

MICROMACHINE

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MMC Activities

Overview of MMC's Activities in Fiscal 2003

I. Basic Objectives of Activities

The basic objectives of MMC activities are, firstly, to establish basic micromachine technologies and increase utilization of micromachines through research and investigation of micromachines (tiny machines, comprising functional components measuring only a few millimeters or less, that are capable of minutely detailed and complicated operations), collection and provision of micromachine information, and exchange and cooperation with worldwide organizations; and secondly, to contribute to the further development of Japan's industrial economy and to international society.

MMC's basic objectives in FY 2003 are, as in the previous fiscal year, to actively disseminate information on Japanese micromachines; to engage in technical issues concerning the fusion of micro- and nanotechnologies; and to promote the further industrialization of micromachines through such events as MEMS.

II. Description of Primary Activities

1. Research and Investigation of Micromachines

Planned activities are aimed 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) Microanalysis/Production System Project (recommissioned NEDO project)

This project involves the systematic collection of all pertinent information regarding the hardware design, which are indispensable for achieving high efficiency in a diversity of analytical and chemical processes, and which is achieved through designing, manufacturing and evaluation processes of microchip devices, into a database that will facilitate efficient use of this information during the term of the project, store and maintain the information after the project's conclusion, and ultimately be made available to the general public. The data framework and accumulated information in the test database created in 2002 will be revised and the database upgraded; survey research will also be conducted to gather further relevant data.

(2) Studies on the future prospects of micromachine technology

As we anticipate the industrialization of the micromachine technologies that have been 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. Hence, studies on the future prospects of

micromachines are being implemented and approached from various angles.

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

These studies aim to identify and analyze the latest trends in the rapidly expanding field of micromachine technology, and micromachine R&D in Japan and abroad; and to develop basic technological data to aid in developing micromachine technologies.

(4) Studies on the micromachine market

Statistical data on micromachine-related markets that is consistent over time is compiled using models for estimating the micromachine market.

(5) Development of new functional materials for MEMS(application submitted to the Japan Machinery Federation)

In order to make MEMS more applicable in a wide range of industrial sectors, such as the telecommunications, bio and medical fields, this research seeks to clarify the possibility of manufacturing minute devices through the combination of functional and heterogeneous materials comprising piezoelectric, magnetic, ceramic, organic, compound, non-silicone chip, nano, and other materials.

(6) Joint survey research activities concerning the industrialization of MEMS

Opportunities for the industrial application of MEMS have been opening up rapidly in recent years; in order to further accelerate the industrialization of MEMS, this research will comprehensively tackle such challenges as advancing foundry services and coordinating MEMS devices and materials fields. Joint research with businesses that provide foundry services will also be conducted on specific issues such as process standardization, creation of a materials database, and coordination between foundries.

2. Collection and provision of micromachine information

Information and documents on micromachine use in universities, industries, and public organizations in Japan and overseas will be collected, combined with survey results and MCC-produced documents, and made freely available in the MMC library.

(1) Maintaining and upgrading the MMC library

Technical documents and materials are collected and stored in the MMC library and listed in a database together with other relevant information.

(2) Publication of a micromachine periodical

"Micromachine Index," containing abstracts of technical

documents and information on materials, is issued on a regular basis and supplied to supporting members and organizations concerned with micromachines.

(3) Publication of a newsletter

Information concerning the research and governmental trends related to micromachines is distributed monthly to supporting members and other interested individual and organizations.

(4) Database compilation and data management system operations

We will upgrade data in the database and operate to make the database accessible to supporting members.

3. Exchange and cooperation with micro-machine-related organizations worldwide

To promote affiliation, exchange and cooperation with related organizations in and outside Japan, MMC will involve itself in such activities as participating in the micromachine summits, holding international symposiums, inviting to Japan and sending overseas researchers and experts in the field, and building foundry services.

(1) Participation in the 9th Micromachine Summit

MMC will participate in the 9th Micromachine Summit in Beijing, China, taking part in discussions of a wide range of topics, including worldwide trends in micromachine technology and its fields of application.

