MMC

MICRONANO

2008 7

MMC Activities

Micro / Nano 2008: An Overview

Micromachine Center (MMC)

To promote industrial interchange in micro/nano fields (micromachines, MEMS etc.) as effectively as possible, the Micromachine Center is sponsoring Micro/Nano 2008, an integrated event that includes an exhibition, conference and related events. Micro/Nano 2008 will provide attendees with an overview of the latest technical and industry trends in micro/nano fields as well as the opportunity to conduct business exchanges efficiently with micro/nano related organizations and companies from Japan and overseas countries. Micro/Nano 2008 will be held for four days starting Tuesday, July 29, 2008 and ending Friday, August 1, 2008 with Tokyo Big Sight as the main venue.

1. Micro/Nano 2008 Organization and Schedule

Exhibition

The 19th Exhibition Micromachine/MEMS

International Exhibition focusing on MEMS, Nanotechnology, Ultraprecision / Microfabrication and Biotechnology

Date July 30, 2008 (Wednesday) - August 1, 2008 (Friday)
Venue Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1 & 2)

Sponsor Micromachine Center
Organizer Mesago Messe Frankfurt Corporation
Support (planned) Ministry of Economy / Trade and Industry (METI)
Cooperation (planned) The Japan Machinery Federation / Japan Robot Association
Japan Analytical Instruments Manufacturers Association

Concurrent Events

◆The 14th International Micromachine / Nanotech Symposium

Date & Time July 29, 2008 (Tuesday) 10:00 a.m. - 6:10 p.m.
Venue Tokyo Bay Ariake Washington Hotel (Iris Banquet Hall)

Sponsor Micromachine Center
Support (planned) Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO)
Cooperation (planned) The Japan Machinery Federation / Japan Robot Association / Japan Analytical Instruments Manufacturers Association

◆Japanese-German Micro / Nano Business Forum

Date & Time July 30, 2008 (Wednesday) 10:45 a.m. - 5:00 p.m.
Venue Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine / MEMS special venue

Sponsor IVAM Microtechnology Network
Cosponsor Micromachine Center / MEMS Industry Forum

◆Meeting for announcing results of FineMEMS Project

Date & Time July 31, 2008 (Thursday) 12:30 - 4:30 p.m.
Venue Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine / MEMS special venue

Sponsor Fine MEMS Project Promotion Committee / Micromachine Center
Cosponsor New Energy and Industrial Technology Development Organization (NEDO)

◆MEMS Forum

Date & Time August 1, 2008 (Friday) 10:30 a.m. - 4:35 p.m.
Venue Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine / MEMS special venue

Sponsor Micromachine Center / MEMS Industry Forum

2. Overview of concurrent conferences

◆The 14th International Micromachine / Nanotech Symposium

(1) Purpose

The International Micromachine / Nanotech Symposium is held to promote the growth of MEMS related industries and improve the international competitiveness of the key components manufactured in Japan. The symposium includes the exchange of information with micromachine and nanotech researchers who are promoting research and development on the front lines of leading-edge technical fields both at home and abroad, and it also provides MEMS researchers from Japan and overseas countries with the latest information and a venue for discussion. The theme of the 14th International Micromachine / Nanotech Symposium is " Technology Convergence MEMS: LSI, Nano and Bio," and features issues such as LSI/MEMS integration efforts and their application and next-generation BEANS process technologies and the prospects for these technologies.

(2) Program

The 14th International Micromachine / Nanotech Symposium

– International Exhibition focusing on MEMS, Nanotechnology, Ultraprecision / Microfabrication and Biotechnology –

Date & Time: July 29, 2008 (Tuesday) 10:00 a.m. - 6:10 p.m.
Venue: Tokyo Bay Ariake Washington Hotel (Iris Banquet Hall)
Sponsor: Micromachine Center
Support (planned): Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO)
Cooperation (planned): The Japan Machinery Federation / Japan Robot Association / Japan Analytical Instruments Manufacturers Association

	Opening	Chair: Keiichi Aoyagi, Micromachine Center
10 : 00 - 10 : 05	Opening Remarks	Tamotsu Nomakuchi, Micromachine Center
10 : 05 - 10 : 10	Guest Speech	Takeshi Yoneyama, Industrial Machinery Division, Manufacturing Industries Bureau, METI
Keynote Session	Technology Convergence on MEMS	Chair: Hiroyuki Fujita, The University of Tokyo
10 : 10 - 10 : 55	MEMS Industrialization Perspective in Japan	Hidetoshi Kotera, Kyoto University
10 : 55 - 11 : 40	Integrated Micro/nanosystems - Technology and Applications	Roger T. Howe, Stanford University
11 : 40 - 12 : 40	Lunch	
Session 1	MEMS LSI Integration	Chair: Seiji Samukawa, Tohoku University
12 : 40 - 13 : 10	CMOS/MEMS Integration from Foundry Standpoint	Albert Chang, Asia Pacific Microsystems (APM)
13 : 10 - 13 : 40	MEMS and CMOS - Cooperation and Integration	Yoshiaki Toyoshima, Toshiba Corp.
13 : 40 - 14 : 10	Opportunities and Challenges for MEMS at 200 mm	Wilbur Catabay, Silicon Valley Technology Center
14 : 10 - 14 : 40	"FineMEMS" Project: Highly Integrated and Complex MEMS	Susumu Sugiyama, Ritsumeikan University
14 : 40 - 14 : 50	Break	
Session 2	MEMS Emerging Applications	Chair: Kazuyoshi Furuta, Seiko Instruments
14 : 50 - 15 : 20	Emerging Micro / Nano Applications from Euro	Uwe Kleinkes, IVAM
15 : 20 - 15 : 50	MEMS MEMS Microphone and 8 inch manufacturing	Yoshio Sekiguchi, Omron Corp.
15 : 50 - 16 : 20	MEMS Applications on Biotechnology and Sensing	Ryo Ota, Olympus Corp.
16 : 20 - 16 : 30	Break	
Session 3	Emerging Technology – BEANS	Chair: Takashi Usuda, AIST
16 : 30 - 17 : 00	MEMS and innovative nano-patterning	Jouni Ahopelto, VTT
17 : 00 - 17 : 30	Nano-structure Design Using Protein	Ichiro Yamashita, Matsushita Electric Industrial
17 : 30 - 18 : 00	Realizing High Efficiency Overcoming the Material Limitation in Thermoelectric Power Generation Using Nano-structure	Koji Miyazaki, Kyushu Institute of Technology
Closing		
18 : 00 - 18 : 10	Closing Remarks	Keiichi Aoyagi, Micromachine Center

◆Japanese-German Micro / Nano Business Forum

(1) Purpose

The Japanese-German Micro/Nano Business Forum has been held annually in Japan since 2003. This year's forum, the sixth, will be held for the first time concurrently with and within the same venue as the Micromachine/MEMS Exhibition. The forum is sponsored by the IVAM Microtechnology Network, an organization set up in 1993 in the North Rhine-Westphalia (NRW) province of Germany with the objective of promoting networking among small and medium-sized microtechnology companies. The forum introduces state-of-the-art technical developments in Japan and Germany, two countries that lead the world in the microtechnology field.

