



MMC Activities.....	1
MEMS Pj .....	4
Column.....	6
Overseas Trends.....	7
Member's Profiles .....	8

## MMC Activities

# New Operation System of MMC

**Keiichi Aoyagi**, Executive Director of Micromachine Center

The Micromachine Center (MMC) is actively promoting technical development projects, sponsored primarily by the Japanese government and the New Energy and Industrial Technology Development Organization (NEDO), in an effort to establish a technical infrastructure in the micronano field that includes micromachines and MEMS. At the same time, the MMC is also actively involved in activities to improve the environment for the industrialization of micronano fields, such as policy proposal activities, industrial networking and incubating activities, research projects, standardization projects, dissemination and publicity activities and so on, in order to promote the dissemination and industrialization of these basic technologies. Through these activities, the MMC is working to assist in the development of Japanese industry and to contribute to the international community.

This basic approach will be continued in the new fiscal year as well, and the Micromachine Center will be involved in a variety of projects.

In terms of national and NEDO projects, the MMC has submitted a proposal for the Bio Electromechanical Autonomous Nano Systems (BEANS) Manufacturing Technology Development Project (FY 2008 - 2012). In the event that the proposal is accepted, a concentrated research and development organization with several development centers will be established for industry-academic collaboration, and the focus will be on establishing the technical infrastructure for the achievement of the third generation of MEMS (BEANS). In addition, this is the final year for the Highly Integrated / Complex MEMS (Fine MEMS) Manufacturing Technology Development Project (FY 2006 - 2008), so the Micromachine Center will work to ensure maximum achievements for the project. Moreover, the Micromachine Center is also concentrating on distribution and dissemination activities for the MEMS Open Network Engineering System Design Tools (MemsONE) achieved in the MEMS Open Network Engineering System Design Tools Project (nicknamed the MemsONE Project), which concluded development in FY 2007.

In terms of activities to improve the environment for industrialization in the micronano field, the MEMS Industry Forum established to conduct various activities to support industrial development has begun its third year. The number of participating members continues to grow steadily, and the content of its activities continues to be more fully developed. Exhibition Micromachine/MEMS is attracting more and more attendees each year. The Exhibition will be held again this year at the end of July at Tokyo Big Sight, as part of MicroNano 2008 which also includes various conferences. In addition, the Micromachine Center will promote many other activities this year, including the Micromachine Summit, various international interchanges, research activities that include MEMS market research and technical trend surveys both at home and abroad, international standardization activities for the MEMS materials and devices that are playing a leading role in various countries, and industrialization promotion activities that include operation of the MEMS Foundry Network and opening of the MEMS Mall.

We are grateful for your continued understanding and support.

# Overview of FY 2008 Project Planning

## I. Basic policy for project planning

FY 2008 is the final year of the Highly Integrated / Complex MEMS (Fine MEMS) Manufacturing Technology Development Project, a three-year project that began in FY 2006. The goal for this year will be to complete the project and ensure that its goals have been achieved. As last year, efforts with regard to the MEMS Open Network Engineering System Design Tools Project (nicknamed the MemsONE Project), for which development was concluded in March 2007, will focus on the creation of a support organization and dissemination of the project's achievements. Furthermore, a concentrated research and development approach is > planned for the Bio-electro mechanical Autonomous Nano Systems (BEANS) > development project, and a proposal has been submitted in the open > competition for this project. With regard to activities to improve the environment for industrialization, the focus will be on policy proposal activities for the MEMS Industry Forum and industry interchange and stimulation projects. Moreover, as last year, an active effort will be made to promote research projects, standardization promotion projects, dissemination and publicity projects and so on.

## II. Major projects

### 1. National / NEDO projects

In order to establish a technical infrastructure for micromachines and MEMS, the Micromachine Center is actively working to promote research and development projects sponsored by the national government and the New Energy and Industrial Technology Development Organization (NEDO), harnessing the combined capabilities of industry, academia and government. In FY 2008, the Center will promote the following projects.

