

NO MORE “FEAR FACTOR” –UNDERSTANDING MEMS FABRICATION

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In the past, the ‘fear factor’ of MEMS’ complex fabrication processes restricted the widespread adoption of MEMS in many markets. Today, however, MEMS’ fabrication is keeping pace with market demand for mass-produced MEMS devices which are being fabricated in the millions. Early commercial successes in inkjet print heads and automotive air bags have given rise to widespread adoption in mobile handsets, video game hardware, laptop computers and reams of new automotive applications.

With a strong trajectory in consumer electronics—market analyst firm iSuppli predicts a 19% CAGR in consumer markets through 2013—emerging growth areas for mass-market MEMS include telecommunications and bio/medical (diagnostic and “quality of life” applications). iSuppli also identifies high-margin opportunities in high-end gyros, microbolometers, professional inkjet, drug delivery systems, and energy harvesting and other ‘green’ technologies.

At the core of all this upward movement is MEMS fabrication.

As the trend in MEMS manufacturing moves toward designing for both standard processes and for CMOS integration, the number of potential players in the industry increases. According to an industry-wide survey conducted by MEMS Industry Group (MIG) in January 2010, just over half of the respondents are currently outsourcing fabrication. The majority of MEMS companies surveyed (73%) carry out their design work in-house, making the need to design for foundry specified processes increasingly important to consider during the design process. The trend towards the fabless business model creates a huge opportunity for existing MEMS foundries as well as foundries in peripheral industries. Both US based and high-volume Asian-based semiconductor foundries are now taking notice and seeking out MEMS customers as their manufacturing needs are now at levels that make them attractive.

For companies considering entering into the MEMS industry or designing a new product there are many considerations to keep in mind. MIG surveyed the industry about the tradeoffs of manufacturing in-house versus outsourcing. The respondents remarked that a company has to carefully consider using foundry-specified/standard processes versus custom, device manufacturer-designed processes. There are also cost considerations and flexibility/experimentation tradeoffs. The fact that many companies design in-house and then transfer the process out to an independent foundry presents a whole new set of tech transfer challenges. MEMS companies often discover that processes that worked in developmental fabs don’t work with commercial fabs because the equipment is different or not maintained the same way. Whatever the reason, the process engineers need to tweak the design. It’s hard to determine whether the MEMS device designer or the foundry is at fault once you get to the end of the process and it produces lower than expected yield.

The key to overcoming some of these challenges—as MIG learned from interviews conducted with a variety of MEMS companies, is not a complex equation or a new theorem; it’s that fundamentally good communication throughout the whole manufacturing process is critical. This isn’t just communication between sales and business development personnel, but weekly communication among counterparts. From process engineers and designers to CEOs, it’s imperative to communicate effectively so that everyone within each organization is on the same page. Device manufacturers must be upfront about their needs and expectations. They must also estimate volume

predictions as accurately as possible so that foundries are fully stocked with the materials needed.

Once a device manufacturer's needs are communicated to the foundry, it's time to stop making major changes. Big movements at this stage delay time-to-market. Even if the design isn't changed, delays may still occur, and both companies must plan for every possible outcome. "However long you think your product is going to take to bring to market, you're probably underestimating it!" was the sentiment that we heard over and over during the interview process. MIG's survey respondents also emphasized that foundries need to hold up their end of the bargain, showing process control for consistent yields, providing a cost roadmap, and allowing for additional flexibility on capacity.

Both device manufacturers and foundries agreed on the important factors to consider when selecting a foundry: process capabilities, experience, quality control/yield, and IP protection ranked as the most important factors for considering a foundry.

MIG surveyed respondents about the growing manufacturing trends that enable MEMS to occupy less space while being more easily integrated with other components on a chip. More than half of the respondents currently use wafer-level packaging with another 30% considering it. A third of respondents use through-silicon vias (TSVs), with over 40% considering it. The trend toward CMOS integration also has increased with 75% percent of respondents either already integrating or considering integration. These are very important trends to pay attention to if you're considering entering into the MEMS industry.