(2) Holding symposiums on micromachine technology (partially subsidized by activities promoting the machine industry)

This year MMC will hold the 9th International Micromachine/Nanotech Symposium (focusing on the fusion of MEMS and nanotechnology) with the aim of establishing and disseminating micromachine technologies. The Symposium will include presentations from various countries describing their R & D achievements, as well as their applications of and policies for promoting technology.

(3) International Exchange and Dispatch of Researchers

A group will be dispatched overseas to promote the exchange of information and opinions with micromachine-related research institutes in universities and similar institutions. This group will also participate in international symposiums and academic meetings held overseas. MMC will further promote exchange by inviting experts in the field from America and Europe and by sending our experts and researchers overseas.

(4) Building a foundry network system

Foundries are vital to the industrialization of micromachines, particularly MEMS. In order to improve these facilities, we will undertake the establishment of a system to improve services through a network comprising members of the Foundry Service Industry Committee, who represent businesses either involved in or related to the provision of foundry services.

(5) Establishing a forum for the exchange of micromachine technology

In order to accelerate the development of micromachine technology - a basic technology expected to have a diversity of applications in various fields - MMC will promote this technology by establishing a forum for the exchange of information, joint research, and other promotional activities. This year, MMC will hold a meeting for the exchange of biotechnology and other technologies outside but related to the micromachine field.

4. Standardization of micromachines

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

(1) Standardization of fatigue testing methods for micro-nano materials(application for sponsorship submitted to the Ministry of Economy, Trade and Industry)

MMC will undertake the development of conventional 1/1000 sized specimens for testing micro-nano materials, R&D on the capabilities required of testing equipment, and the establishment of stable testing conditions for compiling and analyzing data, and standardization of these.

(2) Standardization of tensile testing methods for thin film materials

The results of MMC research conducted between Fiscal 1999 and Fiscal 2001 as part of the NEDO project "standardization of evaluation method of properties for micromachine material" have been included in international standardization proposals and will be implemented with the support and approval of the Japanese Standards Association.

(3) Support for standardization of IEC terminology

The specifications proposal "Technical Terms in Micromachine Technology" submitted to IEC/TC47/WG4 has been approved at the NP (New Project) stage and is now at the CD (Committee Draft) stage. This year MMC will continue its support of work towards international standardization.

(4) Research and investigation of micromachine standardization

The results of this study will be transmitted worldwide to encourage international standardization, while demonstrating initiative in establishing international standards. This year, in addition to presiding over the on-line International Standardization Forum, MMC will continue its development of standardization policies regarding measurement and evaluation based on its consideration of the selection and prioritization of standardization items.

5. Dissemination of information and education about micromachines

By issuing and distributing quarterly magazines and by holding exhibitions, we hope to disseminate information on micromachines extensively in order to educate as many people as possible.

(1) The quarterly magazine "MICROMACHINE" will be published periodically and distributed to those in or connected with the field. The quarterly magazine will also be made available on the Internet through the Center's home page.

(2) The 14th Micromachine Exhibition and other events will be held to present the latest research achievements, as well as instruments and equipment for aiding research.

(3) We will serve as the Federation of Micromachine Technology Secretariat to work with and strengthen micromachine-related organizations.

2002 Micromachine Drawing Rally

The Micromachine Center (MMC)-sponsored Micromachine Drawing Contest for elementary and junior high school students was held for the eighth and final time in 2001. For the 2002 competition, it was decided to hold a smaller-scale "drawing rally" instead of a full-scale contest. The 2002 Micromachine Drawing Rally attracted a total of 1,526 entries (714 entries in the elementary school category and 812 entries in the junior high school category) submitted by students from the following 7 elementary schools and 4 junior high schools. The kind cooperation of teachers at these 11 schools is gratefully acknowledged.

