
Activities of the Micromachine Center in Fiscal 2002

I. Investigation and Research on Micromachines

Research activities were aimed at towards gaining a clear understanding of the trends in micromachine technologies and industries and conducting investigations of and research on new technological issues regarding the fusion of micro- and nanotechnologies, as well as making adjustments appropriate for the multidirectional expansion of micromachine technology.

1. Investigative research for the high-efficiency micro-chemical process technology "Microchip Device/System Database Construction" project (recomissioned by New Energy and Industrial Technology Development Organization [NEDO])

This project involved the systematic collection into a comprehensive database of information concerning hardware design, measurement technology, and technological issues, obtained in each process of designing, manufacturing, and evaluating microchip devices.

- (1) In addition to considering the data framework and information suitable for inclusion in the database, we designed an operational format that includes two-way connections with databases containing highly relevant documentary information.
- (2) Basic specifications for the test database were designed, and a software company commissioned to create the database software.

2. Studies on the future prospects of micromachine technology

As we anticipate the industrialization of the micromachine technologies developed thus far, from a technological perspective we must also strive toward further miniaturization in this new technological system of micromachines. With regard to applications, MMC is pursuing the possibilities for the fusion of micromachine technologies with technologies in other fields such as medical care and biotechnology. Against this background of growing demand for a multidimensional approach, MMC established a "long-term vision subcommittee" and conducted research related to planning directions for micromachine technology development and roadmaps for the main technologies.

3. Studies on R & D trends for micromachine technology in Japan and abroad

MMC set up a think tank to consider trends in R&D both in Japan and abroad; conducted exploratory analysis of the latest situation regarding the rapid expansion, both domestically and internationally, of micromachine technology and research trends; and built up basic technological data that contributes to the advancement of micromachine technology.

4. Investigation and Research into the Applicability of Basic and Sprout Micromachine Technologies

This joint study between industry and academia is aimed at encouraging the establishment of theories in micro and nano science and engineering and probing for technological seeds necessary for promoting the merging and application of micro and nanotechnologies. Research related to the fields of cell manipulation and nano-optics also continued on from the previous year.

(1) Research Related to Cell Manipulation

As in the previous fiscal year, technology themes suitable for government promotion were considered and proposals for projects prepared. As part of the decision process, a workshop entitled "Cell Manipulation Technology for the 21st Century" was held on February 10, 2003.

(2) Research Related to the Field of Nano-Optics

A subcommittee was established to examine research

related to the field of nano-optics, and three specific technological areas — (1) basic nano-optics technology, (2) nanostructure building technology, and (3) nano-optics response technology — were selected for consideration.

5. Research on Constructing a System for Evaluating the Micromachine Market

With the aim of building up an economically consistent database of micromachine-related market statistics, a subcommittee was convened to consider issues related to the creation of a market-estimation system; methods were chosen and statistics compiled.

6. Investigation and Research on Scale Interface (commissioned activities to help promote the machine industry)

From the perspective of scale interface, MMC will study the trends for optical devices in demand for next-generation optical communications and evaluate the sophisticated functionality possible by fusing micromachine technologies and nanotechnologies. To this end, an investigative committee was set up to consider scale interface-related technologies and, within the committee, two subcommittees (looking at standards and dimensional precision, respectively). In addition to considering the present situation regarding technology and technologies of the future, the committee prepared a report identifying problems experienced by users, as well as issues and problems associated with dimensional measurement.

7. Research related to simulation systems for MEMS-design and analysis support (commissioned by the Mechanical Social Systems Foundation)

MMC set up an investigative committee to examine issues related to simulation systems for MEMS design and analysis support, as well as a panel to look at related technologies. These groups conducted surveys on such topics as existing software, analytical tools, and basic specifications for user-friendly systems about simulation systems for MEMS design and analysis support that can be utilized effectively by businesses (particularly foundry service enterprises) and universities — in other words, software systems to efficiently design and analyze MEMS.

8. Research related to technology development strategies in the MEMS industry (commissioned by NEDO)

MMC and the Nomura Research Institute were commissioned by the Ministry of Economy, Trade and Industry to jointly prepare a draft plan for the "MEMS Project" to be launched in 2003 as part of the Ministry's "Focus 21" program. In order to obtain comments from the public, MMC established a committee to consider technology strategies and held a workshop.

II. Collection and Provision of Micromachine Information

Information and documents on micromachines in universities, industries, and public organizations both in Japan and overseas have been collected and combined with survey results compiled and documents produced by MMC, and made freely available in the MMC library.

