

CMOS players eye MEMS system business

Maturing process technology and tighter integration of MEMS and CMOS systems are attracting a range of CMOS players to the MEMS business, with strategies as varied as Global Foundries' CMOS-compatible standard processes to Silicon Laboratories' monolithic integration using SiGe.

Are MEMS veterans right that the CMOS folks don't realize how hard it will be to ramp MEMS to good yields in high volumes? Or is the value moving up to the system, with some MEMS just a commodity component in the IC makers' system?

GLOBALFOUNDRIES targets more CMOS-like approach to production

GLOBALFOUNDRIES argues MEMS is poised for big volumes, and for more CMOS-like approaches to high volume manufacturing, including more standard process modules. Rakesh Kumar, director of MEMS for Global Foundries, is emphatic that the company sees high volume business in MEMS. "We've done a lot of work looking at the market and feel that this is a turning point for the MEMS business," he says, noting all the products just entering the consumer market and starting growth, with multiple sensors in all those millions of cell phones and most other consumer electronics products. "As volumes increase, costs will decrease, and spur further growth in volume. That's a huge number of wafers that will become a real business for CMOS foundries."

The company targets applications that can run 1000 wafers a month or more, starting with accelerometers, gyroscopes and RF devices, and focusing on bulk MEMS with engineered SOI wafers to simplify manufacturing. It's finishing installing its infrastructure this year, aiming at starting risk production with two customers in 3Q 2011. And it recently announced a partnership with SVTC for a window in the US for development and to align manufacturing for porting to the volume fab.

Though it has been reported that GLOBALFOUNDRIES plans CMOS MEMS, Kumar clarifies that what the company means by that is CMOS-compatible manufacturing, by making the MEMS process as close to CMOS as possible. That means sharing tools with CMOS where possible to reduce capital spending, making most of the front end on CMOS processes first, doing the contaminating MEMS processes separately afterwards. It also means making sure the MEMS is compatible with the CMOS and the WLP, looking at the CMOS design to understand the issues like thermal mismatch that impact MEMS system performance.

But it doesn't mean monolithic integration. Kumar notes that hybrid integration makes most sense for low cost consumer inertial MEMS, though high frequency RF devices may need short interconnects to avoid parasitics, probably with TSVs, though the process may be too expensive. Wafer-to-wafer bonding looks promising if die sizes are similar. It's developing a wafer-level packaging module and may start to go to TSV technology in perhaps 2013, if customers require it.

Coming from the CMOS world, however, GLOBALFOUNDRIES counts on standard process modules to make production more efficient and reduce time to market. Kumar argues that most MEMS production processes are in fact already becoming fairly standard, and most MEMS makers already develop a few process modules and then try to build all new products on that same platform. "MEMS is not like CMOS where you can go from design to product in 3-6 months. It won't happen that way," he says. "But new entrants will find it too costly to enter the business unless they develop on standard processes, and CMOS foundries can do that."



GLOBALFOUNDRIES is working closely with Singapore's Institute of Microelectronics for development, and getting support from the government in Singapore, who aims to develop a local MEMS industry, with research grants and support of IME's development fab. A consortium has also formed to try to bring in standards in design and packaging to help develop the local industry infrastructure. Singapore already claims 12% share of worldwide MEMS manufacturing, though almost all of that is from the STMicroelectronics plant there.

Silicon Laboratories opts for monolithic integration with SiGe MEMS

Coming down firmly for monolithic integration is Silicon Laboratories, who aims to make a higher performance MEMS timing product, to add to the product lineup in its fast growing ~\$60 million timing business. The company has never made a MEMS device, but prides itself on solving similar integration problems in building its complicated mixed signal products in mainstream CMOS processes.

"MEMS timing hasn't lived up to its promise so far," argues Mike Petrowski, GM of the SiLabs timing products business. "There's room for improvement in performance, and customers find comfort in an established supplier with high volume capacity.... We looked at the technology and considered the other MEMS structures being used, and decided the easiest possibility was just to add a few more layers on to the CMOS wafer, as long as the recipe worked to grow the structures." So the company acquired Silicon Clocks last spring for its relatively straightforward low temperature SiGe MEMS on CMOS process to eliminate the bonding wires with their parasitic capacitance. Monolithic integration also made sense because the timing products could potentially be very high volume, and the programmability already offered in the CMOS meant there wasn't much need for flexibility in switching out the parts.