Participating Schools

Elementary Schools:

Iho-Minami Municipal Elementary School
(Takasago, Hyogo Prefecture)
Takasago Municipal Elementary School
(Takasago, Hyogo Prefecture)
Kijo Municipal Elementary School
(Kariya, Aichi Prefecture)
Omiya-Minami Municipal Elementary School
(Saitama, Saitama Prefecture)
Omaki Municipal Elementary School
(Saitama, Saitama Prefecture)
Kasumigaseki-Minami Elementary School
(Kawagoe, Saitama Prefecture)
Shimo-Inayoshi Municipal Elementary School
(Chiyoda, Niihari-gun, Ibaraki Prefecture)

Junior High Schools:

Shoyo Municipal Junior High School
(Takasago, Hyogo Prefecture)
Kariya-Minami Municipal Junior High School
(Kariya, Aichi Prefecture)
Fukagawa 8th Municipal Junior High School
(Koto-ku, Tokyo)
Takayama Municipal Junior High School
(Tsukuba, Ibaraki Prefecture)

The MMC Dissemination Committee (headed by Mr. Hitoshi Tateoka of Olympus Optical Co., Ltd.) selected 10 prizewinners each from the elementary and junior high school categories. The winning entries are shown on the following pages. These drawings are to be used in future promotional activities to enhance diffusion and awareness of micromachine technology. Each prizewinner in both the elementary and junior high school categories was presented with a Certificate of Merit, and each of the participating elementary and junior high schools was presented with a testimonial and a School Cooperation Award.

2002 Micromachine Drawing Rally Prizewinners

Elementary School Category

Allergy Repulsion Machine



Keishi YOKOYAMA
Kijo Municipal
Elementary School
(6th grade)

Micro - Message Glasses and Transmitter



Kazuhiro HAGIWARA
Shimo-Inayoshi Municipal Elementary School
(6th grade)

Bacteria Removal Machine



Shuto KATAGISHI
Omiya-Minami Municipal Elementary School
(5th grade)

Hover - board



Tatsuya SAKAMOTO
Shimo-Inayoshi Municipal Elementary School
(6th grade)

Memory Pencil



Hiroaki KUDO

Shimo-Inayoshi Municipal Elementary School
(6th grade)

Guide - Machine



Shoko CHIZAWA

Omaki Municipal Elementary School
(6th grade)

Handy Animal Desk Set



Tomona KOMATSUZAKI

Shimo-Inayoshi Municipal Elementary School
(6th grade)

Water - Pipe Rescuer



Ryota NOZAWA

Omiya-Minami Municipal Elementary School
(6th grade)

Kumokumo : Spider - Shaped Landmine Detecting Robot



Yuko YOSHIDA

Iho-Minami Municipal Elementary School
(6th grade)

Lost Property Finder

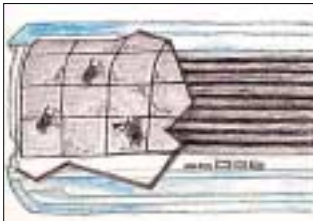


Yuta SAKAKIBARA

Kijo Municipal Elementary School
(6th grade)

Junior High School Category

Rhinoceros Beetle / Stag Beetle Buggies



Takaaki MIYAMOTO

Shoyo Municipal Junior High School
(1st grade)

The EMS Master Tank: Paralysis? Piece of Cake!



Takanori SUZUKI

Kariya-Minami Municipal
Junior High School
(3rd grade)

Dr. Tooth



Akari ITO

Kariya-Minami Municipal Junior High School
(3rd grade)

Stuck - on - Safety Sticker



Kaoru TANAKA

Kariya-Minami Municipal Junior High School
(3rd grade)

Eyesight Preservation Ring



Chika WATANABE

Kariya-Minami Municipal Junior High School
(1st grade)

Audible Text Machine



Takaya SAIKI

Kariya-Minami Municipal Junior High School
(3rd grade)

Training Pace-Setter Earring-Phones



Kyoko YOKOYAMA

Kariya-Minami Municipal Junior High School
(2nd grade)

Anesthesia + Micromachine



Yui TAKAMATSU

Fukagawa 8th Municipal Junior High School
(2nd grade)

Automatic Braille Translator Earrings



Natsuko KAMIYA

Kariya-Minami Municipal Junior High School
(3rd grade)

Footpath Safety Ring



Kanta KATO

Kariya-Minami Municipal Junior High School
(2nd grade)

MEMS 2003 Report

MEMS2003, The 16th Annual International IEEE Micro Electro Mechanical Systems Conference, was held from January 19 to 23, 2003, at the Kyoto International Conference Hall, Japan.