#### (1) Highly Integrated / Complex MEMS (Fine MEMS) Manufacturing Technology Development Project (NEDO project)

The project was initiated in FY 2006 as a national government / NEDO project. In this, the final year of the project, the Center will continue working on and will strive to complete a database of highly integrated / complex MEMS knowledge that collects, organizes and compiles knowledge information relating to the three development categories of the project: (1) complex technologies to implement MEMS / nanofunctions (2) integrated construction with semiconductor chips (3) methods to connect MEMS components in a highly integrated manner.

#### (2) Promotion and dissemination of MemsONE

In FY 2008, the Micromachine Center will operate the MemsONE Support Center established in cooperation with software vendors based on the dissemination infrastructure created during the previous fiscal year. The Center will also promote MemsONE dissemination activities. Specifically, the academic version of MemsONE will be distributed to universities and research institutions, and energetic efforts will be made to promote dissemination through user groups, seminars for showing examples of use, training sessions and other user support activities and promotional activities.

#### (3) Proposal for "Bio & Electro-mechanical Autonomous Nano Systems (BEANS) Manufacturing Technology Development Project" (METI Project)

A proposal will be submitted in the open competition for the research and development project entitled "Bio & Electro-mechanical Autonomous Nano Systems (BEANS) Manufacturing Technology Development Project" to be initiated in FY 2008 by the Ministry of Economy, Trade and Industry. If the proposal is accepted, the project will be implemented using a concentrated research and development approach.

## 2. MEMS Industry Forum Projects (policy proposal, industry interchange and stimulation projects)

The MEMS Industry Forum was established as a special project committee whose goal is to support the further development of MEMS industries and contribute to the international competitiveness of Japanese industry. Its membership is made up primarily of companies in MEMS-related industries. The Forum maintains ties with affiliated academies, regional centers and overseas institutions, and it promotes the following activities:

- (1) Policy proposal activities
- (2) Industry-academia liaison activities
- (3) Establishment of infrastructure for MEMS development
- (4) Interchange activities for businesses in MEMS and other industries

Participation in the 14<sup>th</sup> World Micromachine Summit (to be held April 30 - May 3 in Taejeon, Korea), 14<sup>th</sup> International Micromachine / Nanotech Symposium (to be held July 29 at the Tokyo Bay Ariake Washington Hotel, exhibition at the Hannover Messe etc.

## 3. Research Projects

Research will be conducted for the micromachine and MEMS technologies that are rapidly becoming key technologies in manufacturing industries. Efforts will focus on accurately determining technical and manufacturing trends and exploring new technical issues in the domains in which these technologies are fused with nanotechnology.

#### (1) Research aimed at strengthening manufacturing centers for highly integrated MEMS

Even after the conclusion of the three-year Highly Integrated / Complex MEMS Manufacturing Technology Development Project that has been underway since 2006, research that is based on policy proposals for FY 2009 will be conducted so the achievements of the project can be quickly and accurately applied to the manufacturing industry in Japan.

- (2) Survey of technical trends both at home and abroad
- (3) Survey of industrial trends
- (4) Enhancement of micronano database

## 4. Activities to promote standardization

Standardization projects in micromachine and MEMS technology fields will be promoted concurrently with international initiatives.

- (1) Research and development in the area of standards certification for the purpose of proposing international standards
- (2) Follow-up regarding proposed standards for thin film material fatigue test methods
- (3) Study of overseas standards
- (4) Adoption of thin film material tensile test method standard as a JIS standard

## 5. Dissemination and publicity projects

Efforts will be made to promote wide-ranging dissemination and educate the general public regarding micromachines and MEMS by publishing and distributing a journal, holding exhibitions and so on.

- (1) Use of website to disseminate information and strengthen ties
- (2) Publication of MicroNano Journal
- (3) Publication of monthly news bulletins
- (4) Provision of information, etc. through the "MicroNano Express" newsletter
- (5) Upgrading of reference room including database of reference abstracts
- (6) Holding of Exhibition Micromachine/MEMS & Nanotechnologies

The 19<sup>th</sup> Exhibition Micromachine/MEMS & Nanotechnologies will be held at Tokyo Big Sight as part of MicroNano 2008. Plans called for the trade show to be held July 30 - August 1.