(2) Program

Japanese-German Micro / Nano Business Forum

Date & Time: July 30, 2008 (Wednesday) 10:30 a.m. - 5:00 p.m.
Venue: Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine/MEMS special venue
Sponsor: IVAM Microtechnology Network
Cosponsor: Micromachine Center / MEMS Industry Forum

Opening (Registration Starts 10:30 -) (Attendance free / Simultaneous interpretation provided)

10 : 45 - 11 : 00	Opening Remarks	
Session 1	Solutions for Production of Microsystems	
11 : 00 - 11 : 20	Electrical vias for multi-stack MEMS and packaging issues	Michael Schilling, Plan Optik AG (Germany)
11 : 20 - 11 : 40	Equipment Solutions for Automatic Assembly of Microsystems	Manfred Glantschnik, Datacon Technologies (Austria)
11 : 40 - 12 : 00	Micro machining system for cutting and laser processing	Naoki Iwamura, Leybold Co., Ltd. (Japan) / Kugler GmbH (Germany)
12 : 00 - 13 : 00	Lunch	
Session 2	Business development for Micro and Nano	
13 : 00 - 13 : 40	Innovations for industry- market chances for micro and nano in Europe	Dr. Uwe Kleinkes, IVAM Microtechnology Network (Germany)
13 : 40 - 14 : 00	Technology Transfer Europe-Japan	Dr. Robert Harrison, 24IP LAW GROUP Sonnenberg Fortmann (Germany)
14 : 00 - 14 : 20	MEMS Industry Forum plays a key role of technology and business development on microtechnology in cooperation with the academia and the government	Junji Adachi, Micromachine Center
14 : 20 - 14 : 40	- to be announced -	Dr. Heiko Kopf, MST. factory Dortmund (Germany)
14 : 40 - 15 : 00	Break	
15 : 00 - 15 : 20	- to be announced -	
Session 3	Innovation in Measuring and Analysis	
15 : 20 - 15 : 40	- to be announced -	
15 : 40 - 16 : 00	Optical 3D Surface Measurement Tools for Micro Production	Heinz-Peter Hippler, NanoFocus AG (Germany)
16 : 00 - 16 : 20	Complex Miniaturized Analysis System for Nuclear Magnetic Resonance Spectroscopy	Stefan Leidich, Fraunhofer IZM (Germany)
Closing		
16 : 20 - 16 : 40	Towards successful MEMS business by open collaboration	Prof. Masayoshi Esashi, Tohoku Universty
16 : 40 - 17 : 00	Q & A	

◆ Meeting for announcing results of FineMEMS Project

(1) Purpose

This conference is held to disclose the interim achievements of the "Highly Integrated and Complex MEMS Manufacturing Technology Development Project," a three-year project that has been implemented since FY 2006 by NEDO. This project, also known as the "Fine MEMS" project, seeks to develop key manufacturing technologies for the creation of complex and integrated functions through the creation of advanced tiny three-dimensional structure processing technologies and the use of nanomaterials and different types of materials. This is a key technology supporting the development of the MEMS industry.

(2) Program

Highly Integrated and Complex MEMS Manufacturing Technology Development Project (FY 2006 - 2008) (commissioned by / subsidy provided by NEDO)

Meeting for announcing results of FineMEMS Project

Date & Time: July 31, 2008 (Thursday) 12:30 - 4:30 p.m.
Venue: Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine/MEMS special venue
Sponsor: New Energy and Industrial Technology Development Organization (NEDO) / Micromachine Center
Support: Ministry of Economy, Trade and Industry (planned)
Attendance: Free of charge but first-come-first-serve due to limited seating capacity (200) and quantity of extended abstracts

Session 1	Opening	Chair: Tomoyuki Koike, Micromachine Center
12 : 30 - 12 : 35	Opening Remarks	Akira Uehara, NEDO
12 : 35 - 12 : 50	MEMS industry strategies and expectations for the Fine MEMS Project	Motoki Korenaga, Ministry of Economy, Trade and Industry
12 : 50 - 13 : 10	Overview of Fine MEMS Project	Isao Shimoyama, The University of Tokyo
Session 2	Achievements of Fine MEMS Project consignment projects (1)	Chair: Mitsumasa Koyanagi, Tohoku University
13 : 15 - 13 : 35	Selective nanomachine structure formation technology	Isao Shimoyama, University of Tokyo
13 : 35 - 13 : 55	Selective modification technologies for biomaterials (proteins, etc.)	Yoshio Suzuki, AIST
13 : 55 - 14 : 15	Selective formation technologies for nanomaterials (CNT, etc.)	Kenji Hata, AIST
14 : 15 - 14 : 35	Low-stress dicing technology for multilayer wafer level joints	Masayuki Fujita, Institute for Laser Technology
14 : 35 - 14 : 45	Break	
Session 3	Achievements of Fine MEMS Project consignment projects (2)	Chair: Susumu Sugiyama, Fine MEMS Project Subleader
14 : 45 - 15 : 05	Development of a fine MEMS system design platform	Professor Gen Hashiguchi, Shizuoka University
15 : 05 - 15 : 25	General monolithic manufacturing technologies for MEMS - semiconductor processing (the search for a new sensing principle)	Hisayuki Toriyama, Ritsumeikan University
15 : 25 - 15 : 45	MEMS - semiconductor transverse wiring technologies (high-density low temperature laminate integration mounting technologies)	Jun Akedo, AIST
15 : 45 - 16 : 05	MEMS - semiconductor transverse wiring technologies (high-density low temperature laminate integration mounting technologies)	Mitsumasa Koyanagi, Tohoku University
16 : 05 - 16 : 15	Fine MEMS knowledge database	Toshio Sakamizu, Micromachine Center
Closing		
16 : 20 - 16 : 30	Closing Remarks	Keiichi Aoyagi, Micromachine Center

◆ Micro / Nano 2008 MEMS Forum

(1) Purpose

The MEMS Forum is a forum for the exchange of information and views regarding the various activities of the MEMS Industry Forum. Its purpose is to achieve a deeper common recognition of the issues that must be resolved for the expansion and development of MEMS related industries. The Forum introduces the status of activities by the MEMS Industry Forum and affiliate members (local clusters, publicly funded laboratories and academia), from the perspective of building an infrastructure for the MEMS industry and the creation and development of a MEMS technical infrastructure through industry-academic collaboration.

(2) Program

Micro / Nano 2008 MEMS Forum

– For the Development of MEMS Industries –

Date & Time: August 1, 2008 (Friday) 10:30 a.m. - 4:35 p.m.
Venue: Tokyo Big Sight (Tokyo International Exhibition Center, West Hall 1)
19th Exhibition Micromachine/MEMS special venue
Sponsor: MEMS Industry Forum / Micromachine Center
Attendance: Free

Chair: Shun'ichi Adegawa, Micromachine Center

Opening		
10 : 30 - 10 : 35	Opening remarks	Koichi Imanaka, Assistant Director, MEMS Industry Forum
Session 1	Advancement of MEMS industries and technologies	
10 : 35 - 10 : 50	Overview of MEMS Industry Forum activities	Keiichi Aoyagi, Micromachine Center
10 : 50 - 11 : 20	Strengthening of MEMS industry infrastructure	Isao Shimoyama, The University of Tokyo
11 : 20 - 11 : 40	Toward MEMS market expansion: 1st generation MEMS - 3rd generation MEMS (BEANS)	Junji Adachi, Micromachine Center
11 : 40 - 12 : 00	Technical strategy roadmap for the MEMS field	Hideaki Watanabe, NEDO
12 : 00 - 13 : 10	Lunch / break	
Session 2	Industry-Academic Collaboration Session	Organizer: Professor Kazuo Sato, Nagoya University
13 : 10 - 13 : 20	Remarks at the beginning of the industry-academic collaboration session	Kazuo Sato, Nagoya University
13 : 20 - 13 : 40	Wearable microsensors: an advanced general sensing technology for achieving a safe and secure society	Kazusuke Maenaka, University of Hyogo
13 : 40 - 14 : 00	Mass production of next-generation optical elements through ultra-precision micro three-dimensional machine processing	Eiji Shamoto, Nagoya University
14 : 00 - 14 : 20	Introduction to the Micro Energy Research Council, Micro/Nano Optical Specialist Forum, Japan Society of Mechanical Engineers	Hiroki Kuwano, Tohoku University
14 : 20 - 14 : 30	Break	
Session 3	Issues for MEMS Industry Development	
14 : 30 - 14 : 50	International standardization trends in MEMS fields	Professor Kunie Owada, Teikyo University
14 : 50 - 15 : 10	AIST training of micro/nano manufacturing personnel, focusing on industry-academic personnel training partnership projects	Ryutaro Maeda, AIST
15 : 10 - 15 : 30	Strengthening of MEMS Foundry infrastructure	Susumu Sugiyama, Ritsumeikan University
15 : 30 - 15 : 50	Activities for the establishment of a MEMS foundry network	Fumihiko Sato, Omron Corporation
15 : 50 - 16 : 10	Case studies of the use of MEMS technologies in research and development assistance by the Kanagawa Industrial Technology Center	Manabu Yasui, Kanagawa Industrial Technology Center
16 : 10 - 16 : 30	MemsONE functions and future plans (MEMS design and analysis support system) Ver. 1.1	Yukihisa Maeda, MemsONE Consortium, Nihon Unisys Excelutions
Closing		
16 : 30 - 16 : 35	Closing Remarks	Keiichi Aoyagi, Micromachine Center

Activities of the Micromachine Center in FY 2007

Overview

The Micromachine Center (MMC) actively promotes technical development projects commissioned by the national government and the New Energy and Industrial Technology Development Organization (NEDO) in an effort to establish the core technologies in the micromachine, Micro Electro Mechanical Systems (MEMS) and other micro/nano fields. At the same time, in order to promote widespread use and industrialization of these core technologies, the Center also aggressively pursues activities to improve the environment for micro/nano technologies. The Center's activities include policy proposal activities, industry interchange / stimulation projects, research projects, standardization promotion projects and dissemination and publicity projects designed to promote industrial development in micro/nano fields and contribute to the international community.