The 500 pre-publication papers submitted for presentation at MEMS2003 exceeded last year's record of 454, and of these, 22 were chosen for oral and 151 for poster presentations, a selection rate of approximately 35%. Since applications mushroomed in 1995, it has become increasingly difficult to have a paper accepted for presentation at a MEMS conference. Although attendance at this year's conference was 664, slightly less than the 700 who attended MEMS2002 in Las Vegas, USA, last year, the fact that approximately half the participants were from overseas ensured that the conference was, as its name promises, a truly international event.

MEMS began in 1987 as the Micro Robots and Teleoperators Workshop, and the present name was adopted in 1999. Although the number of presentation papers and conference participants has gradually increased over the years, MEMS has consistently maintained its original single session format for oral presentations. The number of oral presentations at MEMS2003 was reduced from the previous year's 41 to 22, partly in order to ensure a consistent selection rate. Needless to say, this decision was neither an easy for organizers to make, nor necessarily welcomed by participants. However, in the poster sessions, for which a much greater number of presentations were accepted, the standard of research in a large proportion of presentations was very high. Furthermore, in Poster Preview sessions, a new feature introduced experimentally at MEMS2003, held prior to the poster sessions each day, the content of presentations was classified into relevant categories and topics selected by commentators explained, and this additional service was well-received among participants.

By region, the largest number of poster presentations was made by American researchers (71 presentations), followed by Japanese researchers (49 presentations). Although the number of presentations by European researchers was noticeably small (19 presentations) this year, the number of presentations by Korean and Taiwanese researchers again rose over the previous year.

According to the results of a questionnaire answered by conference attendees, participants showed the greatest interest in presentations

concerning either materials or processing technologies, but interest in bio- and micro fluid-related topics combined was greatest overall. The strong interest in these two fields is a growing trend that has been commonly observed in micromachine-related international conferences of late.

Breakdowns of the papers submitted to and presented at MEMS2003 according to topic and region, as well as the results of the attendees' questionnaire, are available on the Ritsumeikan University website (<http://www.ritsumei.ac.jp/se/~tabata/mems2003/>).

The MEMS2003 Proceedings (soft cover/ 711 pages/ 12,000 per copy (¥10,000 for IEEE members), CD-R and shipping fee included) can be ordered from the following website: <http://home.inter.net/mems2003/>

The 17th Annual International IEEE Micro Electro Mechanical Systems Conference, MEMS2004, is to be held in Maastricht, The Netherlands, from January 25 to 29, 2004. Program details are available from the following website: <http://www.mems2004.org>

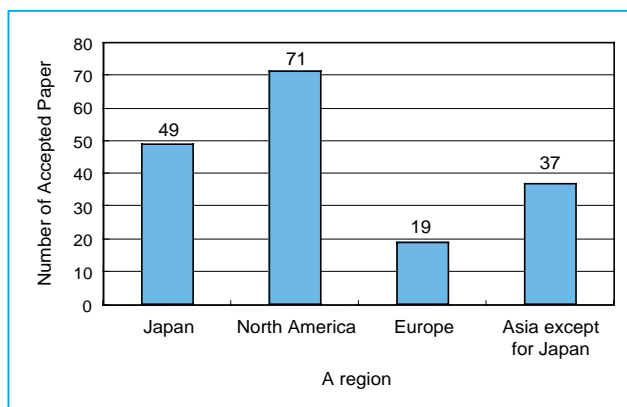


Fig. 1 Regional Distribution of accepted Paper for MEMS2003

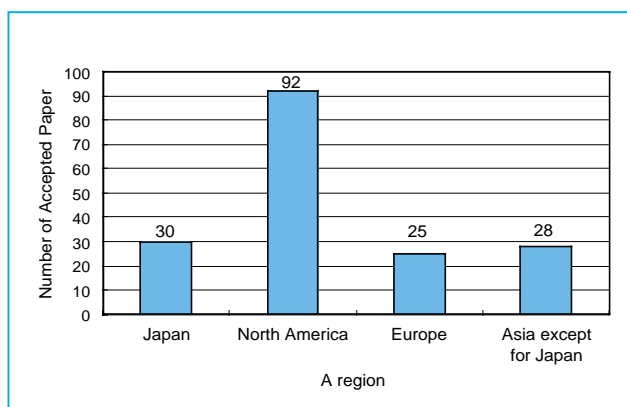


Fig. 2 Regional Distribution of accepted Paper for MEMS2002(For Reference)