# MemsONE Ver. 1.0 Release

## MEMS System Development Center

The MEMS-ONE Project was completed in FY 2006, and in FY 2007 the “MEMS-ONE Project Achievement Dissemination Project (hereafter “Project”)” was commissioned by the New Energy and Industrial Technology Development Organization (NEDO). In this Project, a beta version of MemsOne (achieved in the MEMS-ONE project) was distributed, and activities that included user support, function improvement / upgrading and study regarding dissemination were conducted. The Project issued more than 450 distribution licenses for the beta version and more than 200 persons attended user support seminars. This made a major contribution to the establishment of a functional infrastructure for MemsONE as well as to the achievement of dissemination and publicity objectives.

Development of a commercial version was pursued concurrently with the Project, and MemsONE Ver. 1.0 was released in mid-February 2008. MemsONE Ver. 1.0 represents an advanced function version of the program and reflects approximately 90% of the functional improvements and upgrades to the beta version that were achieved by the Project.

Two versions of MemsONE have been prepared: an enterprise version for general company use and an academic version for universities and research institutions. The enterprise version will be marketed by software vendors and the academic version will be distributed by the Micromachine Center. The detailed product configuration is shown below.

- (1) Mechanical simulator
- (2) Process simulator
- (3) Wet etching simulator
- (4) Inverse process analysis
- (5) Nano imprint simulator
- (6) MEMS circuit simulator

### @ Enterprise version

The enterprise version is designed for general company use. There are two editions: a professional edition and an entry-level edition. (Both were released starting in mid-February.)

#### - Professional edition (for actual use)

This edition is designed for real-world use and has no functional limitations. It comprises the basic product set ((1) - (3)) as well as the separate products ((1) - (6)).

#### - Entry-level edition (for functional evaluation)

This is a low-cost edition provided for functional evaluation purposes, with some limitations on the number of nodes and so on. It comprises only the separate products ((1) - (6)).

### @ Academic version

The academic version is designed for universities and research institutions. There are two editions: a research edition and a classroom edition. (Both were released starting in mid-March.)

#### - Research edition (for researchers)

This edition contains the full set of professional use functions, subject to the following restrictions.

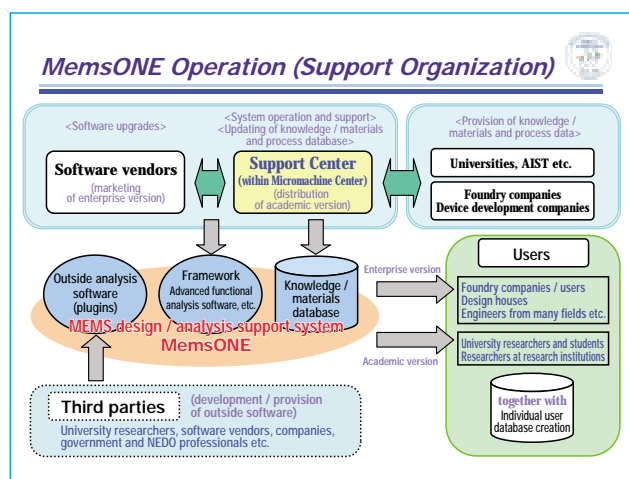
- Licensed period of use: 1 year (upgraded annually)
- Conditions for use: comes with an obligation to provide knowledge data, teach seminars, etc.

#### - Classroom edition (for teaching use)

This edition contains the full set of entry-level functions, subject to the following restrictions.

- Licensed period of use: 4 years or 1 year  
(two types: 30 licenses per classroom and 50 licenses / classroom)

As the organization for future support, a MemsONE Support Center will be established within the Micromachine Center, and the Micromachine Center will work with three software vendors to pursue dissemination activities. Major releases will be issued annually. Version 1.1 (representing the achievements of this Project) is scheduled for release in May, and Version 2.0 is scheduled for release in January of next year.



