

Overview of FY 2009 Project Planning

Micromachine Center

I . Basic Policy for Project Planning

The Highly Integrated, Complex MEMS Production Technology Development Project, more commonly referred to as the Fine MEMS Project, is a three-year project that began in 2006 and concluded in the last fiscal year having achieved its original goals satisfactorily. Thus, in 2009 we have turned our attention to promoting and disseminating the project's achievements. Further, as the BEANS Laboratory has now assumed its new role as the primary association responsible for continuing implementation of the Project to Develop Next-Generation Device Manufacturing Technologies That Use Different Fields, a five-year project initiated in 2008 and more commonly referred to as the BEANS project, the MMC will now serve as a member of this association and will continue to provide human and financial resources and other support for the project.

In light of the current troubling economic conditions, we recognize the importance of strengthening Japan's industrial competitiveness, which is currently reliant on advanced technologies. Accordingly, we will step up our efforts to create a better environment for further stimulating industrialization and research in the MEMS field through activities of the MEMS Industry Forum (MIF) founded in April 2006, which activities will include policy recommendations and the encouragement of industrial exchange and vitalization. We also remain firmly committed to continuing activities from the previous year; namely, investigative research, and activities to promote standardization and to encourage the dissemination of research findings.

II . Major Projects

1. National / NEDO projects

This year, MMC will aggressively continue activities to promote and disseminate MemsONE, a product of the MemsONE Project, and will begin vigorous promotion and dissemination of the fine MEMS knowledge database and the new MEMS equivalent circuit generator developed in the Fine MEMS Project. In addition, we will work to formulate a framework for bases from which we can firmly establish highly integrated, complex MEMS in Japan's industry, and to write up drafts and proposals for plans related to relevant R&D projects.

(1) Promotion and dissemination of MemsONE

In 2009 MMC will work more closely with software vendors to provide support for MemsONE and will carry out activities to disseminate MemsONE with an emphasis on stabilizing the infrastructure for future sales and distribution. Part of the dissemination activities will involve discussions with the Committee for the Promotion and Dissemination of MemsONE regarding promotion and dissemination challenges and strategies. We will also work to strengthen cooperation between the MIF and the Foundry Service Industry Committee (FSIC).

(2) Compilation of MEMSPedia

In order to disseminate the knowledge database of highly integrated, complex MEMS created as part of the Fine MEMS Project and to promote further accumulation of knowledge, MMC plans to make the database available to the general public on the Internet and to use events such as this year's Exhibition Micromachine/MEMS as venues for introducing the database. We will also be establishing a new MEMSPedia Compilation Committee this year aimed at further upgrading and expanding the database. The committee will function as a vehicle for identifying and analyzing technical fields and knowledge of interest to users based on server activity at MMC and management of user registration, and for exploring issues and operations relevant to the highly integrated, complex MEMS

knowledge database according to the results of this analysis and discussing the role of MEMSPedia, which will serve as a comprehensive knowledge base for MEMS fields.

(3) Dissemination of the MEMS equivalent circuit generator

One of the products of development in the Fine MEMS Project is the MEMS equivalent circuit generator. The generator is scheduled for release at the end of May 2009 as a Web-based service. There has been an increase in R&D activity on the integration of MEMS and electric circuits and on integration through combinations of different types of MEMS. As more and more successful products emerge through this research, the MEMS equivalent circuit generator will play an important role as a new design tool capable of compensating for the shortcomings in the conventional design methods that focus primarily on MEMS mechanical components. We recognize that creating a better environment for MEMS research through a Web-based service capable of replacing MEMS with equivalent electric circuits will be essential to the growth of fine MEMS. Therefore, we are working hard to make this service available to all MEMS researchers in Japan.

(4) Support for the BEANS Project

With the primary responsibility of the BEANS Project (FY 2008–2012) shifting to the BEANS Laboratory in 2009, MMC will now participate as a member of the association. We will provide personnel and financial resources and other suitable support for implementation of the BEANS Project in order to ensure the project produces adequate results in the remaining years.

(5) Examination of new projects for technological development

Since technological development on circuit integration and the merging of dissimilar fields has recently gained momentum in micro/nano-related fields through the Fine MEMS Project and the BEANS Project, it will be necessary to establish centers for MEMS research, development, and prototype manufacturing to keep pace with this trend. In light of this, we will collaborate with the relevant organizations and businesses to study potential new projects for technological development.

2. Investigative research and standardization

MMC will be conducting investigative research to get a clear picture of technological and industrial trends in micromachine and MEMS technologies, which are emerging as key technologies in the manufacturing industry. We will also investigate new issues in micro/nano technology that arise when merging nanotechnology with technologies in other fields. We hope to demonstrate our initiative on the international stage while promoting standardization in the fields of micromachines and MEMS.

(1) Investigative research on strengthening production centers for highly integrated MEMS

(2) Surveying of technological trends at home and abroad

(3) Surveying of industrial trends

(4) Upgrading of the micro/nano database

(5) Joint research for the purpose of proposing international standards

(6) Follow-up on the international standardization of accelerating life tests, bonding strength tests for MEMS materials, and standard test pieces for calibration conducted in 2006–2008 under the project title "Measurement and evaluation of mechanical properties of MEMS materials and their standardization" ; the project is referred to as a priority follow-up and has been consigned to JSA

(7) Follow-up to a proposal of standards for testing

MEMS wafer-to-wafer bonding strength **(8) Investigative study on overseas standards**

Conducted a study on Japan's response to the escalating number of proposals for MEMS standards in South Korea and other countries overseas (including standards related to RF-MEMS and bending test methods).