Fuji Research Institute Corporation

1. The Challenge of Microfabrication Technology

While Europe and America are the leading nations in the microfabrication industry, an effort to establish this technology as a new pillar of industry in Taiwan, Singapore, and other Asian countries has recently gained momentum through the support from their national governments. There are also growing expectations in Japan that its manufacturing industry can be revitalized by microfabrication technologies, such as accelerometers, pressure sensors, and inkjet printer heads. Against this backdrop, Fuji-RIC has proposed applying our simulators (see Table) to provide various services such as data analysis, consulting, and the development of simulation systems for the microfabrication industry for which market growth is considered promising.

2. Future Challenges

In the future, Fuji-RIC would like to contribute to



Mitsuru Annen
President

the field of microfabrication by developing an advanced simulation system through the use of our current achievements, including semiconductor process analysis, electrostatic/magnetostatic field analysis, optical, electronic and plasma analysis, thermal fluid analysis, chemical reaction analysis, and structural analysis. We would like to strive to take the lead among Japanese company in simulation systems for microfabrication technology.

Achievements in Development

Fuji-RIC Development Simulators	Description
FUJI-RIC / μ -FLOW	The mesh generator can provide higher quality meshes which were difficult using the structured grids of FUJI-RIC / α -FLOW.
FUJI-RIC / α -FLOW, EWS version	FUJI-RIC / α -FLOW is the CFD system for a wide range of flow models.
FUJI-RIC / α -FLOW, PC-UNIX version	PC-UNIX version supports full-spec of EWS version on a Linux platform.
MISTRAL/MP (multiphase flow simulation system)	MISTRAL/MP is the CFD code for multiphase flows(gas/liquid,liquid/liquid) including evaporation/condensation model.
Microstructural stress and structure analysis simulation system	This structural analysis simulator can evaluate the thermal stress natural period, phase shifts, and time response of structures.
Microstructural fatigue and thermal stress analysis simulation system	This structural analysis simulator can evaluate changes in properties of materials, stress singularities in interfaces of layer structures, and fatigue characteristics.

Seeking Revolutionary Biomaterials

Kazuhiko Ishihara, Professor
Madoka Takai, Lecturer

Department of Materials Engineering, School of Engineering, The University of Tokyo

There has been much anticipation for the development of a new biotechnology that would enable us to recover our humanity and contribute to healthy enjoyable lives. In addition to the great contribution from materials created through our latest technologies, the construction of a biointerface for interfacing with organisms is an important subject. It is our hope that Japan will pioneer future biotechnology in medical devices, time reset medical treatment, order-made medical treatment, brain function analysis, biochips, after genetic information analysis.

Biomaterial is indispensable for constructing a reliable interface between living organisms and material. At the Ishihara-Takai Laboratory, we have no doubt that "biomaterial engineering is the field that will enable us to realize our dreams." Under this philosophy, we are working toward the development of new biomaterials and advanced medical devices for the 21st century. To achieve this, we have studied the design, synthesis, and functional evaluation of novel polymer materials dividing four research teams responsible for biointerface, bioconjugate, biomatrix, and nanobioprocessing. These teams are systematically conducting research in the following eight fields.

