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IBM rolls 45-nm SOI foundry service

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SAN JOSE, Calif. -- Seeking to take the lead in another emerging technology, IBM Corp.'s Microelectronics Group has rolled out what it claims is the industry's first 45-nm, silicon-on-insulator (SOI) foundry offering.

IBM has also bolstered parts of the shaky SOI supply-chain to propel its initial SOI foundry service in the market. But some wonder if the technology will gain traction amid the current IC slowdown and economic crisis.

To fuel a new class of SOI designs, IBM will provide a 45-nm foundry service within its own fabs. As part of the plan, Singapore's Chartered Semiconductor Manufacturing Pte. Ltd. will act as a "second source" foundry for IBM's 45-nm SOI offering. And ARM Holdings plc announced a physical intellectual-property (IP) library offering for IBM's SOI technology.

With SOI, IBM appears to have taken the lead in another technology. The company and its foundry partners have recently announced a high-k/metal-gate offering at the 32-nm node, putting the group ahead of its rivals in Taiwan. In comparison, Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC) and United Microelectronics Corp. (UMC) separately will not offer a high-k/metal-gate solution until the 28-nm node.

In the digital foundry markets, IBM also appears to have a lead in SOI. Germany's X-Fab Semiconductor Foundries AG provides a Bipolar-CMOS-DMOS (BCD) offering on SOI for analog/mixed-signal designs. ARM and UMC have promoted a 65-nm SOI offering with marginal success. And over the years, TSMC has been in--and mostly out--of SOI, generally claiming it has seen little demand for the technology.

SOI makes use of a layered silicon-insulator-silicon substrate in place of conventional bulk substrates in IC manufacturing. SOI-enabled devices are said to reduce parasitic device capacitance, thereby boosting performance. IBM claims 45-nm SOI can offer up to a 30 percent performance improvement or 40 percent power reduction, when compared to bulk silicon.

Despite its apparent advantages, SOI has been considered a niche technology. It is still more expensive than bulk silicon, thereby limiting its appeal in mass markets.

"To date, two major barriers have inhibited the broad adoption of SOI: foundry capacity and IP library availability. ARM and IBM have together taken the first step toward breaking down these barriers and making SOI a viable alternative for many more applications in the networking, storage, communication and consumer applications," said Joanne Itow, an analyst at Semico Research Corp. (Phoenix).

IBM itself has poured millions of dollars in SOI R&D. Since the 1990s, IBM has been shipping SOI-based processors within its own servers. The processors are based on its Power architecture.

Then, in 2007, the company rolled out a 45-nm ASIC offering that included SOI. IBM's ASIC offering is called Cu-45. Based on a 45-nm, dual-logic oxide technology, IBM's ASIC line features 9 to 10 levels of metal layers, ultra low-k dielectrics and 200 million wireable gates. IBM's 45-nm ASIC process is different than its common platform technology, which is offered by foundries Chartered, IBM and Samsung.

At 90- and 65-nm, IBM also offered SOI in the form of "custom chips" for select customers. For example, within their respective game consoles, Microsoft, Nintendo and Sony make use of central processing units, based on SOI. Those game processors, which are considered "custom designs" or ASICs, are all made by IBM and its fab partners.

Advanced Micro Devices Inc. (AMD) uses IBM's SOI technology for its processor designs, but rival Intel Corp. has dismissed and slammed the technology. For years, Intel claims that SOI is too complex and expensive to develop for mainstream devices.

Duncan Needler, manager of technology marketing at IBM's Microelectronics Group, dismissed claims that SOI is too expensive and exotic. "That's absolutely not true," Needler said. As for the cost issues, "the raw (SOI) wafers are still more expensive than bulk, but we're closing the gap."

Now, with the new foundry offering, IBM's customers also have more choices to enable SOI designs. This, in turn, will bring SOI "to a much broader set of clients," he told *EE Times.*

Some IBM customers prefer the ASIC model, which is geared for those who want "very complex chips" with a time-to-market advantage, he said. IBM's ASIC offering makes use of the company's proprietary process, EDA tool methodology and yield management technology. The end result for customers is the development of finished package modules.

In the foundry model, IBM provides the process, SOI and other services upon request, but the customer is responsible for their own EDA tools and designs. The foundry option is a "higher-volume, lower-cost" offering, as compared to the ASIC route, he said.