In FY 2007, the Micromachine Center conducted the following activities.

1. National / NEDO projects

In FY 2007, the Micromachine Center vigorously promoted the Highly Integrated and Complex MEMS Manufacturing Technology Development Project, a three-year project initiated in FY 2006. The Center also actively promoted the dissemination of MemsOne, the research and development achievement of the MEMS Design and Analysis Support System Development Project (commissioned by the national government and NEDO) that concluded in March 2007.

(1) Highly Integrated and Complex MEMS Manufacturing Technology Development Project (Project commissioned by NEDO)

In FY 2007, as in the previous fiscal year, active development efforts continued to focus on gathering, organizing and building a database of knowledge data in three areas:

① Combination of MEMS / nanofunctions
② Integrated formation of MEMS / semiconductors
③ High integration of MEMS with other MEMS

A new project to research and develop a fine MEMS integrated design platform was also initiated in FY 2007 as a single-year FY 2007 special financial resource for project promotion. A web browsing system was also created by organizing information relating to research and development issues 1 - 3 as well as information peripherally related to these issues involving an equivalent circuit model as a design platform suitable for highly integrated and complex MEMS devices.

(2) Promotion of MemsONE dissemination

MemsONE was the research and development achievement of the MEMS Design and Analysis Support System Development Project, a project commissioned by the national government and NEDO that concluded in March 2007. The Center worked with the MEMS Industry Forum to energetically promote the dissemination of MemsONE.

(3) MemsONE Achievements Dissemination Project (commissioned by NEDO)

The Center initiated a MemsONE achievements dissemination project (commissioned by NEDO) to disseminate MemsONE in order to achieve the project's stated objective of promoting the expansion of the MEMS industry base and the development of new MEMS products.

More than 450 licenses for the beta version have been issued, and the training course was attended by more than 150 persons. These activities made a major contribution to establishing an infrastructure for dissemination.

2. MEMS Industry Forum projects (policy proposal and industry interchange / stimulation projects)

In order to support the further development of the MEMS industry, the MEMS Industry Forum was established in April 2006 as a Special Projects Committee with a membership made up primarily of companies involved in the MEMS industry. The MEMS Industry Forum also works to establish ties with academies, local centers, overseas institutions and the like as affiliates. The Forum makes policy proposals to relevant institutions and promotes a variety of activities aimed at industry interchange and stimulation.

(1) Policy recommendation activities

On November 8, 2007, members of the MEMS Industry Forum Promotion Committee and representatives from the government and related agencies exchanged views on MEMS. In addition, a MEMS Forum was held at the Micro-Nano 2007 general exhibition in July 2007. Various issues were raised with regard to design (MemsONE), manufacturing (MEMS Foundry) and MEMS personnel training, with the aim of strengthening the infrastructure for the MEMS industry. These policy recommendation activities were conducted to promote the development of MEMS-related industries.

(2) Industry-academia liaison activities

Micro/Nano Cutting Edge Technology Exchange meetings were held three times during the fiscal year (in July, November and March), in order to deepen understanding and recognition of state-of-the-art technologies in various fields relating to micro/nano technology, and to disseminate micro/nano technologies and promote industry-academia interchange. For each session, two knowledgeable persons from universities, the National Institute of Advanced Industrial Science and Technology (AIST) and so on were invited to give presentations and provide technical consultation.

(3) Creation of an infrastructure for MEMS development

① Expansion and upgrading of MEMS Foundry Network systems
② Promotion of MemsONE dissemination
③ Strengthening of collaboration with public foundries in each area and local clusters
④ Promotion of personnel training projects

(4) MEMS business interchange activities both at home and abroad

① Opening of a MEMS Malll

Study of basic activities and site configuration for MEMS Mall and preparation of a MEMS Mall draft proposal.

② Holding of Micro/Nano 2007 general exhibition

Micro/Nano 2007 was held July 25 - 27 primarily at Tokyo Big Sight.

③ Participation in 13th World Micromachine Summit

The 13th World Micromachine Summit was held Thursday, April 26, 2007 through Saturday, April 28, 2007 in Venice, Italy (at the Telecom Future Centre).

④ Formation of an international affiliate network

The establishment of cooperative ties with overseas MEMS related organizations was promoted. As of FY 2007, there were 11 overseas affiliates.

⑤ Dispatch of overseas missions and researcher interchange

In FY 2007, the Micromachine Center participated in a micro/nano related event in Germany (Hannover Messe), and also dispatched missions to overseas countries and promoted interchange with both research institutions/organizations and individual researchers.

3. Research projects

The Micromachine Center conducted research relating to micromachine and MEMS technologies in order to accurately determine technical and industry trends and study new technical issues in the areas in which micro- and nanotechnologies are becoming integrated.

(1) Implementation of research relating to the BEANS Project

The BEANS project represents the achievement of the "MEMS Frontiers: Study of Future Device Technologies Made Possible by Fusion with Nanodevices" project implemented in FY 2006. In order to make the BEANS project into a national project, a "BEANS Project Research Council" was established and study was conducted of the project scheme, organization, research content and the like.

(2) Study of technical trends in Japan and other countries

In the first half of the fiscal year, study focused on the type of presentations made at TRANSDUCERS '07 and the trends in oral presentations for each field. In the second half of the year, as in past years, a study was conducted of the type of presentations featured at MEMS2008 and the trends for each industry.

(3) Study of industry trends

To stimulate MEMS industries and expand the MEMS industry base, a study was conducted to determine the current status and market trends relating to the MEMS foundry industry in Japan, as well as the state of MEMS foundries in other countries. In addition, basic data needed to upgrade MEMS foundry functions in the future was compiled.

(4) Periodic survey of MEMS technology strategy map

As a periodic survey of the technical strategy map for the MEMS industry, a roadmap for improving the environment for MEMS personnel training was established in order to accommodate MEMS market expansion.

(5) Upgrading of micro/nano database

An effort was made to further enhance the database on the Micromachine Center website by provide a search function for documents made available to supporting members as well as by including survey reports, mini-survey reports, a map of research centers and so on.

4. Projects to promote standardization

Standardization projects were pursued with our international initiatives in micromachine/MEMS technology fields.

(1) Standardization priority review

With regard to standardization candidate topics in core common fields and device fields, studies were conducted of the current status and the need for technical verification, the need for development of new measurement methods, research and development organizations, priorities, existing standards and so on. Accordingly, in the device field it was decided to give top priority to angular velocity sensors (gyro) and geomagnetic sensors.

(2) Research and development activities relating to certification of standards for the purpose of proposing international standards

With regard to life acceleration tests, test specimens for individual universities were prepared from the same test materials and fatigue tests were conducted using various methods and the results were compared. With regard to bonding strength tests, testing equipment was developed and a qualitative determination of the current state of bonding strength evaluation research was conducted for microstructure members, and a study of existing standards was conducted.

(3) Follow-up activities relating to proposal of standards for thin film material fatigue testing

The views of various countries were accommodated and follow-up activities were conducted up through the submission of a committee draft for vote (CDV).

(4) Study of overseas standards

Following a review of the following standards proposed by Korea, voting and the submission of comments from Japan were conducted.

① General Principles of MEMS (CDV)
② RF-MEMS switch (CD)
③ Bonding test method (CD)

(5) Creation of JIS standards for thin film material tensile test method standard

Work was begun on the creation of JIS standards for the tensile test method and standard test specimens standardized by the IEC in 2006.

(6) In June 2007, the Micromachine Center became the Japanese review body in the MEMS field for IEC/TC47 (specialist committee for semiconductor devices). The Center also proposed that Working Group 4 (WG4) in the MEMS field be upgraded to a subcommittee (SC).