MemsONE Support Organization

For details regarding MemsONE Ver. 1.0, see the following website:

[http://mmc.la.coocan.jp/mems-one/hiroba/ver1\\_info/](http://mmc.la.coocan.jp/mems-one/hiroba/ver1_info/)

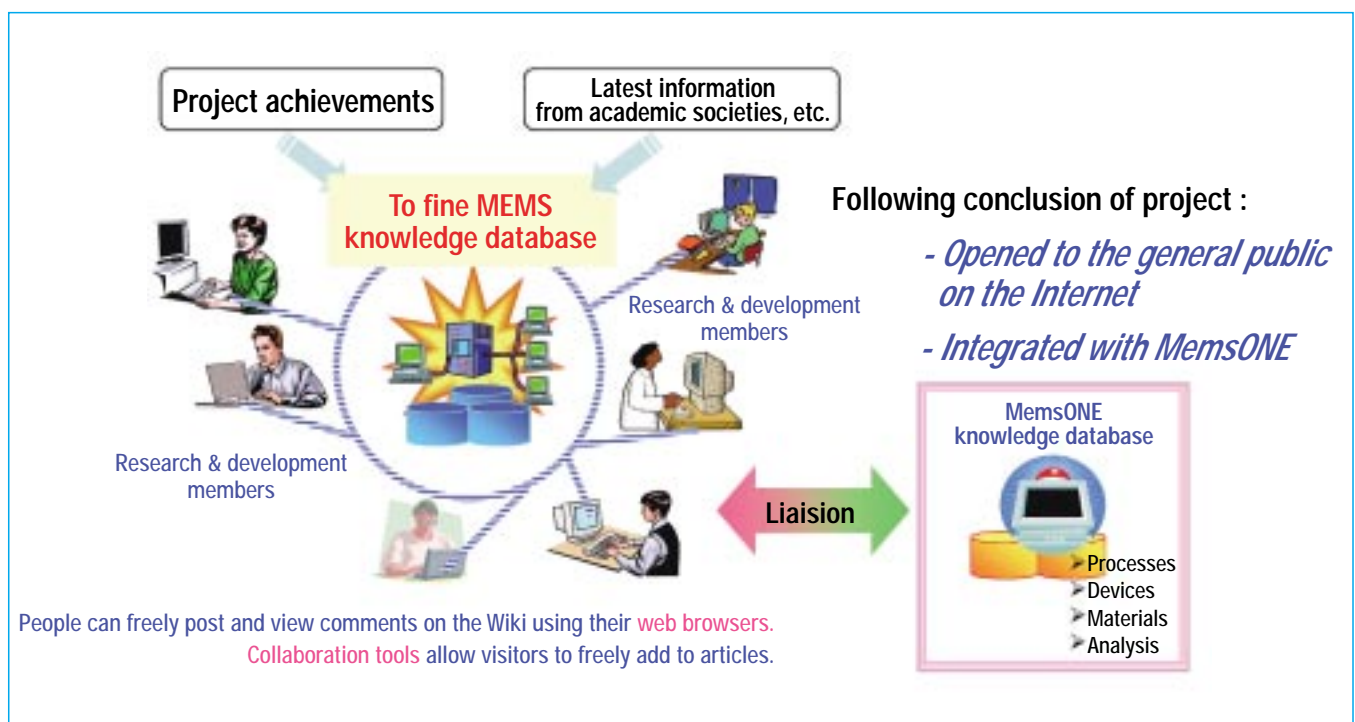
For inquiries regarding MemsONE, please contact the MemsONE Support Center:

TEL (81) 3-5835-1870  
Email mems1-user@mmc.or.jp

## Fine MEMS Project Compiling of a Knowledge Database and Development of an Integrated Design Platform Final Project Year

FY 2008 will be the final year of the Fine MEMS Project that began in FY 2006. Steady achievements are being realized in each research and development topic. The Micromachine Center will place particular emphasis on the following three topics in order to establish various types of manufacturing technology infrastructure to achieve the second generation of what are referred to as highly integrated and complex MEMS.

