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## **IBM transits to 45nm SOI**

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With an objective to lead in an emerging technology, IBM Corp.'s Microelectronics Group has launched what it claims as the industry's first [45nm](#), silicon-on-insulator (SOI) [foundry](#) offering.

The company has also bolstered parts of the shaky SOI supply-chain to propel its initial SOI foundry service in the market. But some are pondering if the technology will achieve traction amid the current IC slowdown and economic downturn.

To fuel a new class of SOI designs, IBM will offer a 45nm foundry service within its own fabs. As part of the plan, Chartered Semiconductor Manufacturing Pte Ltd will act as a "second source" foundry for IBM's 45nm SOI offering. 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 launched a high-k/metal-gate offering at the 32nm 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 28nm node.

### **IBM's new wave**

In the digital foundry markets, IBM seems to have a lead in SOI. X-Fab Semiconductor Foundries AG gives a bipolar-CMOS-DMOS (BCD) offering on SOI for analog/mixed-signal designs. ARM and UMC have promoted a 65nm SOI offering with marginal success. Over the years, TSMC has been in and mostly out of SOI, generally claiming it has seen low demand for the technology.

### **The SOI wonders**

SOI employs a layered silicon-insulator-silicon substrate in place of conventional bulk substrates in IC industry. SOI-enabled devices are believed to reduce parasitic device capacitance, thereby increasing performance. IBM claims 45nm SOI can give up to a 30 percent performance enhancement 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, 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 option for many more applications in the networking, storage, communication and consumer applications," said Joanne Itow, analyst, Semico Research Corp.

### **IBM's long preparation**

IBM itself has spent millions of dollars in SOI's [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 45nm ASIC offering that included SOI. IBM's ASIC offering is known as Cu-45. Based on a 45nm, dual-logic oxide technology, IBM's ASIC line has 9 to 10 levels of metal layers, ultralow-k dielectrics and 200 million wireable gates. IBM's 45nm ASIC process is different than its common platform technology, which is provided by foundries like Chartered, IBM and Samsung.

At 90nm and 65nm, 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 CPUs, based on SOI. Those game processors, which are considered "custom designs" or ASICs, are all made by IBM and its fab partners.

### **SOI detractors**

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

Duncan Needler, manager of technology marketing, 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," he added.

"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 wider 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 result for customers is the

development of finished package modules.

In the foundry model, IBM has 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 added.

Looking forward, Needler said SOI is set to take off in new applications. "Soon, you will see it in networking and storage applications," he added. "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," he noted.

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. 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.

#### **IBM mum over downturn scenario**

Those projections could be far too optimistic, because partly of the current economic crisis. Now, the overall IC industry is seeing a major slowdown, with a downturn projected in 2009.

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

#### **ARM's participation**

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

Aside from processor cores and physical IP, ARM is pushing hard in SOI. In 2006, ARM bought Soisic SA, a developer of SOI IP. Soisic is a company associated with SOI wafer substrate supplier Soitec SA. Last year, ARM's SOI libraries were taped-out on UMC's 65nm 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 toward 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," he added.

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

Yet to be seen, however, is if TSMC will get involved again in the SOI market. At one time, the company had SOI on its foundry road map 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.

#### **What the SOI wafer market holds**

Others are also thinking 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 Technology Corp., Soitec and the silicon wafer makers. Japanese silicon wafer giant Shin-Etsu Handotai Co. Ltd has 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 struggling. 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," said Soitec.

The company recently said sales were down 28.1 percent in Q2 08, compared to the same period a year ago. Because of the uncertain economic times, it said it expects its 2H sales to decline 15 percent to 20 percent, compared to 1H 08. For the whole year, sales revenues should then be lower by 20 percent.

#### **Continuing the battle**

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

The company remains in decent shape, but loss-ridden Ibis 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 options 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.

- **Mark LaPedus**

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