5. Dissemination and publicity projects

The Micromachine Center issued and distributed a newsletter and sponsored exhibitions and the like in an effort to promote widespread dissemination and education regarding micromachines and MEMS. The Center also collected micro/nano information and reference materials from universities, industry, public institutions and so on both at home and abroad and organized these materials together with the reference materials from studies conducted by the Center. These materials can be viewed and searched in the MMC library, and they have also been made available to researchers both at home and abroad via the MMC website.

(1) Improved dissemination and exchange of information through the MCC website

The Micromachine Center worked to provide information and conduct interchange activities using the MMC website. The content available to supporting members has also been upgraded.

(2) Publication of "MICRONANO" quarterly

The Center published a quarterly magazine entitled "MICRONANO" in April, July, October and January and distributed it to supporting members and other relevant entities, and also posted English and Japanese editions on its website.

(3) Publication of monthly newsletter

The Center published a monthly newsletter in Japanese entitled *MMC/MIF News* and distributed it to supporting members, MEMS Industry Forum members and other entities via the Micro/Nano Net. The newsletter provides MMC-related news for the previous month, information on upcoming events and so on.

(4) Publication of MicroNano Express newsletter

The Center published an electronic newsletter in Japanese to provide information on special events and the like and distributed it to supporting members, MEMS Industry Forum members and other entities via the MicroNano mailing list.

(5) Maintaining and upgrading of the MMC library (by upgrading the academic paper abstract database, etc.)

The Center summarized abstracts of technical papers and references in the *Micro/Nano Index* newsletter (Japanese only) and distributed the newsletter in electronic form to supporting members, related institutions etc.

The Center also upgraded the library by organizing and storing the technical documentation and references that had been gathered and making these materials available for viewing.

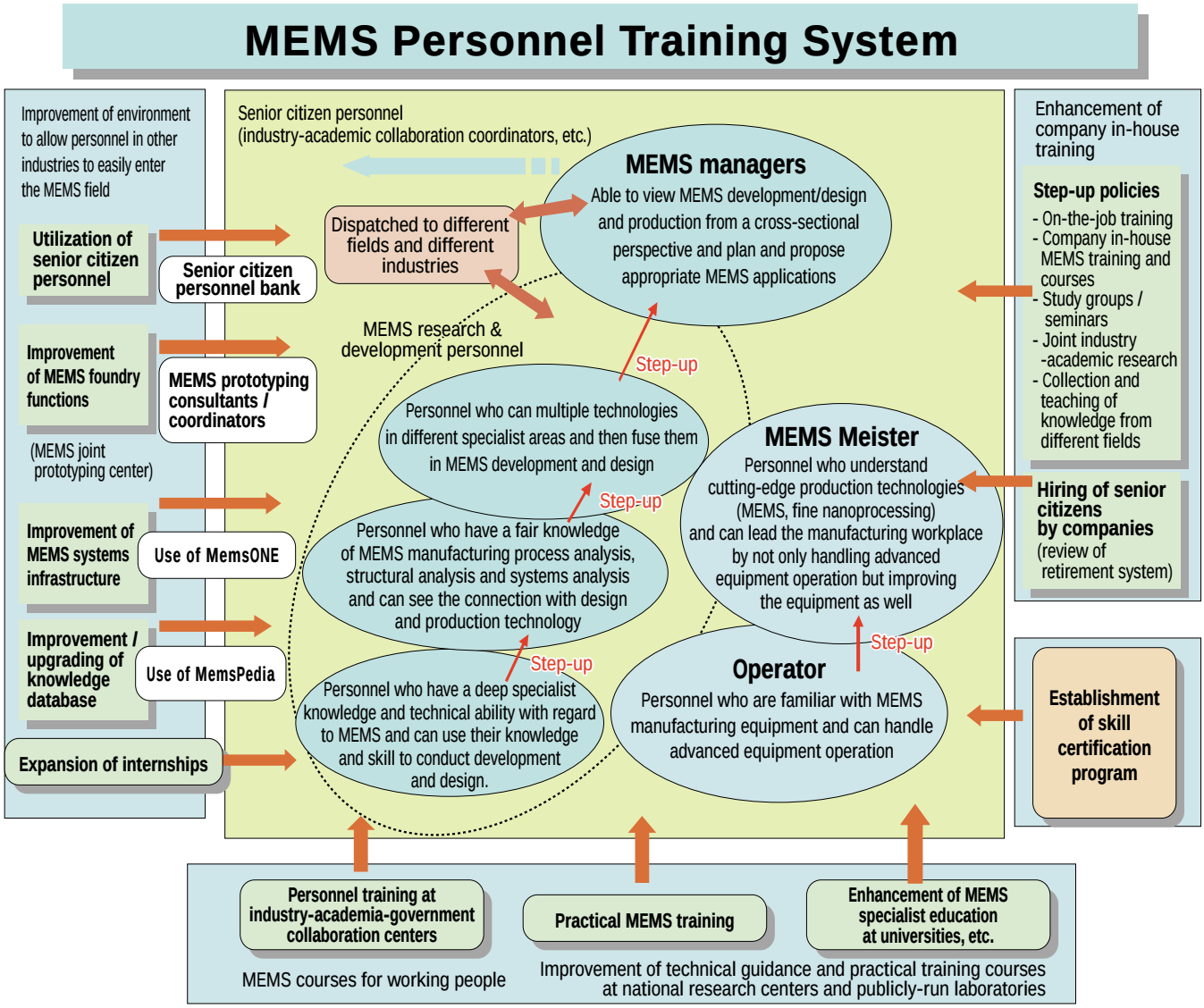
(6) Micromachine/MEMS Exhibition

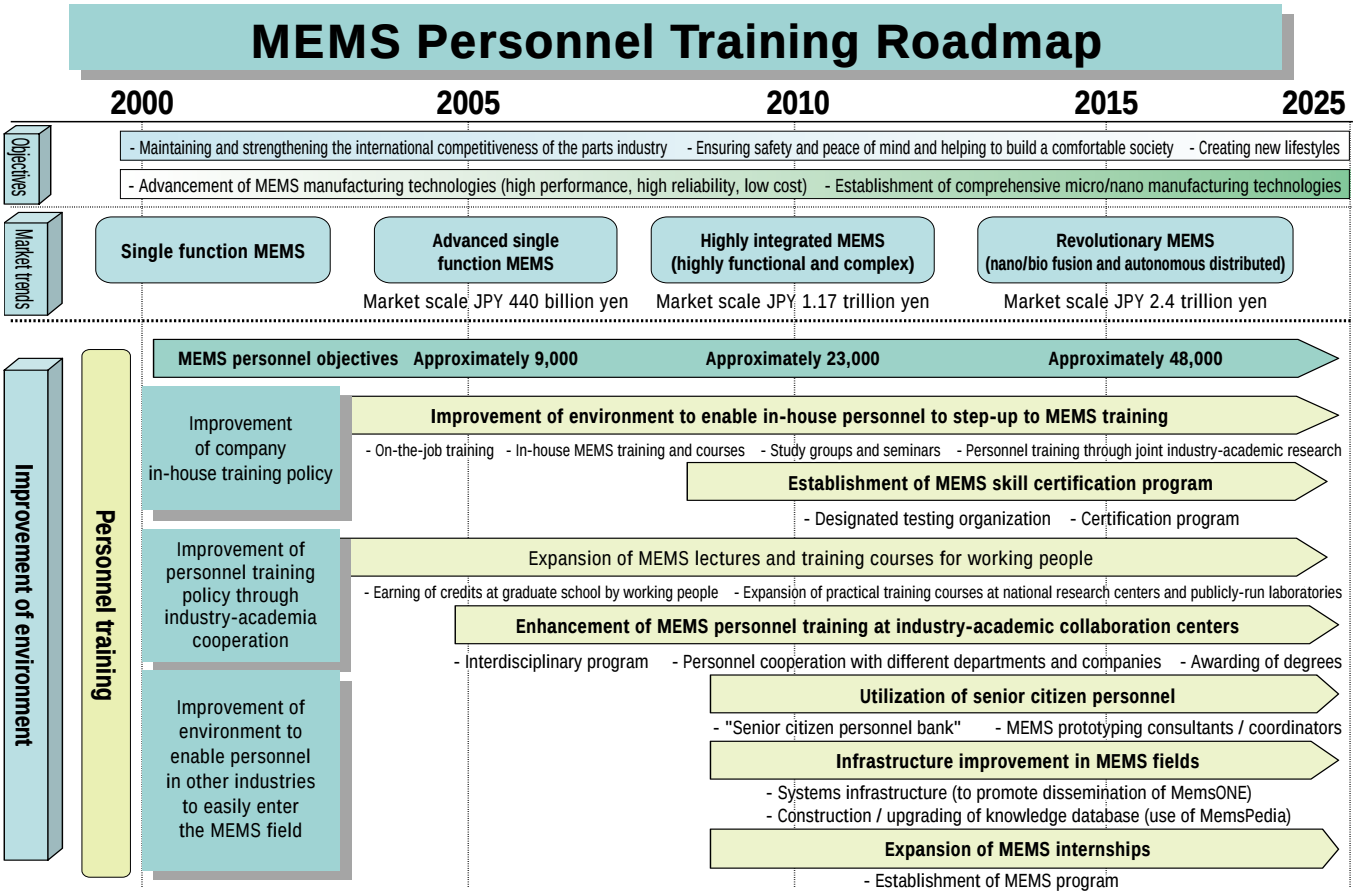
The 18th Micromachine/MEMS Exhibition was held as part of Micro/Nano 2007 at Tokyo Big Sight Wednesday, July 25 through Friday, July 27, 2007. Total attendance was 12,424 persons, the largest yet (last year's attendance was 11,736 persons). The exhibition featured 362 organizations exhibiting at 484 booths.