The first task is the creation of a fine MEMS knowledge database (**Fig. 1**). A server has been set up within the Micromachine Center, and a database system in MediaWiki format has been completed on the Internet. This database will ultimately contain more than 1,000 case studies of knowledge data; as a result of steady progress in registering data, the database already contains many items. In order to both increase data quantity and improve the quality of the data, new functions have been provided, such as the ability to vote for registered case studies, rankings for individual keywords, identification of case studies recommended by committee chairman Shimoyama and so on. Moreover, to improve usability, a search function and improved patent information have been provided. Currently users of this database system are limited to researchers that have registered with the Project. During this fiscal year, however, a general user interface will be provided and integration with the MemsONE knowledge database will be conducted in anticipation of the opening of the database to the general public following the end of the project.

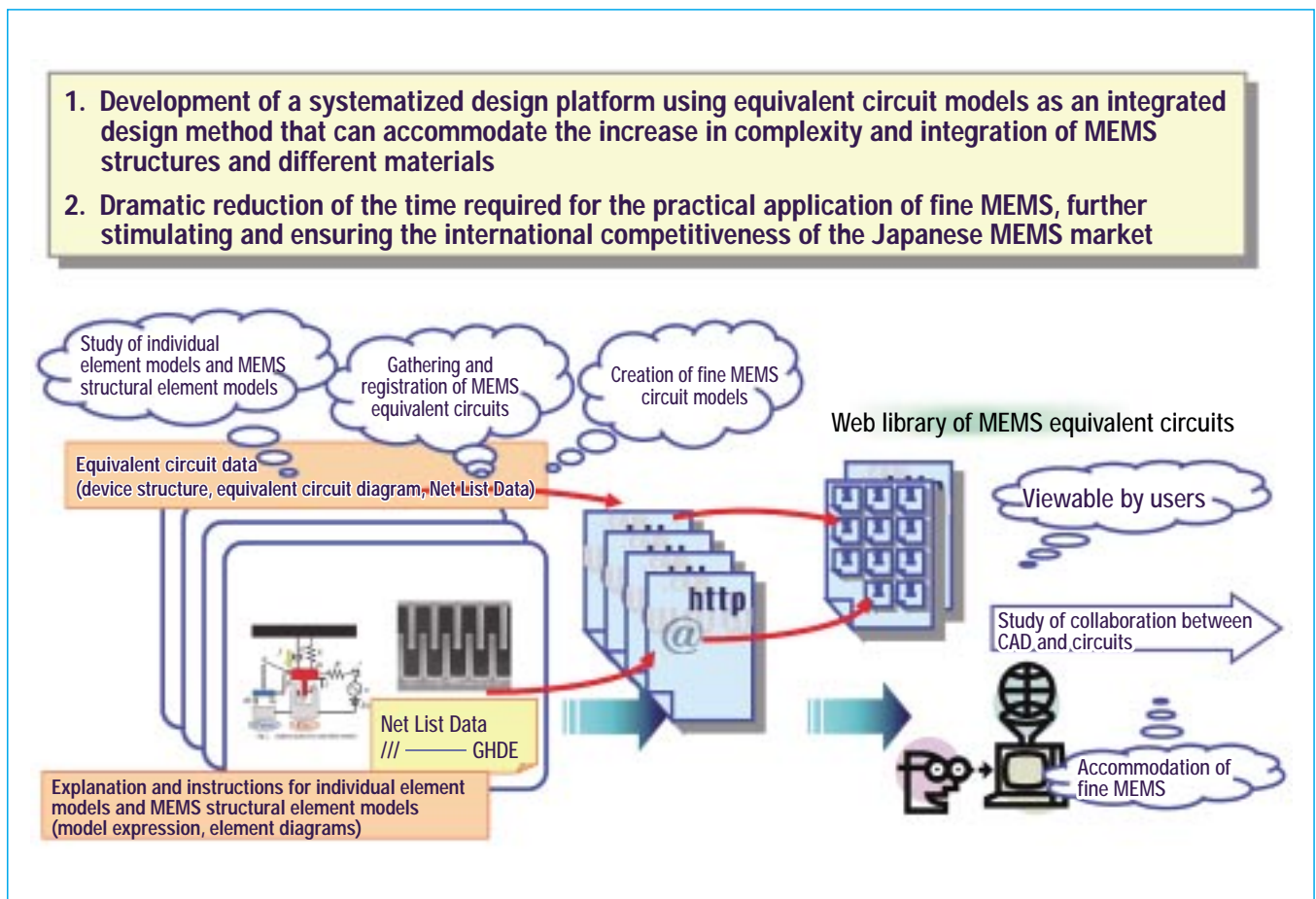


**Fig. 1**

Secondly, with regard to the "Research & Development of Integrated Design Platform for Fine MEMS" that began in the previous fiscal year, an equivalent circuit model – an integrated platform for MEMS and electronic circuits – was developed and then used to model various devices. In addition, a web library that allows people to view these models over the Internet was developed and the device models, etc. were placed in this library. Based on these achievements, development during this fiscal year will focus on providing greater versatility and making it easy for MEMS and electronic circuit engineers to conduct design. Efforts will focus on the following three points:



- 1) Enhance device models through the use of MEMS equivalent circuit model, which is useful when integrating MEMS with one another, in order to construct a fine MEMS equivalent circuit model that can connect MEMS devices to one another and support high integration.
- 2) Build a collaborative environment between the circuit simulator and the web library system (created to develop functions to extract electrical properties and mechanical properties) in order to develop a function for extracting the electrical properties of MEMS devices and the mechanical properties of the moving parts of MEMS devices.
- 3) Develop mutual transformation of equivalent circuit models and three-dimensional CAD models to enable mutual transformation of the shape data and material property values of equivalent circuit models and three-dimensional CAD models.



