

The Eleventh International Micromachine/Nanotech Symposium

On November 10 (Thursday) 2005, the Eleventh International Micromachine/Nanotech Symposium was held in the Science Hall of the Science Museum in Tokyo's Kitanomaru Park, sponsored by the Ministry of Economy, Trade and Industry and the New Energy and Industrial Technology Development Organization (NEDO), with assistance from the Japan Auto Racing Association. The symposium started with an opening address from Tamotsu Nomakuchi, Chairman of the Center, followed by a greeting from the guest of honor, Tetsuya Yamamoto, Director of the Machinery System Technology Development Dept. at NEDO. This time, before the lectures, a special session was planned with a keynote speech and panel discussion on the theme of "Towards development of the MEMS industry", followed by twelve lectures in the three sessions "The frontiers of the micromachine business", "Micromachine applications expected to blossom", and "The leading edge micromachine technologies". Three hundred and thirty-nine people from a range of specialist fields attended, from a number of companies, universities, and research institutions in the fields of electronics, equipment and machinery, automotive, materials and chemicals and so on, making the symposium a great success. This is a report of the symposium overall.

The special session was held to raise awareness of the MEMS Industry Group to be inaugurated by the Micromachine Center in April 2006 with the aim of promoting the further development of the MEMS industry in a situation where the market for MEMS devices and products is expanding, and to contribute to enhancing the international competitiveness of the Japanese MEMS industry. First Prof. Hiroyuki Fujita of Tokyo University gave a keynote speech entitled "The expansion of the MEMS industry and policies for developing new sectors", followed by a discussion of the themes "The direction of the MEMS industry" and "Policies for creating a new industry and driving development", mediated by Prof. Fujita with the six panelists Hitoshi Ogata (Senior Director of Development at Mitsubishi Electric Corporation, and MEMS Informal

Committee Representative), Haruo Ogawa (Director of New Core Business Planning at Olympus Corporation), Hiroya Taguchi (Chairman of The Japan Society of Mechanical Engineers and Chief Engineer of the Hitachi Research and Development Center), Hiroshi Tsuchiya (Assistant Section Chief, Industrial Machinery Division, Manufacturing Industries Bureau of the Ministry of Economy, Trade and Industry), Tsuneyuki Miyake (Deputy Editor of Nikkei Microdevices), and Prof. Harri Kopola (Research Director, VTT Electronics), one of the lecturers.

Regarding "The direction of the MEMS industry", Mr. Ogawa and Mr. Ogata talked about the micro and nano strategies of their respective companies, while Prof. Kopola explained the efforts towards building a MEMS industry in Finland. It was very much apparent that companies both in Japan and overseas are focusing on MEMS and nanotechnology as core technologies. Mr. Miyake rounded off the discussion by talking about how there is no doubt that MEMS represents a third wave that is forming a significant market, with semiconductors as the brains, displays as the face, and MEMS devices as the limbs and the senses, and how major disparities will open up between companies depending on their strategies. Next, they discussed the topic "Policies for creating a new industry and driving development". Mr. Taguchi compared the MEMS research approaches of the Society of Mechanical Engineers and the Institute of Electrical Engineers, stressing the necessity for horizontal linkage between them for MEMS development. Then Mr. Ogata, the representative of the MEMS Informal Committee which is promoting the establishment of the MEMS Industry Group, talked about the need for exchanges within industry to promote the MEMS industry, introducing the MEMS Industry Group as the organization for fulfilling this role. Next Mr. Tsuchiya of the Ministry of Economy, Trade and Industry explained the strong policies of the Ministry in providing the best backup for raising MEMS technology, such as preparing new projects to meet the expectations for the MEMS industry. Finally the discussion was completed with the



The panel discussion



The keynote speech from Prof. Fujita

presentation of a video letter from MANCEF President, Dr. Kees Eijkel expressing strong support for the MEMS Council.

