

Where is MEMS Headed Next?

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When glancing through recent industrial news on MEMS and micromachines, I noticed that these technologies have drawn attention from various industries and that there is a trend toward undertaking MEMS business activities. The following is just a sample of some of the headlines over the past six months (all taken from the MEMS International news Web site at <http://techon.nikkeibp.co.jp/MEMS/>).

■“RFMD Introduces MEMS Switches for Use in Mobile Phones and Announces Plans to Build a New Facility” (Nov. 28, 2007), ■“OMRON to Construct a 200-mm line for MEMS Production” (Dec. 13), ■“U.S. Company Technitrol Acquires Denmark-based Sonion” (Jan. 10, 2008), ■“Wireless Crop-Monitoring Network Deployed in Vineyards” (Jan. 30), ■“Mitsumi Show: Mitsumi Electric Developing a 3-axis Accelerometer with 2.8 mm per side” (Feb. 21), ■“ST and Veredus Market Lab-on-chip for Rapid Detection of Influenza” (Mar. 24), ■“iSuppli to Conduct Market Research on MEMS and Solar Cells” (Apr. 7), ■“NHK Proposes a New User Interface for TV Remote Controller with Built-in Motion Sensor” (Apr. 24), ■“NTT DoCoMo Invests in MEMS Gyro Startup” (Apr. 30), ■“TSMC Announces Full-Entry into MEMS Market” (Apr. 30), ■“EPCOS Acquires NXP’s RF MEMS Business” (May 2), ■“Toshiba Jointly Develops a DNA Chip for Monitoring Infectious Disease in Animals” (May 30), and ■“Toshiba Unveils Technology to Encapsulate MEMS Devices in Front-end Process” (May 31).

It is clear that numerous industries involved in semiconductors, electronic parts and components, cellular telephones, broadcasting, and the like have invested human and financial resources in MEMS. This is likely because recent advances in MEMS technology and improvements in the infrastructure (design and production) have lowered the entry level required for developing MEMS devices. The continuous mass-production of inkjet heads and mass-production of devices used in consumer equipment, such as accelerometers and silicon microphones (see left diagram below), are two factors that have facilitated the use of MEMS.

Recently companies have begun integrating MEMS of various types from other industries into their own core businesses. I think this is particularly embodied by trends in the semiconductor industry over the past year. For those readers who have followed MEMS and micromachines over the years, it must feel that the materialization of such trends was a long time in coming.

The question is where is MEMS headed next? In this IT (information technology) age, wireless sensor networks will be used to incorporate enormous amounts of information from the real world into the computer world, enabling anyone to reference and manage this information. There have been many predictions on when this scenario might come about (see right diagram below), but there is great potential for MEMS contributing to sensors and tiny power sources in these circumstances. Corporate players who can harvest the added value of MEMS are still looking forward to this day with anticipation.

Period	Applications	Impact on the MEMS industry	Major players in production
1990 -	▼MEMS built into equipment (inkjet heads, etc.)	▼Establish mass-production	Equipment manufacturers Automobile manufacturers
2000 -	▼MEMS devices (accelerometers, etc.)	▼Accelerate low-cost technologies and expand production infrastructure	Semiconductor manufacturers Parts manufacturers
2005 -	▼Integrated MEMS (devices merging CMOS and LSI, etc.)	▼Develop standards for production processes and advance integration with LSI production	Semiconductor manufacturers MEMS foundries
2010 -	▼MEMS integrated devices from semiconductor manufacturers	▼Developing an IP core for MEMS functions	Silicon/MEMS foundries Semiconductor manufacturers

Application	Personal computers	Digital consumer electronics	Real world information systems
Start of industry	1980s	2000s	2010s
Leading players	Intel Corp., Microsoft Corp.	Apple Inc., Matsushita Electric Industrial Co., Ltd. (Panasonic), Nokia Corp., Sony, etc.	Google Inc.
High added value players	Intel	Apple, ARM Ltd.	Google Inc.?
Required devices	Microprocessors, DRAM, HDDs	SoC, flash memory, wireless chips	Sensors, wireless chips, tiny power sources
Major infrastructure of industry			