Personnel Training and Improvement of Foundry Functions to Accommodate MEMS Market Expansion

The market for Micro Electro Mechanical Systems (MEMS) – tiny, highly sensitive key devices with excellent energy conservation properties – is expected to expand in diverse fields such as telecommunications, automobiles, robots, medical care and biotechnology. However, knowledge and technologies in a wide array of fields including machinery, electricity, chemistry, physics, materials, optics and medical care will be needed for the development and manufacture of MEMS. The training of MEMS personnel who can take a comprehensive view of the entire technical development process will also be essential.

Securing of personnel in the MEMS field is a matter of pressing urgency in order to accommodate the expansion of the MEMS market. Taking this into account, the Micromachine Center studied the status of personnel training programs in the MEMS field that are currently being implemented by MEMS related companies, as well as the MEMS personnel training programs being promoted and supported by the national government. Based on the results, the objectives have been divided into two areas ("improving the environment for company in-house personnel training policies" and "improving the environment to enable personnel in other fields to easily enter the MEMS field"). A conceptual diagram of a MEMS personnel training system has also been prepared and this has been reflected in the technical strategy roadmap for MEMS fields.

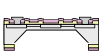




Moreover, to accommodate the expansion of the MEMS market, it is essential to upgrade MEMS foundry services to make it easy for even companies that do not possess manufacturing equipment to actively engage in MEMS business. For this reason, a study of the current state of MEMS foundry business in Japan was also conducted. This study determined that the scale of use of MEMS foundries in Japan is currently estimated at approximately JPY 35 billion yen, and this is expected to increase each year along with the expansion of the scale of the MEMS market. However, the study made it clear that shortened durations and cost reductions are the biggest issues that must be resolved to enable the MEMS applications needed for creating new markets to be prototyped and verified as quickly as possible. Moreover, as overseas dedicated MEMS foundry companies are beginning to appear, the Micromachine Center put together a proposal emphasizing that there is an urgent need in Japan as well to upgrade MEMS foundry functions, through the creation of entities such as a MEMS joint prototyping center with MEMS development and prototyping functions as a mechanism for producing and supporting MEMS ventures.

The Micromachine Center also conducted a study for the purpose of establishing a mechanism by which, in cooperation with foundry companies, small and medium-sized companies and the like with little knowledge of MEMS manufacturing methods can submit a request to MEMS foundries and order MEMS of feasible shapes and sizes created using basic manufacturing processes. The Center also compiled a draft collection of standard process recipes (ready-made processes). The use of these standard process recipes is expected to reduce the cost of new MEMS manufacture and shorten deadlines and so on. A study will be conducted together with the use of these recipes in MemsONE.

Overview of Draft Collection of Process Recipes

Platform	Process Recipe	Device Structure	Sample MemsONE emulation
Device: Piezoelectric acceleration sensor			
Device: Electrostatic capacity type acceleration sensor			
Device: Micromirror powered by static electricity			
Device: Piezoelectric pressure sensor			

Starting the BEANS Project

Atsushi Yusa, President, BEANS Laboratory

This month, the Project to Develop Technologies for the Manufacture of Next-Generation Devices That Fuse Different Fields – a FY 2008 research and development project of the Ministry of Economy, Trade and Industry – was initiated. The "next generation devices that fuse different fields" referred to in the project's title are none other than the Bio & Electro-mechanical Autonomous Nano Systems (BEANS), the revolutionary devices of the future that the Micromachine Center has been studying for the past four years. As you know, BEANS is a concept for the creation of third-generation Micro Electro Mechanical Systems (MEMS) devices. A committee chaired by Professor Hiroyuki Fujita of the University of Tokyo was established and specialists from companies, universities and national reserch institute that are supporting members of the BEANS Research Center have pooled their knowledge and expertise to create these devices.

I am most gratified that BEANS have been selected as one of the candidates for application of the device manufacturing technologies that is the aim of the new project. I salute the enthusiasm and the efforts of all of you who have contributed their energies to involvement in BEANS research up to now. Thanks to your hard work, the Micromachine Center has been selected by the Ministry of Economy, Trade and Industry as the research promotion entity for the new project. In response, the BEANS Laboratory has been set up within the Micromachine Center to plan and propose new projects and conduct research promotion activities. This paper will provide an overview of the BEANS Laboratory and will cover its research management policy, research areas and research promotion organization in that order.

1) Research Management Policy

A basic policy for research management has been established in order to guide the project to success and ensure that its research achievements provide wide-ranging benefits to society. (**Fig.1**). The watchwords for this policy are "integration" and "open." The goal of the project is the integration of technologies in different fields, combining MEMS (which is the title of one of the research and development projects) with nanotechnology and biotechnology. The project will also work to establish ties between state-of-the-art technology centers and integrate company management with cutting-edge research. Another goal is to accomplish the heretofore difficult task of establishing a framework for fusion research. Moreover, since the research areas are pre-competitive research areas, a knowledge database containing both academic achievements and test data will be compiled to make the achievements and data widely available. In addition, steps will be taken to make licenses widely available for the patents and other intellectual property rights that have been acquired, to ensure that the research achievements contribute to the growth of domestic industries and the creation of new businesses. In addition, as personnel training and development is also considered to be of crucial importance, research management that integrates industry and academia will be conducted and an effort will be made to create interchange between young university researchers and company engineers. For this purpose, many managers that previously worked at companies and have experience in research management will be recruited to accelerate and effectively promote research.

2) Research Areas

Fig.2 shows the research areas planned for implementation at the BEANS Laboratory. Under this Basic Project Plan, there will be three major research areas:

(1) Bio and organic materials fusion process technologies
(2) 3-dimensional structure formation process technologies
(3) Micro/nanostructure large-area / continuous manufacturing processes

To these will be added one common research area: the compiling of a database of manufacturing technology development knowledge.

