



EE Times: Semi News  
Hold off on the extra-large wafers

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San Jose, Calif. -- Squeezed between rising manufacturing costs and penny-pinching end markets, semiconductor fab productivity has become an industry mantra, inspiring a new Sematech program called 300 mm Prime.

The program aims to boost productivity in 300-mm fabs and ease the transition to tomorrow's pizza-sized 450-mm silicon wafers. The 300 mm Prime program, which was first publicly mentioned at the Semico Impact Conference here last week, will include as many as 25 projects that could result in new productivity products for today's 300-mm fabs, next-generation 300-mm fabs and 450-mm follow-ons.

Conference speakers emphasized the importance of productivity efficiencies as the industry moves forward. "We need to find ways to wring more out of our capital investment. That's one of the big themes going forward," said speaker James Doran, executive vice president of operations for flash maker Spansion Inc.

"Today's chip factories look just like those of 20 years ago in terms of their layout," Art Zafiropoulo, chief executive of Ultratech Inc., said in a conference keynote speech. "Efficiencies of fabs are probably less than 50 percent now, but we could get that up to 75 percent."

Zafiropoulo estimated that a 65-nanometer fab could cost as much as \$4 billion and take three years to reach 100 percent capacity. An Altera Corp. spokesman said his company had spent \$500 million just to design its 65-nm family of FPGAs, which will hit the market later this year.

Raul Camposano, chief technology officer for Synopsys Inc., also focused on rising costs. "The cost of designing a state-of-the-art chip is exploding," said Camposano, who spoke at a conference panel. Those costs will drive further industry consolidation as companies pair up to pool capital and pursue bigger markets.

With costs of designing new chip families at \$100 million or more, chip makers must find billion-dollar opportunities to recoup their investments, said Robert Payne, vice president for systems technology and architecture at Philips Semiconductors. For its part, Philips is seeking a merger with or acquisition by another chip company in its core handset, consumer and automotive markets so it can gain the scale it needs to continue such big investments, he added (see main story, top of page 1).

Finding markets for chip products can be difficult in an era when companies such as eBay and Wal-Mart create intense price pressures in the growing consumer electronics sector. Meanwhile, such emerging markets as China and India promise huge-volume opportunities but also demand lower prices for cell phones, PCs and other mass-market items.

"We are moving into a consumer world, and it will be very different from what we are used to," said Mark Liu, senior vice president of operations at Taiwan Semiconductor Manufacturing Co. Ltd.

In this climate, said Ultratech's Zafiropoulos, "the future [for chip makers] is in improving productivity. That will get us the money to move to 450 mm."

Members of the International Sematech Manufacturing Initiative (ISMI) aimed to take a first crack at defining the 300 mm Prime program during a meeting late last week. At that time, 13 chip makers planned to hammer out a more paced road map to 450-mm wafers, bringing to the meeting a tentative list of as many as 25 productivity enhancements that could be applied to today's 300-mm fabs as well as tomorrow's 300-mm and 450-mm fabs. The road map includes advances in single-wafer processing, direct interfaces between wafer carriers and fab tools, and other enhancements that could bolster wafer throughput.

"The objective for the next generation is to make it more evolutionary," said Scott Kramer, director of ISMI, in an interview with EE Times. He added that "300 mm was quite an abrupt change with many new standards. If we repeat that, we will have failed."

"The move from 200- to 300-mm wafers was a revolutionary transformation, creating the first fully automated fabs," said Kramer. "It required a very high R&D investment to make that happen."

If engineers can find a way to improve productivity in 300-mm fabs by 20 percent at every node, it would be the equivalent of delivering a new wafer size, Mike Polcari, president of Sematech, said in a keynote address at the Semico event. Even backers say it's not likely the 300 mm Prime effort can deliver such ambitious advances.

ISMI members voted last October to create the 300 mm Prime program.

Conference attendees had mixed opinions about the best pace for the transition to 450-mm fabs, however.

An Intel staff engineer said the industry will need to build too many 300-mm fabs, wasting energy and water if it doesn't step quickly to 450-mm wafers. "You have to plan and coordinate [the 450-mm transition] aggressively," Alan K. Allan, an Intel staff engineer, said in an informal discussion after the event.

But a quick move to 450-mm wafers "is unrealistic," countered Joanne Itow, a Semico manufacturing analyst. "The capital-equipment people haven't recovered yet" from the 300-mm transition, she said.

In his keynote, Zafiropoulos called for more work at 300 mm, saying, "450 mm will occur, but I hope not in my lifetime." He added, "We have gone through pain and anguish with all these transitions, and we tend to forget the pain. We have a long way to go to do 300 mm better."

Besides Intel and Samsung, chip makers in ISMI include Advanced Micro Devices, Freescale, Hewlett-Packard, IBM, Infineon, Matsushita, Philips, Taiwan Semiconductor Manufacturing (TSMC) and Texas Instruments.

Output at today's 300-mm fabs ranges widely, from 20 wafers/hour for some CMP machines to as much as 90 wafers/hour for some scanners. Some chip makers would like to see throughput raised for all tools to rates of 120 wafers/hour.

"That's a good goal," said Liu of TSMC.

Kramer agreed, but offered a caveat. "We need to speed things up, especially for high-mix environments, but the question is whether we can do that reliably," he said.

ISMI members will meet with business leaders from semiconductor-equipment makers for the first time in early March. The purpose of that meeting is to translate the goals of the 300 mm Prime

program into "economic models to estimate R&D costs and product timing" for new fab tools, said Kramer.

"As the road map becomes clear, there will be many venues for discussions between engineers in both groups of companies," he added.

Individuals involved in those discussions will soon be able to consult a formalized history covering the 300-mm transition. Ashwin Ghatalia, who helped lead industry efforts toward that transition, has helped draft a report on the lessons learned. The report has been submitted to Sematech officials, who will not disclose its details until the annual conference of the Electrochemical Society, which will be held this May.

More automated fabs

Chip makers said they'd like to see the 300 mm Prime effort lead to faster, more automated fabs.

"The future fab will be focused on cycle times. We believe we can get down to the one day per mask layer the industry has been searching for," said Tom Sonderman, director of advanced precision manufacturing at Advanced Micro Devices Inc. "Ten years from now you will have to have automated fabs."

A move to process individual wafers rather than batches in bulk carriers could help, eliminating waiting time, which accounts for almost 75 percent of the time a wafer spends in the fab, Sonderman said. He also called for the 300 mm Prime effort to deliver standards to ease the transition.

TSMC's Liu said improvements in fab throughput must go hand in hand with advances in fab automation systems to handle the increased traffic.

Simon Yang, chief technology officer for Chartered Semiconductor Manufacturing, said he'd like the group to develop new ways of testing without damaging the dinner-plate-sized 300-mm wafers, which can cost as much as \$10,000 today.

Several executives at the Semico event said the fab of the future will tie together design and manufacturing tools.

"What needs to be built is a bidirectional highway between design and manufacturing tools," said Mike McAweeney, vice president of industry alliances at Cadence Design Systems Inc.

-- Mark LaPedus contributed to this report.

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