**Fig. 2 Development of fine MEMS systemized design platform**

Lastly, the Micromachine Center has been contracted to assist in the overall operation and management of the fine MEMS project. The Center holds meetings of the Project Promotion Liaison Committee (four times a year), Knowledge Database Committee (six times a year) and Platform Study Committee (four times a year). These committees contribute to the smooth promotion of the project and dissemination of project achievements. In FY 2007, exhibits were displayed at the International Exhibition Micromachine / MEMS and Nanotech 2008. Moreover, a project interim achievements briefing was held in July to present the latest achievements to the many attendees. Exhibiting at International Exhibition Micromachine / MEMS and the holding of an interim achievements briefing are planned for this fiscal year as well.

The final year of the project promises to be filled with activity and we look forward to the results.

## Expectations for the New BEANS Project

**Hiroyuki Fujita**, Professor, Institute of Industrial Science, the University of Tokyo

With microsensors now being widely used in game machine controllers and image stabilizers for cameras, among other applications, consumers are beginning to appreciate the true value of sensors as they are able to play TV games using gestures and body movements and can produce sharp photographs even when the camera moves slightly. While the same consumers might not fully understand that advances in MEMS technology are responsible for these sensors, we MEMS engineers are inwardly proud. Such advances in MEMS products directly help secure and expand our future areas of activity, making it particularly satisfying to see our efforts in development finally begin to bear fruit.

Already 20 years have elapsed since surface micromachining was developed in the late 1980s and since we were first amazed to see micro-gears and micro-turbines rotating on silicon chips. Through the development of many advanced process technologies during that time, including wafer bonding and deep reactive-ion etching (DRIE), microstructures can now be freely created and moved with precision. By devising various micromachining techniques adapted to CMOS circuitry and by incorporating electronic circuits on chips, we have added such advanced functions as temperature and sensitivity correction, self-diagnoses, and various data processing functions. We have accumulated much data on reliability and bettered our knowledge in packaging and other areas of industrial science through earlier achievements made in automotive pressure sensors and accelerometers and in projectors employing movable micro-mirror arrays.

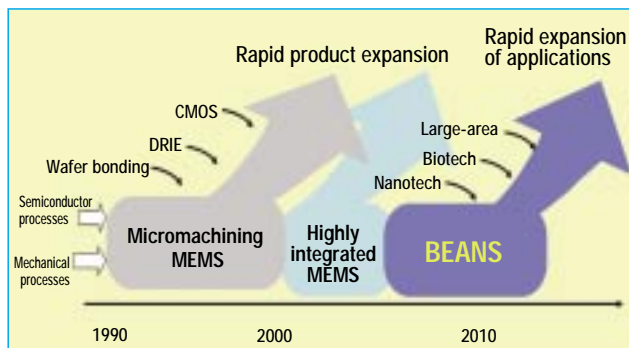
Since the Micromachine Technology Project conducted from 1990 to 2000, Japan has supported technological development primarily at the corporate level through the MEMS Foundry Project, and the MEMS Open Network Engineering System of Design Tools (MemsONE) Project. Currently underway is the fineMEMS Project targeting highly integrated, complex MEMS. This foundation of progress has allowed us to make rapid advances in commercialization.