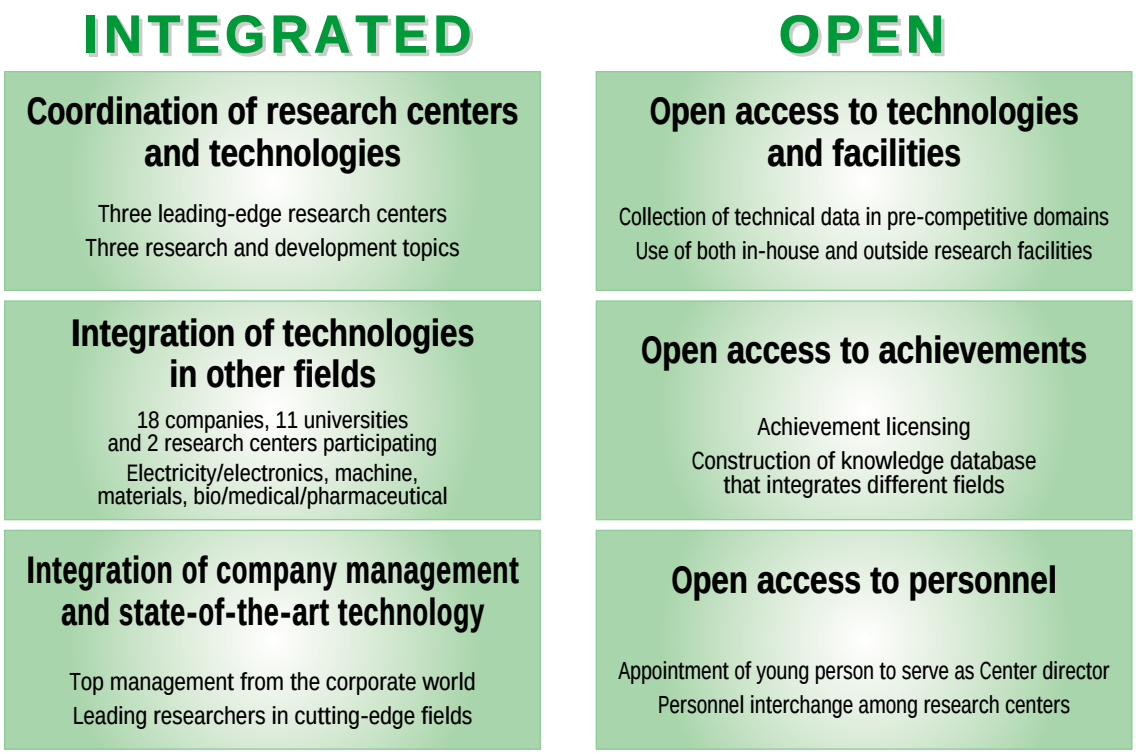


Fig 1 BEANS Research Center Policy: Integrated and Open

Research Topic 1　Bio and organic materials fusion process technologies (1) Process technologies for nano-interface fusion (2) Process technologies for the formation of bio and organic material higher-order structures
Research Topic 2　3-dimensional structure formation process technologies (1) Ultra-low damage / high-density three-dimensional nanostructure formation technologies (2) Three-dimensional nanostructure formation technologies for integrating different types of functions (3) Three-dimensional nanostructure formation technologies for use in aerospace applications　(Note: implemented by the Institute for Unmanned Space Experiment Free Flyer)
Research Topic 3　Micro/nanostructure large-area / continuous manufacturing processes (1) Process technologies for the formation of high-grade nanofunction membranes over a large area in non-vacuum environments (2) Process technologies for continuous fine processing / integration of fibrous substrates
Research Topic 4　Creation of a knowledge database for next-generation device manufacturing technologies that integrate different fields

Fig 2　Research Topics Studied by the Beans Research Center

(1) Bio and organic materials fusion process technologies

The goal in this area is the development of process technologies for achieving the device functions and mechanisms needed in next-generation health, medicine and environmental fields. In addition to the conventional inorganic dry materials such as silicon, research and development will be conducted for fusion processes that utilize the unique functions of bio and organic materials such as synthetic organic molecules, biomolecules, cells, structures, microorganisms and so on. One example is technologies to enable biological organic materials (such as lipid bilayer membranes, hydrogels and peptide synthesis) to be handled freely within microsystems.

(2) 3-dimensional structure formation process technologies

As a core technology for BEANS devices, process technologies will be developed for integrating inorganic and organic nanostructure materials on silicon, glass or other 3-dimensional structures to achieve functions not possible with silicon alone. The ultra-low damage etching conducted up to now using neutral particle beams has been developed into a method of creating 3-dimensional nanostructures that achieve surface smoothness at the atomic layer level, enabling the formation of “bottom up” structures through the self-assembly of nanomaterials on the surface of three-dimensional nanostructures. This will make it easy to manufacture terabit class high-density recorders and ultra-sensitive sensing devices.

(3) Micro/nanostructure large-area / continuous manufacturing processes

One of the efforts in this area involves the development of process technologies for the continuous manufacture, over a large area and in non-vacuum environments, of microstructure high-grade functional materials for use in electronic devices. This can be achieved by combining atmospheric pressure plasma equipment with nanomaterial coating technologies and self-assembly technologies. Another effort is the development of processing technologies capable of continuously nanoimprinting or forming functional membranes on glass fibers and other fibrous substrates. There are also plans to develop weaving technologies to turn these fibrous substrates into cloth. This would create an applied technology with wide-ranging applications for industry.

3) Research Promotion Organization

This project will be promoted by the BEANS Laboratory, a new entity set up within the Micromachine Center. The BEANS Laboratory will include three research centers, one for each research area: Life BEANS, 3D BEANS and Macro BEANS. These three research centers will be set up outside the Micromachine Center. Life BEANS will be located at the University of Tokyo and Kyushu University. 3D BEANS will be located at the University of Tokyo as well. Macro BEANS will be located at the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba (see Fig. 3). In this way, the

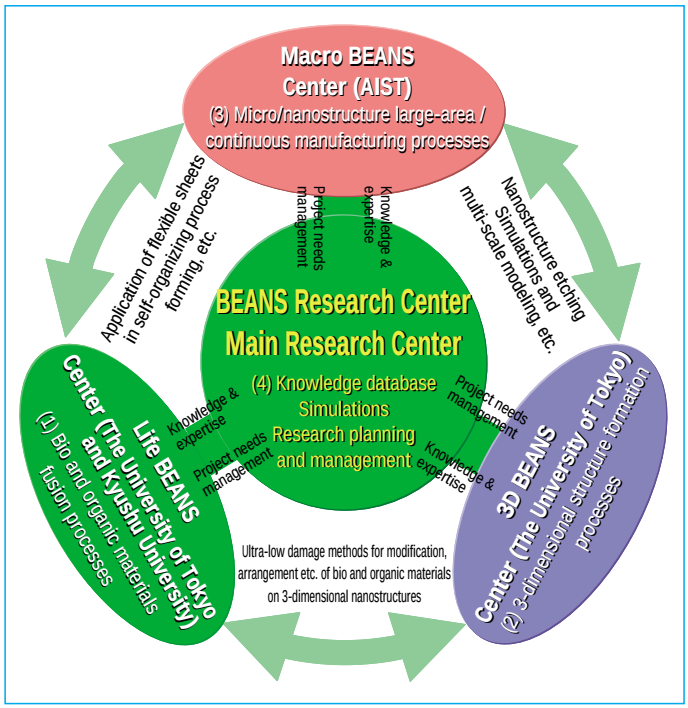


Fig 3　BEANS Research Center: Cooperation with Other Research Centers

research activities of the BEANS Laboratory will be conducted in three separate locations, but the research planning and budgeting for project areas, personnel allocation and other aspects of project management will be centralized at the BEANS Laboratory. Moreover, project management will live up to the “Fuse Different Fields” part of its name by accelerating integration and coordination among the three centers with regard to research areas, and by ensuring close cooperation among these centers. During this fiscal year, 18 companies, 11 universities and 2 research centers are scheduled to participate in the project, with the involvement of a total of 102 researchers from companies, universities and research centers. Apart from the research achievements, it is project management that will be the key to the success of the project. As we move forward with this project, I hope we can count on the continued understanding and cooperation of all who are involved in the BEANS project.

Column

Where is MEMS Headed Next?

Tsuneyuki Miyake, Deputy Editor of Nikkei Microdevices, Nikkei Business Publications, Inc.

When glancing through recent industrial news on MEMS and micromachines, I noticed that these technologies have drawn attention from various industries and that there is a trend toward undertaking MEMS business activities. The following is just a sample of some of the headlines over the past six months (all taken from the MEMS International news Web site at http://techon.nikkeibp.co.jp/MEMS/).