Going forward, Needler said SOI is set to take off in new applications. "Soon, you will see it in networking and storage applications," he said. "We've seen interest in digital TV. We've seen people kick the tires in mobile applications. We would love to crack the graphics market."

The market could get a boost, especially when Nvidia Corp. recently joined the SOI Industry Consortium. The consortium, formed in 2007, hopes to accelerate SOI technology in the market.

Other members include AMD, Applied Materials, ARM, Cadence, CEA-Leti, Chartered, Freescale, IBM, Innovative Silicon, KLA-Tencor, Lam, Magma, Samsung, Semico, Soitec, SEH Europe, STMicroelectronics, Synopsys, TSMC, Tyndall Institute, UCL and UMC.

VLSI Research Inc. (Santa Clara, Calif.) projected that the SOI market hit $654 million in 2007. The sector is expected to grow 11 percent a year and reach $1.1 billion by 2012, according to the firm.

Those projections could be far too optimistic, due in part to the current economic crisis. At present, the overall semiconductor industry is seeing a major slowdown, with a downturn projected in 2009.

IBM declined to comment on how the economic crisis would impact its new offering. But to help stimulate demand in a poor market, ARM rolled out an SOI physical IP library for IBM's service, including standard cells, memory and I/O.

IBM's offering, coupled with ARM's IP, provide customers with a strong one-two punch. The offering will enable "more energy efficient" designs, said Tom Lantzch, vice president of marketing for the ARM's physical IP division.

Besides processor cores and physical IP, ARM (Cambridge, England) is pushing hard in SOI. In 2006, ARM acquired Soisic SA, a developer of SOI IP. Soisic is a company associated with SOI wafer substrate supplier Soitec SA (Grenoble, France).

Last year, ARM's SOI libraries were taped-out on UMC's 65-nm SOI process. The test chip consists of a set of ARM physical IP that used a standard cell library, an I/O library and a single-port SRAM memory compiler.

At the time, ARM and UMC said the tape-out represented the next step towards the mainstream adoption of SOI technology for improved speed and power in complex designs. "We still have activities with UMC," Lantzch said. "We're foundry agnostic."

Also in the foundry world, Singapore's Chartered has been a "second source" to IBM on the SOI front. Chartered has made SOI-enabled game processors and other products since the 90-nm node, according to IBM.

Still to be seen, however, is if TSMC will re-enter the SOI market. At one time, the company had SOI on its foundry roadmap and it even started working with Freescale Semiconductor Inc. in the arena. But recently, Freescale moved to IBM's "fab club" camp, which all but ended its SOI alliance with TSMC.

Others are also wondering about the fate of the SOI substrate wafer market, a key part of the overall SOI supply chain. The substrate makers supply wafers to the foundries and other customers for processing.

Suppliers of SOI substrate wafers are Ibis, Soitec and the silicon wafer makers. Japanese silicon wafer giant Shin-Etsu Handotai Co. Ltd. (SEH) offers thin SOI wafers, a technology licensed from Soitec. Another Japanese silicon wafer maker, Sumco Corp., licensed technology from Ibis.

Ibis has fallen on hard times, while Soitec is also suffering. Soitec develops products based on a so-called "Smart Cut" technology. "This technology is based on ion implantation, wafer bonding and atomic level splitting. Ion implantation weakens the silicon crystal at the desired depth. This acts as an atomic scalpel, lifting off a thin layer from the donor substrate and placing it onto a new base wafer," according to Soitec.

Soitec recently said sales were down 28.1 percent in the second quarter of 2008, compared to the like period a year ago. Due to the uncertain economic times, Soitec said it anticipates its second-half sales to decrease by 15-to-20 percent, compared to the first half of 2008. For the full year, sales revenue should then be lower by 20 percent.

Amid the downturn, Soitec this month inaugurated its previously-announced 300-mm wafer fab in Singapore. Soitec's Singapore fab is the company's first manufacturing facility in Asia.

Soitec remains in decent shape, but loss-ridden Ibis Technology Corp. (Danvers, Mass.) is on life support. Earlier this year, Ibis announced that it has engaged the investment bank BlueLake Partners LLC for the purpose of assessing strategic alternatives for Ibis, including a potential sale of the company or its assets.

Ibis develops Simox-SOI wafers and implantation equipment. Simox stands for separation by implantation of oxygen. Its implanters produce Simox-SOI wafers by implanting oxygen atoms just below the surface of a silicon wafer to create a very thin layer of silicon dioxide between the thin operating region of the transistor at the surface and the underlying silicon itself.