Recent MEMS Trends in the U.S.

Microelectromechanical Systems (MEMS) is a technological concept that originated in the U.S. in the late 1980s. MEMS function to form electromechanical devices by integrating the functions of actuators and other mechanical elements with circuitry on wafers using microfabrication. Following subsidies provided by the National Science Foundation (NSF) to support MEMS, the Defense Advanced Research Project Agency (DARPA) began a full-scale MEMS program with an annual budget of $40-50 million.

We interviewed academic and industrial experts to understand the current state of MEMS in the U.S. as part of a survey commissioned by the Japan Industrial Policy Research Institute. Contacts are listed below.

Prof. Wen Ko, Case Western Reserve University
Has been studying pressure sensors since the 1960s and is now conducting training on MEMS in China.

Dr. Clement, Managing Director, MEMS Industry Group
Serves as the day-to-day manager of MIG operations and activities.

Dr. Gabriel, Akustica, former Prof. of Carnegie Mellon University
Served as Director in the initial DARPA MEMS Program and contributed to establishing the existing MEMS research system.

Dr. Bob Rao, Technology and Manufacturing Group, Intel Corporate
Actively involved in research on microsystems and nanotechnology

Prof. Tang, UC Irvine, former MEMS Director of DARPA
Former MEMS Director at DARPA and is now launching MEMS research at UC Irvine.

MEMS research and infrastructure in the U.S. have been developed under the sponsorship of DARPA. DARPA's goals in supporting MEMS R&D are to determine potential applications of MEMS technology in national defense, as well as commercial applications. Accordingly, DARPA has continuously funded MEMS projects anticipated to spark developments in microfabrication technology, changing the focus of the research topics to meet the needs of the times. In the initial stages of the MEMS Program, DARPA aimed at enhancing overall MEMS technology and subsequently focused on applied research in the fields of optics and biotechnology. At present, the agency has shifted its research thrust to biotechnology and wireless technology from optical switches, which it had supported during the "IT bubble era."

In order to ensure that research findings lead to commercialized products, DARPA has recently sought to include private companies in the program. In addition, the agency undergoes strict evaluations at the completion of each 18-month phase in a total of three phases.

DARPA also funds research conducted by startup companies until they can find venture capital and other financial sources. The funding has proved effective in luring serious investors. As the MEMS infrastructure is still in its growing stage, DARPA supported a foundry service based on standardized multiuser MEMS processes (MUMPs) that enable us to fabricate different types of devices on a single wafer. After the MEMS infrastructure was fully developed, the foundry was transferred to a private company. The MEMS Exchange, currently in operation, is a network of fabrication facilities at universities designed to aid universities and small to medium-size companies. By linking the facilities at these universities, the project is beneficial for universities that conduct only small-scale MEMS research.

With the support of DARPA and other organizations, startup companies have started to commercialize the results of research conducted by universities. Some professors and university researchers who pioneered the field of MEMS are taking two-year long sabbaticals to launch their own venture companies, where their achievements are put into practical use. Dr. Gabriel, former professor of Carnegie Mellon University, created an innovative method for developing MEMS-based speaker and microphone chips. About two years ago, he founded a fabless company named Akustica with some twenty employees and is currently involved in operations, while on sabbatical from CMU. Akustica is expected to break even by 2005. Since startup companies like Akustica rely on investments from venture capital and individual investors, their success depends both on the technology to be commercialized and their fund-raising ability.

California is a center for hi-tech companies, such as those located in Silicon Valley, and academic research. The state has many prestigious universities, such as the University of California, Berkeley, but since their campuses have reached a saturation point for research facilities, additional facilities and faculties for advanced research are being constructed in Irvine, located 40 mile south of Los Angeles. Many biotechnology companies and other ventures are flocking to Irvine because of the venture capital available and are working closely with UC Irvine in biotechnology research. Irvine is already beginning to take the form of a "Bio Valley."

Normally new companies look outside the company for technological seeds to develop MEMS products, but U.S. companies establish relationships, in the form of joint research and the dispatch of in-house researchers, with universities that have accumulated technological expertise through advanced research. Intel Corporation, for example, has begun conducting biotechnological research in cooperation with universities.

According to comments we received, it is extremely important for startup fabless companies to find foundry services that can maintain repeatability in product quality and performance.

A widely used technology, MEMS is being incorporated into various devices developed with CMOS, SiC and other materials. As measuring technology is becoming vital to the application of MEMS, the MEMS Industry Group (MIG) is holding workshops to address this issue.

The U.S. MEMS community has been shifting to application-oriented research, while firms offering integrated services have also expressed an interest in MEMS technology. Advanced research covers the potential uses of not only silicon but also new innovative materials for MEMS device. Many experts have indicated that commercialization of MEMS technology must include an improvement in reliability and reduction in costs, particularly packaging costs.