■"RFMD Introduces MEMS Switches for Use in Mobile Phones and Announces Plans to Build a New Facility" (Nov. 28, 2007), ■"OMRON to Construct a 200-mm line for MEMS Production" (Dec. 13), ■"U.S. Company Technitrol Acquires Denmark-based Sonion" (Jan. 10, 2008), ■"Wireless Crop-Monitoring Network Deployed in Vineyards" (Jan. 30), ■"Mitsumi Show: Mitsumi Electric Developing a 3-axis Accelerometer with 2.8 mm per side" (Feb. 21), ■"ST and Veredus Market Lab-on-chip for Rapid Detection of Influenza" (Mar. 24), ■"iSuppli to Conduct Market Research on MEMS and Solar Cells" (Apr. 7), ■"NHK Proposes a New User Interface for TV Remote Controller with Built-in Motion Sensor" (Apr. 24), ■"NTT DoCoMo Invests in MEMS Gyro Startup" (Apr. 30), ■"TSMC Announces Full-Entry into MEMS Market" (Apr. 30), ■"EPCOS Acquires NXP's RF MEMS Business" (May 2), ■"Toshiba Jointly Develops a DNA Chip for Monitoring Infectious Disease in Animals" (May 30), and ■"Toshiba Unveils Technology to Encapsulate MEMS Devices in Front-end Process" (May 31).

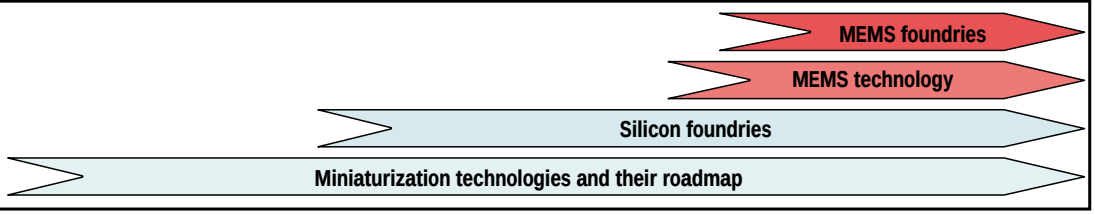
It is clear that numerous industries involved in semiconductors, electronic parts and components, cellular telephones, broadcasting, and the like have invested human and financial resources in MEMS. This is likely because recent advances in MEMS technology and improvements in the infrastructure (design and production) have lowered the entry level required for developing MEMS devices. The continuous mass-production of inkjet heads and mass-production of devices used in consumer equipment, such as accelerometers and silicon microphones (see left diagram below), are two factors that have facilitated the use of MEMS.

Recently companies have begun integrating MEMS of various types from other industries into their own core businesses. I think this is particularly embodied by trends in the semiconductor industry over the past year. For those readers who have followed MEMS and micromachines over the years, it must feel that the materialization of such trends was a long time in coming.

The question is where is MEMS headed next? In this IT (information technology) age, wireless sensor networks will be used to incorporate enormous amounts of information from the real world into the computer world, enabling anyone to reference and manage this information. There have been many predictions on when this scenario might come about (see right diagram below), but there is great potential for MEMS contributing to sensors and tiny power sources in these circumstances. Corporate players who can harvest the added value of MEMS are still looking forward to this day with anticipation.

Period	Applications	Impact on the MEMS industry	Major players in production
1990 -	▼MEMS built into equipment (inkjet heads, etc.)	▼Establish mass-production	Equipment manufacturers Automobile manufacturers
2000 -	▼MEMS devices (accelerometers, etc.)	▼Accelerate low-cost technologies and expand production infrastructure	Semiconductor manufacturers Parts manufacturers
2005 -	▼Integrated MEMS (devices merging CMOS and LSI, etc.)	▼Develop standards for production processes and advance integration with LSI production	Semiconductor manufacturers MEMS foundries
2010 -	▼MEMS integrated devices from semiconductor manufacturers	▼Developing an IP core for MEMS functions	Silicon/MEMS foundries Semiconductor manufacturers

Application	Personal computers	Digital consumer electronics	Real world information systems
Start of industry	1980s	2000s	2010s
Leading players	Intel Corp., Microsoft Corp.	Apple Inc., Matsushita Electric Industrial Co., Ltd. (Panasonic), Nokia Corp., Sony, etc.	Google Inc.
High added value players	Intel	Apple, ARM Ltd.	Google Inc.?
Required devices	Microprocessors, DRAM, HDDs	SoC, flash memory, wireless chips	Sensors, wireless chips, tiny power sources
Major infrastructure of industry			



Exhibition at Hannover Messe 2008 (April 21 - 25)

The Hannover Messe, the largest industrial products sample fair in Europe, was held in the city of Hannover, Germany for five days from April 21 through April 25, 2008. The Micromachine Center was one of the exhibitors and worked to publicize MEMS related research in Japan and industry trends, in cooperation with MEMS Industry Forum members Omron Corporation, Olympus Corporation, Matsushita Electric Works, Ltd., Mitsubishi Electric Corporation, the New Energy and Industrial Technology Development Organization (NEDO) and the University of Tokyo. IVAM Microtechnology Network, a MEMS Industry Forum overseas affiliate, sponsored a "Micro Technology Fair" sub-exhibition at the Hannover Messe. In the spirit of mutual cooperation with the Micromachine Center, IVAM has exhibited at the exhibition since 2006.

Each year a country is designated as the partner country for the Hannover Messe and a variety of events relating to that country are held during the period of the exhibition. Japan was the partner country for this year's exhibition, and JETRO and the Ministry of Economy, Trade and Industry played a leading role in coordinating these events. More than double the usual number of companies and organizations from Japan exhibited at the exhibition and related events were held almost daily.

On April 20, prior to the start of the exhibition, an opening celebration was held at the Hannover Congress Centrum in Hannover. Welcoming addresses were given by former Prime Minister Shinzo Abe of Japan and current Chancellor Angela Merkel of Germany. The featured entertainment was a troupe of dancers performing the famous "Awa-odori" folk dance.

This was the third year that the Micromachine Center has exhibited at Hannover Messe. The Center was able to secure a larger exhibition booth than last year, and exhibits from primarily MEMS Industry Forum members presented information about the MEMS industry in Japan. The exhibits focused on activities to promote industrialization and were divided into sections according to the following categories

1) Overview of the MEMS Industry Forum
- Promotional activities (through exhibitions, etc.)
- Policy recommendation activities for the planning of national government projects for next fiscal year
- Participation in NEDO / METI projects, promotional assistance and follow-up relating to project achievements
- Foundry service network activities
- Formation of network with universities, research centers, clusters, academies and other relevant organizations in Japan
- Formation of international affiliate network

2) Introduction of Micro/Nano 2008
- The 19th Exhibition Micromachine / MEMS
- 14th International Micromachine / Nanotech Symposium

3) Development of industrial technologies through NEDO projects
- Assistance for development of industrial technologies by means of industry-academia-government collaboration
- Scenarios for technical and industrial development in MEMS fields by means of a technical strategy map

4) Overview of NEDO projects
- Overview of Highly Integrated and Complex MEMS (Fine MEMS) Manufacturing Technology Development Project
- Development of selective nanomachine structure formation technology (University of Tokyo)
- Demonstration (device cross-sectional structure model currently under development)

5) MEMS packaging technologies (Matsushita Electric Works, Ltd.)
- Low-heat stress wafer level packaging
- Multilayer ceramic MID packaging
- Video: Introduction to MIPTEC

6) MEMS Foundry (Olympus Corporation)
- Features of Olympus foundry
- Presentation of equipment and case studies

7) Project development in the optical field (Olympus Corporation)
- Optical scanner
- AFM cantilever
- MEMS flap actuator
- Exhibition of MEMS scanner samples

8) Sensing technologies (Mitsubishi Electric Corporation)
- Pressure Sensor, Accelerometer, Air Flow Sensor
- MEMS Switch, MEMS Package, Switched Capacitor Array
- Core processes: bulk micromachining, surface micromachining, 3D integration

9) Project development in the telecommunications field (Omron Corporation)
- Features of MEMS Microphone
- Applications
- MEMS microdemo

On the first day of the fair, Tamotsu Nomakuchi, director of the Micromachine Center visited the venue and expressed words of appreciation to all of the exhibitors for their hard work. He also had informal talks with Mr. Kleikens representing IVAM Microtechnology Network, a sponsor of the fair and a MEMS Industry Forum affiliate. On April 24, the economic minister from the North Rhine-Westphalia (NRW) province of Germany visited the booth and discussed the status of MEMS industrialization promotion activities in Japan and Japanese industry expectations with respect to IVAM's activities.