In Session 1, "The frontiers of the micromachine business", there were presentations that strongly evoked the scene of work at the various companies, on the subject of inkjet printers from Mitsuro Abe of Seiko Epson, mobile phones from Kunihiro Nakamura of Matsushita Electric, and inertia sensors such as acceleration sensors and gyroscopes (angular velocity sensors) from Bob Sulouff of Analog Devices in the US. The printer heads at the heart of inkjet printers are one successful type of MEMS device, and the applications of printer heads are not limited to printers. Mr. Abe explained how recently, the development of applications is taking off with printer heads used as a tool for the manufacture of a range of devices such as LCD color filters, organic EL displays, organic TFTs, plasma display electrodes, biochips and so on, which was greeted with surprise. In order to achieve multiband mobile phones, further technological innovation is required. Among these innovations, there are expectations for the development of small, low-loss RF-MEMS switches and RF-MEMS filters, and it was explained that relevant research and development is taking place around the world. MEMS devices have been commercialized successfully in the form of inertia sensors such as acceleration sensors and gyroscopes (angular velocity sensors), and the wonderful success story of Analog Devices in the US which succeeded in breaking into the MEMS industry gave heart to everybody else involved in the same effort.

In Session 2, "Micromachine applications expected to blossom", there were lectures introducing the frontiers of applied research in medicine, optics, energy, and space, in which MEMS technology is key. Prof. Yoshinobu Baba of Nagoya University gave a lecture on the medical applications of nanotechnology. Nanobiotechnology is making significant advances with microfabrication technology and molecular nanotechnology, making possible the development of methods for separating all sorts of biomolecules such as DNA, RNA, proteins and peptides, for applications in genomics, genetic information copying, protein science and the like, while applications in the treatment of cancer are also expected. In his lecture, Prof. Kopola of VTT Electronics explained that in future optoelectronics and optical communication systems, MEMS technology will be a key technology for miniaturization, integration, and low cost. Osamu Nakamura of Casio gave a talk on the development of subminiature, high-performance reforming fuel cells for use in mobile terminals. MEMS technology is the key technology for making the integrated miniature reformer, an essential part for generating hydrogen from a fuel alcohol such as methanol, and from which the power-generating cell extracts electrical energy. In his lecture, Dr. Thomas George who carried out research at NASA, explained that MEMS and nanotechnology, which achieve the ultralow volume, ultrasmall size, and ultralow energy consumption required in space development, are

extremely useful. To round up the session, Prof. Isao Shimoyama of Tokyo University gave a lecture entitled "Fine MEMS", talking of the need for combinations of MEMS and nanotech functions, integrated fabrication of MEMS and semiconductors, and the development of high integration composite MEMS technologies for high MEMS/MEMS integration, in order for MEMS to meet diversified needs. And although MEMS devices and components are incorporated in many products, the general public is largely unaware of them so he made the interesting suggestion that products containing MEMS should be labeled with a mark like that used by Intel.

In Session 3, "The leading edge micromachine technologies", there were lectures about MEMS and materials, ultraprecision microfabrication and its applications, nanometrology, and the mechanical limits of structural thin-film materials and nanomaterials. Development of the basic technologies regarding materials, fabrication, measurement, and reliability are essential for MEMS development, and on this occasion, we encountered the leading edge of these basic technologies being pursued steadily at universities and the like, both here and overseas. Among these, Yoshimi Takeuchi of Osaka University talked about ultraprecision microfabrication and its applications. Although semiconductor microfabrication technologies tend to play a central part in MEMS fabrication technology, Mr. Takeuchi presented extensive fabrication data showing that machining at the nanolevel is possible not only superficially but on three-dimensional surfaces too. Finally Dr. Christopher Muhlstein of Pennsylvania State University spoke on the subject of understanding the mechanical limits of structural thin-film materials and nanomaterials. He explained how he analyzed the breakdown and fatigue behavior of thin film materials with the aim of improving the reliability of MEMS, and he showed a method of improving the mechanical characteristics of thin films with a protective coating on their surface based on those results. The reliability of thin film materials is an important research issue for commercialization of MEMS, and this topic was of great interest to the audience.

Starting after 9 and going on till 6 in the evening, it was a long event starting with the panel discussion in the special session followed by twelve lectures packed into a tight schedule. The venue was enthused by the palpable sense of potential and expectation surrounding micromachines and MEMS. It was apparent that MEMS technology, that was in its initial phase centered on research and development, is now becoming a functioning industry. Thanks to the timely topics provided by the speakers from Japan and overseas and to the efforts of the program committee, this symposium was a tremendous success.

The Twelfth International Symposium will be held on November 8 (Wednesday), 2006 at the Tokyo International Forum as part of Exhibition MICROMACHINE.