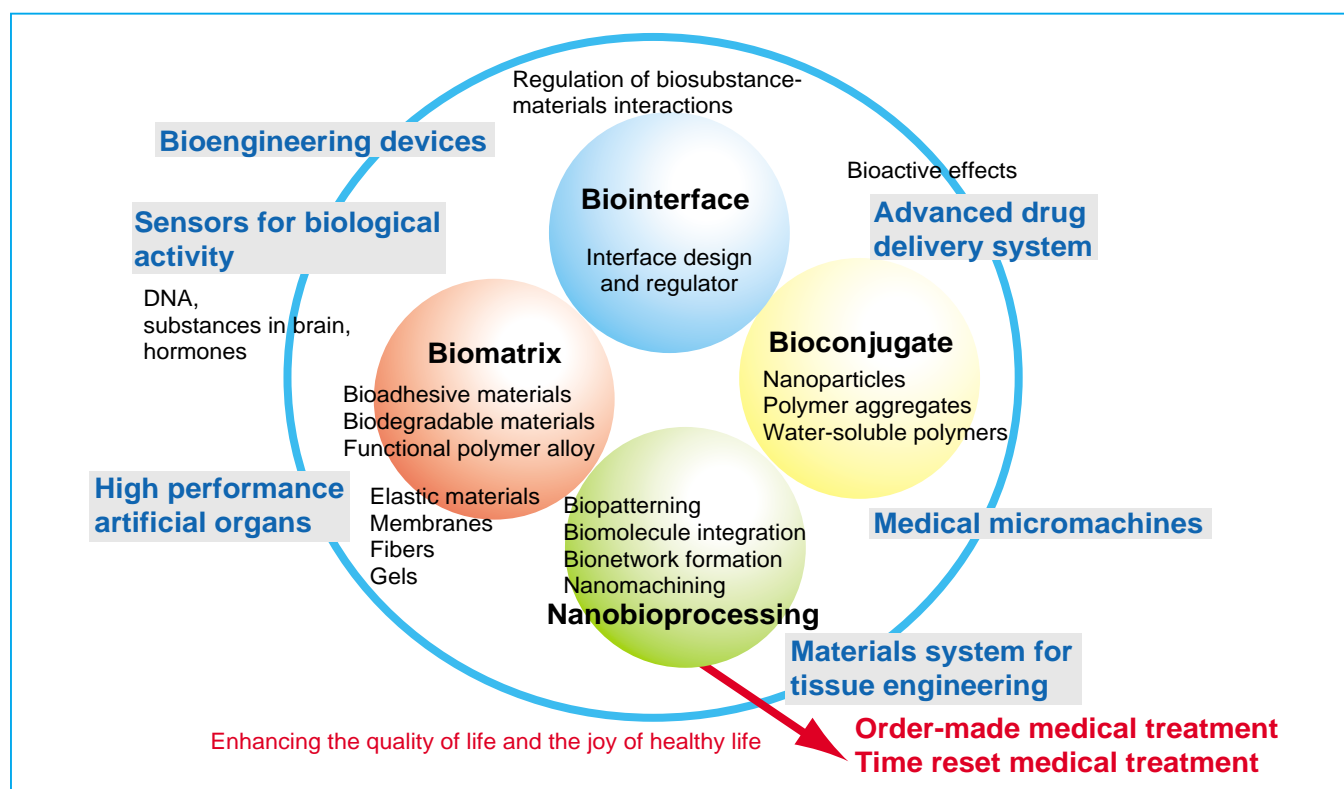
1. Synthesis of phospholipid (MPC) polymers and their applications in biomaterials
2. Preparation of a supramolecular polymer materials for cellular engineering
3. Preparation of polymer membranes for the efficient separation of biomolecules
4. Precision synthesis of polymeric biomaterials
5. Preparation of bioactuator materials
6. Study on bioinspired polymer gel for nanomachines