(9) Adoption of thin film material tensile test method standard as a JIS

3. MEMS Industry Forum projects (for policy recommendations and industrial exchange and vitalization)

MIF was established as a special project committee with the goals of supporting the further development of MEMS industries and contributing to the international competitiveness of Japan's industry. Membership in MIF is composed primarily of companies in MEMS-related industries. MIF performs the activities listed below in collaboration with affiliated academies, regional centers, and overseas institutions. This year's goals are to improve its administrative function and further expand its activities.

(1) Policy recommendations

(2) Collaboration with industry and academia

(3) Improvement of the infrastructure for MEMS development

- a. Expansion and upgrading of the MEMS foundry network system
- b. Promotion and dissemination of MemsONE (mentioned earlier)
- c. Strengthening of collaboration among regional public foundries and local clusters
- d. Implementation of personnel training projects

(4) Information exchange among businesses in MEMS and other industries

a. Opening of the MEMS Mall

b. Holding of the MicroNano 2009 general exhibition

c. Holding of Exhibition Micromachine/MEMS

d. Expansion of the international affiliate network

e. Participation in the 15th World Micromachine Summit

f. Participation as exhibitor at Hannover Messe

g. Dispatch of overseas fact-finding missions and exchange of researchers

4. Dissemination and publicity projects

MMC will continue to publish and distribute newsletters, hold exhibitions, and otherwise disseminate information on micromachines and MEMS to educate the public and make such information widely available. We are collecting reference materials and documentation related to micro/nano technologies from universities, industrial circles, public organizations, and other sources in Japan and overseas. This documentation will be consolidated with reference materials for surveys studies conducted at MMC and will be made available at the MMC archives for browsing and searching. Information will also be provided internally and externally through MMC's Web site.

We will continue to perform dissemination and publicity activities in 2009, striving for efficiency and effectiveness. In addition to our Web site and the quarterly magazine *MICRONANO*, the *MMC-MIF Monthly* (Japanese only), and the *Micro-Nano Express* newsletter issued in collaboration with the BEANS Laboratory, we will also jointly operate an exhibit with the BEANS Laboratory at Exhibition Micromachine/MEMS.

The 20th Exhibition Micromachine/MEMS will be held at Tokyo Big Sight as part of MicroNano 2009. The event is scheduled for July 29–31.

Research Studies and Standardization Activities

1. Survey of Technological Trends at Home and Abroad

This survey has been conducted every year since 1993 to collect and analyze in detail the latest technological data in Japan and overseas in order to follow trends in technology. Recognizing the growing importance of such trends in Asia, the MMC conducted surveys of presentation categories and trends in field-specific presentations at APCOT 2008 in the first half of last fiscal year. The same surveys were conducted in the second half of the year for MEMS 2009, which is an annual focus of our surveys.

The Asia-Pacific Conference on Transducers and Micro-Nano Technology (APCOT) is an international conference held in the Asia-Pacific region to present R&D findings in the MEMS and nanotechnology fields. The conference has convened biannually since 2002 when the first conference was held in Xiamen, China. Since then, the conference has been held in Sapporo, Japan in 2004, Singapore in 2006, and, most recently, Tainan, Taiwan on June 22–25, 2008 (Sun-Wed). A total of 589 papers (compared to 571 at the previous conference) were submitted for APCOT 2008, with 205 submissions from Taiwan (109 previously), 117 from Japan (66 previously), 111 from China (137 previously), 51 from South Korea (48 previously), and 10 from Singapore (110 previously). Of the 589 submissions, 377 papers were accepted, resulting in an acceptance ratio of 64.0%.

MEMS 2009, the 22nd IEEE international conference on Micro Electro Mechanical Systems (MEMS) was held in Sorrento, Italy on January 25–29, 2009 (Sun-Thu). A record-high 856 papers were submitted for the conference, with submissions from Asia accounting for more than half the total (405 papers, or 47%). Asia was followed by North America with 254 submissions and Europe with 197. As usual, the conference organizers were very selective, choosing only 276 of the submitted papers for a mere 32% acceptance ratio. The findings

from the above surveys were summarized in the FY 2008 Survey Results for Field-Specific Trends.

2. Standardization

(1) IEC status

A Final Draft International Standard (FDIS) for Japan's proposal on fatigue testing methods of thin film materials was referred to the IEC, put to vote on March 20, and adopted as an IEC international standard on April 7, becoming the fifth international standard related to MEMS and the fourth submitted by Japan. We also submitted a draft to the IEC in February on fatigue testing methods using resonant vibration, developed under METI's activities for standards certification. While committee drafts (CDs) on RF MEMS switches, FBAR filters, bending test methods, and testing methods for wafer-to-wafer bonding strength proposed by South Korea are currently under review, Japan has submitted many comments, which are being weighed to reflect Japan's opinion. Japan has drafted proposals on a die shear test, 3-point bending test, and blister test as the primary testing methods for wafer-to-wafer bonding strength. Testing methods for micro-pillar compression and thermal expansion coefficients recently proposed by South Korea in August of last year were not approved, because the number of participating nations in the project remains at three, short of the required four.

(2) Research and development

METI has commissioned the MMC to perform research studies on standards certification for accelerating life tests (2006–08), standard test pieces for calibration (2006–08), bonding strength tests for MEMS materials (2007–08), and micro-gyroscopes and electronic compasses (2008–10). A draft proposal for a standard on accelerating life tests has already been submitted to the IEC, while drafts on standard test pieces