From another perspective, MEMS technology on the micro-scale has reached a high level of maturity, entering the domain of competitive development due to its direct link to commercialization. While it will be necessary to further enhance existing technologies and expand the product lineup in commercially viable fields, such as sensors, information and telecommunications, and optics, new fabrication techniques must also be created to prepare for future growth outside of these fields. By merging micromachining based on a typical top-down approach with nanotechnology or biotechnology based on a bottom-up approach, manufacturing processes for MEMS can be developed under unprecedented concepts. We anticipate that these process technologies could be used to produce products having such functions as biosensors for biological measurements, treatment, and diagnoses, efficient energy conversion based on nanostructures, and network-based measurements of extensive environmental data, which projects are anticipated to help resolve national and social issues faced in the 21<sup>st</sup>

century, including issues in health care and welfare, the environment and energy, and safety and security.

From this point of view, the BEANS (Bio Electromechanical Autonomous Nano Systems) Project proposed by METI is aimed at researching manufacturing technologies required to create innovative devices through the integration of micro- and nanofunctions. The basic plan calls for developing processes enabling the fusion of biomaterials and organic matter, the formation of 3D nanostructures, and the continuous large-area manufacturing of micro-nano structures, and for constructing related knowledge databases. Research on processes for merging biomaterials and organic matter will involve harnessing the unique capabilities of biomaterials and organic matter, such as molecular recognition and self-assembly, and selectively adding these capabilities to silicon structures. These processes are expected to produce devices that can be adapted to organisms and operate stably therein for a long period of time, and structures employing nanopores or nanopillars to achieve cell culture and high-sensitivity sensing. Processes for forming 3D nanostructures include a process for creating smooth nanostructures with no internal flaws at the atomic level, and a process for uniformly coating the surfaces of or gaps in nanostructures with a functional film. Since nanostructures and nanoparticles exhibit properties unique to the quantum effect, such as good photoelectric energy conversion not found in bulk materials, they are thought to be useful in ultra-small devices capable of generating power efficiently, among other applications. Finally, research on processes for the continuous large-area manufacturing of micro- and nanostructures is aimed at finding a process to create devices inexpensively on large substrates using printing or embossing techniques rather than a semiconductor process, which, although capable of unrestricted 3D micromachining, is expensive and can only be performed on substrates of a limited size. This process should allow us to manufacture devices continuously over thin, soft substrates, much like a printing press can print newspapers quickly and in high volume.

Just as R&D on MEMS manufacturing techniques began some 20 years ago, the BEANS Project is being initiated with the goal of developing new processing techniques that will prove useful 20 or 30 years from now. Already we are anticipating with pleasure how consumers will come to appreciate the true value of devices developed from the fruits of this project.



## Hannover Messe 2008 (April 21 – 25)

A MEMS Industry Forum exhibit will be included in the Hannover Messe Microtechnology Fair to be held April 21 – 25 (Monday – Friday), 2008 in Hannover, Germany. The exhibit will be presented through the cooperation of Omron Corporation, Olympus Corporation, Matsushita Electric Works, Ltd. and the University of Tokyo Shimoyama Lab.

The Hannover Messe is said to be the world's largest industrial sample fair. Each year the event attracts around 5,000 exhibiting companies from more than 65 countries, as well as 200,000 visitors and 3,000 media representatives. This year, Japan is the official Partner Country for the Messe, and more than 100 Japanese firms (double the usual number) will participate as exhibitors. Many visitors from political and economic circles in Japan will also attend the event.