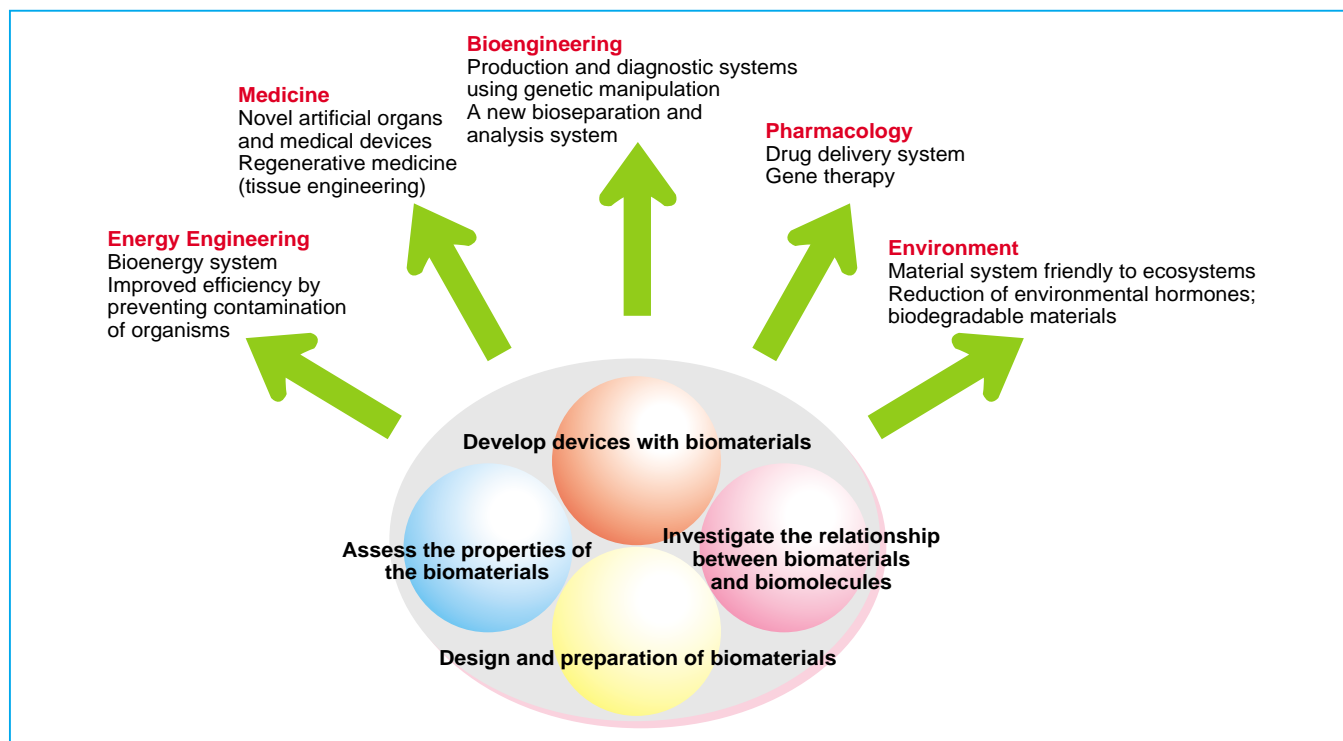
7. Synthesis of polymers for stabilizing bioactive molecules

8. Preparation of protein adsorption resistible materials for use in microspaces to improve chip functions

Professor Kazuhiko Ishihara (an associate professor at the time) established this laboratory in April 1998 with two undergraduate students as part of the material engineering developments. As of April 2003, five years later, the staff at the laboratory includes Professor Ishihara, lecturer Dr. Madoka Takai, research associate Dr. Junji Watanabe, researcher Dr. Kikuko Fukumoto, and Ms Kyoko Fukazawa as an assistant member. In addition, the laboratory includes one project researcher and 17 graduate students (9 in the doctoral course and 8 in the master's course) and 4 senior undergraduate students, making a total of 27 people in this large laboratory.

All researchers at the laboratory vigorously conduct research and development through repeated experiments and discussions on their specific research topics. The environment at the laboratory is such that anyone can freely use instruments for material preparation and processing, polymer synthesis and analysis, and property evaluation. We are involved in much collaborative research with universities and companies domestically and overseas, while supplying MPC polymers that can make biocompatible on the device surfaces. In particular we have succeeded in the industrialization of MPC polymers through close cooperation with businesses and have commercialized skin care and eye care products through our research. Recently we have developed a method of polymer treatment that can reduce protein adsorption on the surfaces of biochips and capillaries by 98% and are providing information on this method. This technology is also effective in





micromachine development. Work at the laboratory is performed in a cheerful and enjoyable environment under the motto that research should always be conducted with viewpoint

towards to the world. (For more information on our research activities, please see the Laboratory web site at <http://bmw.mm.t.u-tokyo.ac.jp/ishihara/>).

Preliminary Announcement

The 9th International Micromachine / Nanotech Symposium

November 13, 2003

at Science Hall, Science Museum, Tokyo, JAPAN



Exhibition MICROMACHINE 2003

November 12 - 14, 2003

at Science Museum, Tokyo, JAPAN

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