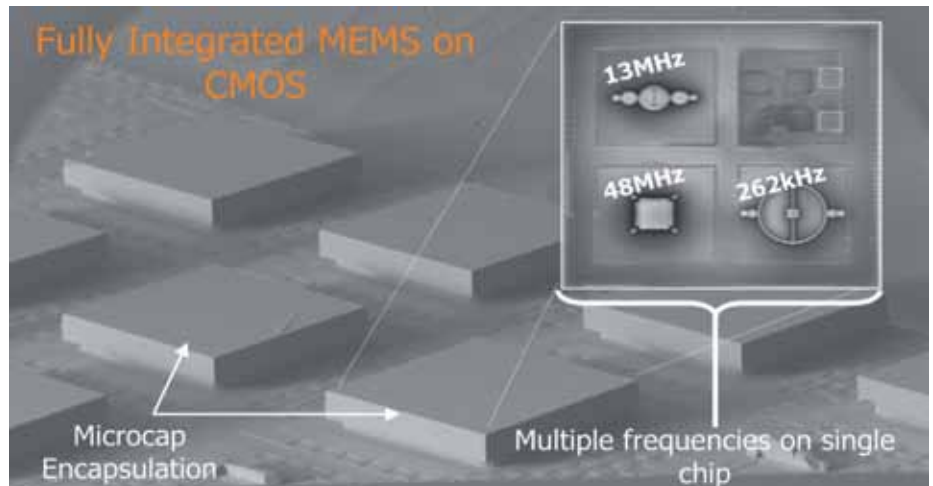
Petrowski argues that SiGe has good mechanical properties, but more importantly can be deposited without high heat on top of the CMOS wafer, with existing equipment in a CMOS foundry with some retrofit, but without major additional capital investment. CTO Emmanuel Quevy has reported in presentations that the LPCVD deposition process stays under 425°C and produces a polycrystalline material similar to polysilicon, with aging of less than 1ppm per year. He said the process used gold SiGe bonding with getters to prevent out gassing.



(Courtesy of GlobalFoundries)

SiLabs sees potential for making other products with SiGe MEMS on CMOS going forward, and Petrowski notes that the extendability of the technology was a major factor in the acquisition. "We have microprocessors with good analog converters for access to the analog world—that start to look a lot like things that use sensors," he says. The company also recently acquired CMOS sensor maker ChipSensors (Limerick, Ireland), adding the startup's monolithic CMOS sensors for temperature, humidity and gases to its portfolio, for another path to adding more content per system.

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Silicon Clocks CMOS MEMS monolithic integration



Michael Petrowski, General Manager, Timing Solutions - Silicon Laboratories Inc.

Michael Petrowski serves as general manager for Silicon Laboratories' timing solutions, responsible for the company's clock generators, oscillators, jitter-attenuating clocks and other timing products. Prior to joining Silicon Laboratories, Mr. Petrowski served as a product manager for Crystal Semiconductor where he was responsible for the strategic direction of the T1 Line Interface Units and Ethernet PHY products. Mr. Petrowski also spent more than 11 years at Harris Semiconductor where he served in senior

engineering, applications and marketing roles for DSP, wireless communications and multimedia audio products. Mr. Petrowski has co-authored numerous technical articles and presented at technical conferences on digital signal processing, frequency synthesis and receiver architectures. Mr. Petrowski has a bachelor's and master's degree in electrical engineering from North Carolina State University.



Rakesh Kumar, Director of MEMS program, GlobalFoundries

He received his B.S. (Hons.) and Ph.D. degrees in electrical engineering from

Punjab Engineering College, India and Nanyang Technological University, Singapore, respectively. He is currently Director of MEMS program (200mm Business Unit) at GLOBALFOUNDRIES, Singapore. Prior to this, he was deputy director of Semiconductor Process Technology Lab at Institute of Microelectronics, Singapore where he was responsible for MEMS process development and technology transfer. His areas of interest include advanced copper interconnects, 3D wafer level packaging and MEMS technologies. He has authored and co-authored more than 90 research publications in journals and conferences.

Status of the MEMS Industry 2010

Growth is back, but only a limited number of players benefit

MARKET TRENDS

"The growth is back, but the industry infrastructure has changed: a limited number of companies are taking full benefit of the growth of the market. Industry restructuring is now about to happen....," says Jean-Christophe Eloy, Yole Développement.

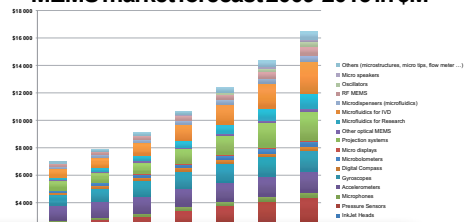
KEY FEATURES

- The objectives of this report are to provide:
- The expected evolution of the MEMS markets applications by application
 - A long term vision of MEMS markets 2008-2020
 - Technology and business trends at equipment and materials level
 - The evolution of the MEMS foundry business, the MEMS production equipment business and the MEMS packaging
 - An analysis of the strategies of the TOP 30 MEMS manufacturers
 - An analysis of the business trends in the major 15 applications areas of MEMS devices

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MEMS market forecast 2009-2015 in \$M



TOP 30 MEMS Company ranking 2009-2008

