MEMS and semiconductors becoming more closely aligned

MEMS is moving from an emerging technology to a commercial force

The MEMS industry is moving toward integration with the semiconductor industry and toward standard outsourced production, according to Jean Christophe Eloy, managing director of Yole Développement at the Emerging Technologies TechXPOT at SEMICON West on Tuesday. For now that means MEMS device makers are increasingly integrating MEMS into fuller-function modules and making use of the existing manufacturing infrastructure.

However, by 2010 Eloy believes that more than 50% of today's system makers will use external manufacturers, and these foundries will produce more than 10% of the world's $9.8 billion in MEMS devices. And by 2015 semiconductor makers will likely control some 70% of an $18 billion MEMS market, and few if any of them will do any internal MEMS manufacturing.

Poster child for both integration and outsourcing, Akustica is getting lots of attention for its one-chip digital microphone, integrating a MEMS sensor on a CMOS chip. The company is getting market traction by showing up at just the right time for computer makers to upgrade their sound for VoIP and other new applications. But equally intriguing is the potential for moving MEMS devices easily into high-volume production by making them with pure CMOS processes—etching the MEMS structures directly out of the metal one.

Ken Gabriel, Akustica

"We're using everything from standard design tools through standard packaging," said Akustica chairman and CTO Ken Gabriel. "We're really becoming part of the IC industry."

The Pittsburgh company places a standard CMOS order with Xfab, then sends the wafer to a MEMS foundry with deep reactive ion etchers to etch out a fine mesh membrane circle from metal one on top of the chip. The isotropic etching dissolves away the silicon below the mesh to release the flexible membrane, which is given a passivation coating to protect it from the environment, then packaged by a mainstream assembly house with standard materials and processes. A hole drilled in the package top leads through a carefully crafted channel to the chip, Gabriel explained. Though open to the environment, the membrane is made stiff enough to survive solder reflow and pass temperature and humidity reliability tests better than other existing microphones.

The company has also demonstrated prototype inertia sensors and RF devices made by the same technology. "This says to us this platform is capable of much more than microphones," Gabriel said. "We wouldn't license it for microphones or other audio products, but if someone saw a way for a better product in other areas, we would partner with some that have design expertise in these other areas."

Another fabless MEMS startup, SiTime, similarly aims at high-volume integration with CMOS, making tiny MEMS resonators and oscillators on silicon that can be integrated with CMOS devices and packaged in standard QFNs, aiming to replace a major portion of traditional quartz crystal products with lower cost and more reliable units. It etches deep trenches in SOI wafer, fills them with oxide, tops with an epi layer of polysilicon, then opens holes in the cap layer and etches out the oxide. Then a high temperature epi seal creates an ultraclean environment that enables the necessary performance.

According to Yole Développement, the global MEMS device market will see 13% CAGR from 2005-2010, spurring an $860 million tool market by 2010. MEMS materials will see 15% CAGR, to $706 million in 2010. Six-inch wafers are becoming the dominant substrate size, although some volume producers are starting to move to eight-inch. MEMS foundries' revenues will see better than 40% growth, expanding from $200 million in revenues last year to almost $600 million by 2010.

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