Mr. Kleikens of iVAM and MMC Director Nomakuchi

Business negotiations

Environment Minister from NRW Province visits the MMC booth

At the Forum held at the Microtechnology Fair venue, the second day of the exhibition (April 22) was designated Japan Day. The day's events opened with words of welcome from MMC Executive Director Keiichi Aoyagi, and this was followed by ten presentations (listed below) from both Japan and Germany regarding technical developments and project development.

Next year, the Hannover Messe will be held April 20 - 24, 2009. Korea will be the partner country.

14th World Micromachine Summit (April 30 - May 3)

The 14th World Micromachine Summit was held for four days from Thursday, April 30 through Saturday, May 3, 2008 at the Hotel Riviera (Dynasty Hall) in Daejeon, Korea.

Since the first Micromachine Summit was held in 1995 in Kyoto, the summit has been held each year in a different country chosen from among those wishing to act as host. This year's 14th summit featured the addition of the Iberian region and Romania, making a total of 18 countries or regions (Australia, the Benelux countries, Canada, China, the EC, France, Germany, the Iberian region, India, Japan, Korea, the Mediterranean region, the Nordic region, Romania, Singapore, Switzerland, Taiwan and the United States). 56 representatives and 43 observers from 26 of these nations and regions attended for a total of 99 participants.

This year's summit began with a review of the situation in each country or region, presented by the chief representative from that country/region. This was followed by presentations from 32 representatives on the status of activities in each region and future prospects. The presentations were divided into five categories:

(1) Technical overview
(2) Cutting-edge technologies
(3) Market standardization and industrialization trends
(4) Education and technology platforms
(5) Foundry and cluster networks

The chief delegate from Japan was Professor Isao Shimoyama of the University of Tokyo. There were 10 participants in all including observers. Three presentations were made by the Japanese delegation.

In the country/region review, Professor Shimoyama of Tokyo University gave a presentation covering the position of MEMS in Japan's science and technology policy, a technical strategy map for the MEMS industry, a roadmap for standardization, the role and activities of the MEMS Industry Forum, MemsONE, Fine MEMS, BEANS and other aspects of the status of national project promotion in Japan. Kazuo Kyuma, senior managing officer at Mitsubishi Electric Corporation, presented an overview of the next-generation BEANS project. Koichi Karaki, executive officer at Olympus Corporation, presented an introduction of MEMS technologies.

At this year's summit, the presentations from each country regarding the current state of MEMS technology covered such matters as the construction of a new 8" line and accelerated mass production that includes CMOS MEMS. With regard to next-generation MEMS technologies, the presentations focused on the creation of new processes and devices through nanotechnology, biotechnology and the fusing of different fields. It was clear from the presentations that countries around the world are moving in roughly the same direction in their pursuit of micro/nanotechnology research and development. Moreover, the emergence of MEMS developing nations and regions such as India, Iberia and China thanks to active support by national and local governments in these nations and regions was also noteworthy.

Technical tours were conducted on the first and fourth days of the summit, before and after the two-day conference. Tour participants visited LG Electronics Institute of Technology, Samsung Electro-Mechanics, the Korea Institute of Machinery & Materials (KIMM), the Electronics and Telecommunications Research Institute (ETRI), the Korea Research Institute of Bioscience and Biotechnology (KRIBB), and National Nanofab.

Next year's summit will be held in Edmunton, Canada May 5 - 8, 2009.

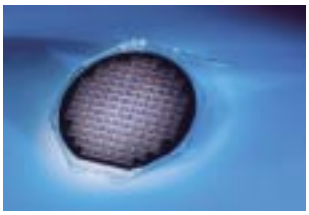
The World Micromachine Summit is expected to continue to grow in influence as a forum for international interchange relating to MEMS and nanotechnology. The Micromachine Center hopes that this summit will continue to prove valuable to people around the world.

Okmetic Oyj

Okmetic K.K.
Sunrise Mita 8F
3-16-12, Shiba
Minato-ku, Tokyo 105-0014
Tel. +81-3-3798-1400
Fax +81-3-3798-1402

1. Okmetic in general

Okmetic is the world's leading supplier of silicon wafers for high-performance MEMS sensor manufacturing. We have acted on the MEMS-market for over twenty years and in Japan since late 1980s. Okmetic has a global customer base and sales network, productions plants in Finland and the US, and contract manufacturers in Japan and in China. Okmetic K.K. in Tokyo serves our Japanese customers and gives technical support. Our team is ready to respond to the growing demand for MEMS wafers in Japan.



Okmetic's solution is our 100-200 mm SOI product range with preprocessed structures

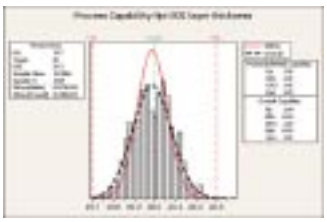
2. Products designed for MEMS sensor manufacturing

Key figures
(1 Jan – 31 Dec 2007 1,000 euro)

Net sales	64,652
Operating profit	7,121
% of net sales	11
Personnel at the end of the period	357

By developing more intelligent substrates a silicon wafer supplier can help to save costs and streamline microsystem fabrication. Okmetic BSOI (Bonded Silicon on Insulator) product family includes enhanced SOI products that meet the most demanding customer requirements. They enable the development of smaller devices, while allowing for greater freedom of design and improved yield. We supply all wafer sizes from 100 mm to 200 mm.

Okmetic BSOI wafers improve cost-efficiency across processes and boost performance. Together with modern manufacturing processes (e.g. DRIE) they provide new opportunities for innovation and exceptional design. For the most demanding designs, Okmetic 0.3-SOI wafers with tighter device layer thickness tolerance offers even more benefits in terms of device performance.



Device layer thickness variation (9 points measurements) of 150 mm SOI wafer.

Okmetic C-SOI (Cavity SOI) is a bonded SOI wafer with pre-etched cavities. Embedded under the thin silicon diaphragm, these cavities take device design to the next level. Our C-SOI solutions are optimized to fit the customer's device design.

Cavity SOI advantages

1. More freedom in element design.
2. Simplified manufacturing process
3. Improved electrical and mechanical properties
4. Integration of IC and MEMS process possible
5. Yield and material responsibilities at material supplier

Okmetic G-SOI (Gettered SOI) wafers support full CMOS-MEMS integration. Their enhanced gettering performance ensures effective binding of impurities to guarantee maximized yield and design flexibility in CMOS processes.

Gettered SOI advantages

1. Proven gettering ability
2. Better gate oxide integrity than in standard BSOI wafers
3. Compatible with CMOS processing on thick SOI
4. No impact on active layer thickness uniformity or other BSOI characteristics

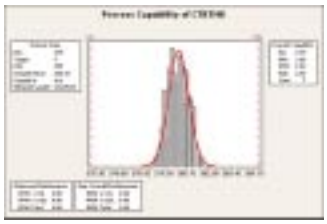
Epitaxial wafers

Okmetic epitaxial wafers offer superior layer uniformity and surface quality, as well as ideal epi thickness. In anisotropic wet etching of silicon, Okmetic epitaxial layers can be used as an etch stop in both electrochemical (N/P interface) and chemical (stress-free Ge co-doped P++) etch processes.

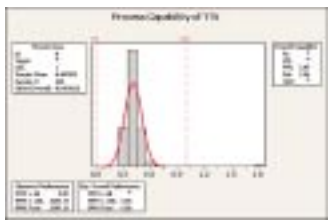
Double and single side polished wafers

Okmetic SSP (single side polished) and DSP (double side polished) wafers both feature outstanding off-orientation accuracy and MEMS-optimized crystal quality. In addition, our DSP wafers boast superior flatness and thickness variation that enable accurate bulk micromachining and double-sided lithography.

DSP wafers are also widely used as cap wafers in wafer level packaging.



Center point thickness variation of 150 mm DSP wafer.



Total thickness variation (TTV) of 150 mm ultra flat DSP wafer.

Boost performance with MEMS-optimized silicon wafers

Okmetic's way of conducting business is based on monitoring and analyzing the future needs and material solutions of our customers industries. With the widest product selection on the market, we offer silicon solutions for the rapidly growing and evolving MEMS market.

For more information please contact Okmetic K.K. and visit www.okmetic.com

MICRONANO is published quarterly by Micromachine Center (MMC) to promote the international exchange of information related to micromachines, R&D and other technical topics, and is circulated free of change. Please send your comments about **MICRONANO** to the publisher :

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/
Date of Issue : July 18, 2008