashima of Kumamoto University gave a presentation entitled "Round-Robin Test on Fatigue of Thin Films for MEMS Applications in Japan." He presented an overview of the round-robin fatigue tests conducted from 2003 through 2005 and talked about a draft proposal for a thin film fatigue test method to be presented to the IEC TC/WG4. Finally, Associate Professor Tsuchiya of Kyoto University gave a presentation entitled "Humidity Effect on Tensile Strength and Fatigue Properties of Single Crystal Silicon Microstructures." He spoke about the latest research into the fatigue properties of single crystal silicon microstructures.

This second Japan-Korea-China MEMS Standardization Workshop was significant in that the presentations from Japanese speakers served to showcase the outstanding and innovative nature of Japan's standardization proposals relating to MEMS material evaluation. Moreover, the Korean presentations demonstrated the great interest in Korea in both standardization in the MEMS field and research into techniques for evaluating thin film materials and underscored the intensive efforts being made in Korea with regard to standardization. At the Welcome Party held at the Gyeongju Concord Hotel following the presentations, there was a spirited exchange of perspectives and technical knowledge between the Japanese and Korean researchers. The location and other details for the next Workshop are expected to be decided this autumn.



Photo 2 Speakers and participants from Japan

Top left : Professor Iwaoka
Bottom left : Associate Professor Tsuchiya
Top right : Professor Takashima
Bottom right : Director Owada

* "MEMS Glossary" (FY2005 International Standard [IS])
"Tension test methods for thin film materials" (FY2006 International Standard [IS])
"Fatigue test methods for thin film materials" (Proposed FY2006 New Process [NP])

Yokogawa Electric Corporation

1. MEMS technology efforts at Yokogawa

Measurement, control and information are the core technology areas of Yokogawa, which provides state-of-the-art "mother tools" for an industrial world. Our major business areas are the control equipment field, which is expanding due to rising oil prices, and the measurement equipment field that comprises semiconductor testers and electronic instruments. In 2005, Yokogawa celebrated its 90th anniversary, and the Corporate Research and Development Headquarters is hard at work developing leading-edge technologies to solve customer problems in anticipation of the company's centennial in 2015. One area in which the company is focusing particular effort is the use of MEMS technology to produce key devices that can distinguish Yokogawa's products from those of its competitors. In the 20 years since Yokogawa began research into MEMS technology, the company has accumulated many basic technologies. We are now employing these technologies to develop new devices that will be the seeds for both core businesses and new businesses.

2. Current status of research and development

Some typical products and devices currently under development are described below.

(1) Silicon resonant sensor device

The key device used in the Dpharp series of process differential pressure sensors first marketed in 1991 is the miniature silicon resonant sensor shown in Fig. 1. This was one of the first products in the world to employ MEMS technology, and ultimately 1.5 million came to be used worldwide. We are increasing our share of the world market, and we feel that it is only a matter of time before we are number one globally. The Dpharp has grown to become one of Yokogawa's main products, and the company is placing a great deal of emphasis on the ongoing development of the silicon sensors that is its core component.

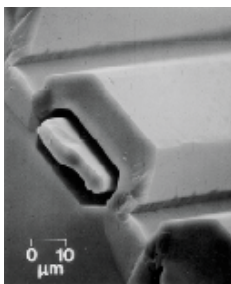


Fig. 1 Si resonant sensor

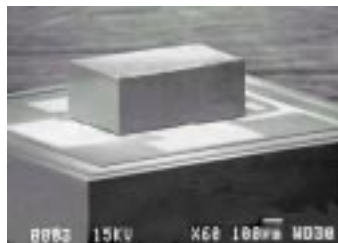


Fig. 2 Tunable MEMS-VCSEL



Director, Advanced Technology Research Center
Katsumi Isozaki

(2) Tunable MEMS-VCSEL

The device shown in Fig. 2 is a tunable MEMS vertical-cavity surface-emitting laser (MEMS-VCSEL) currently being developed with the support of the NEDO High Integration Composite MEMS Fabrication Technology Development Project. Yokogawa is working to create this unique device by combining compound semiconductor technology with the Si-MEMS technology that has helped to distinguish its products from those of its competitors.

(3) Microreactor development efforts

A microreactor is a device that causes chemical reactions to take place inside a tiny micro-fluid channels. As the properties of this tiny space can be freely manipulated, manufacturing plants can be created with sizes and functions heretofore impossible. MEMS is the key technology that enables microreactors to be achieved. Microreactor technology is expected to revolutionize the manufacturing methods for pharmaceuticals and fine chemicals produced in small lots using high value added functional materials. Yokogawa is pursuing development of microreactors on a priority basis. Fig. 3 shows a microreactor chip for on-site gas manufacture, currently being developed jointly with Mitsui Chemicals, Inc.

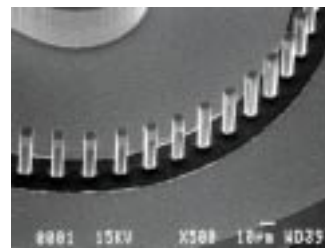


Fig. 3 Microreactor device

3. Future efforts

MEMS is a manufacturing technology. For this reason, it is important to combine MEMS with other technologies to increase added value. In the future, Yokogawa will work to fuse MEMS with chemical technologies, deploying the achievements in microreactors, biotechnology and fuel cells.

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Keiichi Aoyagi, Executive Director, Micromachine Center (MMC)
MBR99 Bldg., 6F., 67 Kanda Sakumagashi, Chiyoda-ku, Tokyo 101-0026, Japan
Tel : +81-3-5835-1870, Fax : +81-3-5835-1873
Internet Home Page <http://www.mmc.or.jp/>
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