1. Maintenance and Expansion of the MMC Library (990 publications as at March 31, 2003)

2. Publication of a Micromachine Periodical ("Micromachine Index")

3. Publication of a Newsletter

4. Database Construction and Data Management System Operations (indexed full-text retrieval)

III. Exchange and Cooperation with Worldwide Organizations Involved with Micromachines

1. Participated in the 8th Micromachine Summit (Maastricht, the Netherlands: April 30-May 2, 2002)

2. Held the 8th International Micromachine/Nanotech Symposium (Science Museum in Kitanomaru Park, Tokyo: November 14, 2002)

3. International Exchange and Dispatch of Researchers

Norichika Fukushima, manager of the Research Department, visited the Netherlands (Twente University) and Germany between January 30 and February 6, 2003, to examine R&D trends in micro fluids-related fields.

4. Constructing a foundry network system

In order to further the industrialization of micromachines, particularly MEMS, upgrading of foundry facilities is vital. To this end, MMC established the Foundry Service Industry Committee to organize businesses providing foundry services, to set up a network system to improve services and to consider ways such a system could be developed. As means of disseminating information, the MMC also set up its own Internet homepage and participated in various lectures and seminars.

5. Establishing a forum for the exchange of micromachine technology

A workshop on micro fluids was held; lecturers were invited from universities to speak on technology trends at international conferences on micro-fluids-related topics and information and opinions exchanged.

IV. Standardization of Micromachines

In micromachine technology and other newly established fields of systemized techniques as well, there is an urgent need for the standardization of terminology, measurement, and evaluation methods. The MMC worked towards it, taking international initiatives into perspective.

1. Creation of an international standard as a method for evaluating the properties and measuring methods of thin film materials

The results of R&D on measuring and evaluating the properties of thin materials, conducted as part of the NEDO Research and Development for Standards project that ended in 2001, were considered for inclusion in proposals for international standards.

2. Investigation and research on micromachine standardization

The results of this research have been transmitted worldwide, encouraging international standardization while exercising initiative in establishing international standards. With regard to terminology, MMC submitted a specifications proposal to IEC/TC47 and supported deliberations through such actions as compiling comments. With regard to measurement and evaluation, MMC continued selecting and prioritizing items standardization items. An international standardization workshop was also held at the 2nd International Standardization Forum in Tokyo in July.

V. Dissemination and Education about Micromachines

1. Publication of a Public Relations Quarterly Magazine "MICROMACHINE"

Vol. 39 to 42 were published in Japanese only.

English versions are available on the MMC website:<http://www.mmc.or.jp/>

2. Micromachine Drawing Rally (Implemented in 2002 as a small-scale means of gathering and utilizing micromachine drawings)

3. The 13th Micromachine Exhibition (Science Museum in Kitanomaru Park, Tokyo: November 13-15, 2002)

4. Administration of the Federation of Micromachine Technology

Served as secretariat for the Federation of Micromachine Technology to link and strengthen micromachine-related organizations.

5. Workshop presenting the results of grant recipient projects for the 8th Micromachine Technology Research Grants (FY 2000) on September 17, 2002

An Introduction of MMC's Activities: Future Vision for Micromachines

It is certain that micromachine technology will play an important role in a variety of social and economic fields in the 21st century and will contribute to improving the quality of our lives. However, today's severe socioeconomic environment does not allow us to foresee the prospects for micromachines accurately.

With the successful completion of Japan's first national micromachine project, conducted over a ten-year period, we are now working on new endeavors aimed at further development of micromachine technology. One of these endeavors is to create viable industrial applications based on results obtained through R&D on advanced technologies. Among other things, Microelectromechanical Systems (MEMS) technology is increasingly used for various applications and furthering its industrialization has become a major objective of ours. The second endeavor is a top-down approach to the nanotechnology research that originated from the U.S. National Nanotechnology Initiative (NNI). Nanotechnology is not truly useful unless it is complemented by a seamless interface with human-sized technology, which is the role micromachine technology should assume.

There is no precedent for any nation having attempted to accomplish these objectives. Given the fact that Japan remains in structural change ten years after the economic boom ended, pursuing these objectives entails great financial risk and considerable effort, as well as requiring diverse expertise and knowledge of researchers in industry, government, and academia. Therefore, a compass is needed by which we can proceed to unexplored disciplines based on the current developments in micromachine technology.

Last year, the Micromachine Center formed a committee for deliberating the long-term prospects of micromachine technology (Chairman: Prof. Isao Shimoyama, Department of Mechano-Informatics, Graduate School of Information Science and Technology, The University of Tokyo). The committee has compiled their deliberations and investigations in an interim report entitled "A Future Vision for Micromachines."

Contents of the report:

1. Introduction: Why is a vision required now?