The Microtechnology Fair is a trade show for applications of micro/nano technology and is sponsored by iVAM, the overseas affiliate of the MEMS Industry Council. The Council participates in this trade show as part of its overseas business liaison activities. This year marks the third time that the Council will provide an exhibit, and through the cooperation of these companies “The Activities of the MEMS Industry Forum” will be presented in terms of the promotion of Japanese industry, support for industrialization, market development and so on. The Council will also promote the MicroNano 2008 exhibition to be held in July.

Moreover, a Japan Day is scheduled for the forums to be held during the Messe in conjunction with the fair. Director Aoyanagi, executive director of the Micromachine Center, will give the opening address. Eight presentations will be held by Olympus Corporation, Mr. Matsumoto, Matsushita Electric Works, Ltd., Mr. Okamoto, Mitsubishi Electric Corporation, Mr. Yoshida, Professor Suga of Tokyo University, the National Institute of Advanced Industrial Science and Technology (AIST), Mr. Maeda, Mr. Takahashi, the New Energy and Industrial Technology Development Organization (NEDO), Mr. Watanabe and the Micromachine Center MEMS Industry Forum.

In addition, the following events will be held jointly with the Partner Country, Japan:

- Japan – Germany Business Summit (April 21)
- Japan – Day MicroTechnology (April 22)
- Mobile Robots & Autonomous Systems / German – Japanese Robotics Forum (April 22)
- German – Japanese Photovoltaic Forum (April 24)
- German – Japanese Roadmap Symposium (April 22)
- Business establishment and personnel recruitment in Japan (April 24)
- Premium Market Japan (April 22)



Left: Hannover Messe venue

Right: Explanations and business consultations at booths



## Members' Profiles

# Mesago Messe Frankfurt

### 1. Overview

Mesago Messe Frankfurt Corporation is the Japanese affiliate of Messe Frankfurt, a company that organizes international trade fairs. Germany is the country in which the most trade fairs (messe) are held, and Messe Frankfurt was the first trade fair organizer in Germany to expand operations globally to other countries. Messe Frankfurt is currently the second largest organizer of trade fairs, and together with its affiliates holds more than 100 trade fairs each year in various locations around the world including Europe, Asia, North America, South and Central America, the Middle East and Russia.

Since its establishment in 1987, the Japanese affiliate has conducted promotional activities for the trade fairs held in various parts of the world. Mesago Messe Frankfurt has also sponsored and operated international specialized trade fairs in Japan as well, utilizing the international network of the group that covers more than 100 countries throughout the world. All of these industrial trade fairs have been key events for the industry, exhibiting both state-of-the-art technologies and up-to-date information and providing a business platform for many industry participants.



### 2. International Exhibition Micromachine/MEMS: Growing along with the Rapid Advances in the MEMS Industry

Exhibition Micromachine/MEMS sponsored by the Micromachine Center is held annually. Its purpose is to present practical applications for the micromachines and MEMS technologies that are fast becoming key technologies for industry, as well as to distribute products, strengthen ties among industry, academia and government, and promote technology exchanges at home and abroad. The Exhibition has a long history; it was first held in 1990, making this its 19<sup>th</sup> year. Mesago Messe Frankfurt has contributed to the growth of the Exhibition since the very beginning. At the outset, the Exhibition served as the venue for presentations on research and development topics by some 40 universities, research organizations and companies. In the past few years, the event has continued to increase in scale each year, propelled by the growth of the MEMS industry. The previous Exhibition was held in July 2007 and attracted 362 companies and organizations and 12,424 visitors. It is now widely recognized as one of the world's largest MEMS related international exhibitions.

The growth of Exhibition Micromachine/MEMS has resulted both in progress in MEMS technologies and expanded needs. There is a clear sense that the MEMS market is one that will attract more and more attention from the general public from now on.

Exhibition Micromachine/MEMS is the only exhibition in Japan devoted solely to MEMS. The Exhibition will continue to provide companies involved with MEMS with the ideal business platform for communicating and acquiring up-to-date information.

Through its sponsorship and operation of the Exhibition, Mesago Messe Frankfurt will continue working to achieve its goal of connecting industry participants with business opportunities and helping to contribute to the growth of the MEMS industry.



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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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