Update: SOI Wafer Market Continues Its Growth

The results of Gartner Dataquest's latest survey of the silicon on insulator (SOI) wafer market indicate demand grew 16 percent in 2001 over the previous year and reached 28 MSI (including captive demand). The SOI wafer segment was expected to be affected by the silicon wafer market's largest recorded downturn since 1985 of 29 percent in 2001. But Gartner Dataquest's survey indicates that the SOI wafer market showed double-digit growth in the four consecutive years since 1998 (not to mention a 119 percent increase in 1998), showing that the market ramped up.

Looking at market breakdown by film segment, ultra thin/thin film SOI wafer demand registered an impressive 42 percent growth following the strong growth in 2000, totaling 19 MSI. On the other hand, thick film SOI wafer demand was unable to avoid the impacts of the market downturn and shrank 17 percent to 9 MSI. As a result, the ultra thin/thin film segment increased its share to approximately 68 percent of total SOI wafer demand in 2001. In particular, thin film SOI wafer demand has been fueled by increased volume production by IBM and other leading SOI device manufacturers for data processing applications, such as high-end servers and PCs. In addition, leading-edge device vendors such as AMD and Motorola contribute by stepping up their commercialization efforts for SOI devices.

In contrast, thick film SOI wafer demand, which still relies on aeronautical and industrial equipment and military applications, was hit hard by the curtailed capital spending on industrial machinery and equipment. Gartner Dataquest estimates that about one-half of SOI wafer demand in 2001 came from the data processing sector.

Major Assumptions for SOI Wafer Demand Forecast

Gartner Dataquest's SOI wafer market forecast is based on the forecast of device demand in six major applications, namely data processing, communication, consumer electronics, industrial electronics, military and aeronautics, and automotive electronics. Then, device demand in each application is linked to demand for different device categories (for example, micro component and MOS logic). To determine the correlation between device demand forecast (market size on a value basis) for each application and silicon wafer demand (surface area), a concept of revenue per square inch to represent wafer consumption is used to forecast wafer demand. In the process, the percentage of SOI technology adoption is added to the device demand trend in each application for the forecast period. Also, the variation of price per square inch according to the anticipated changes in wafer price is taken into account.

In summary, Gartner Dataquest's SOI wafer demand forecast model is based on the following market forecast and perspective for electronics equipment production, semiconductor market and driving applications of SOI technology by Gartner Dataquest:
Electronics production undergoes a moderate recovery in 2002 and will resume expansion in 2003, led by the data processing sector. The compound annual growth rate (CAGR) between 2001 and 2006 is an average 6 percent, with the value of production reaching $1,428.7 billion in 2006.

Linked to the electronics production trend, the device market will record a CAGR of 9 percent during the five-year period and will reach $247.6 billion in 2006. The device market trend for each of the six applications is primarily based on Gartner Dataquest’s forecast in the first half of 2002.

Between 2001 and 2007, SOI device demand will be driven by data processing, communication and consumer electronics. In terms of device, thin film SOI devices will be mainly used for high-speed, low-voltage, low-power consumption and high-voltage devices, whereas thick film SOI devices are driven by demand for power and high dielectric devices.

SOI Wafer Demand Forecast Update

Using the forecast model, SOI wafer demand up to 2007 is shown in Figure 1. In 2002, demand will remain firm as the leading SOI device vendors boost device production and the second-tier ones step up their development efforts. However, as the consumer electronics market, including PC, which is expected to bolster SOI device demand, has still to make a full recovery because of the staggering economy, the continued curtailment of IT investment, and the hovering consumer spending, SOI wafer demand will fall short of full-fledged growth to support volume production. The growth rate in 2002 will become moderate at 24 percent.

Figure 1
SOI Wafer Demand Forecast, 2001-2007

Source: Gartner Dataquest (September 2002)
Between 2003 and 2007, SOI device demand will be driven mostly by three key applications: data processing, communication and consumer electronics. More precisely, thin film SOI devices will be mainly used for high-speed, low-voltage, low-power consumption and high-voltage devices, whereas thick film SOI devices are driven by a demand for power and high dielectric devices. In particular, thin film SOI device demand in the data processing sector will ramp up in 2003 or 2004, when volume production of devices using 0.13 to 0.1 micron design rules becomes full-fledged. In 2002 and 2003, a major impetus will lead manufacturers such as IBM and AMD; this production trend will determine the market growth. In 2004 and afterwards, the market will grow rapidly as driven by capacity expansion of the forerunners and increased commitment of new entrants to SOI technology — particularly foundries. Finally, ultra thin SOI wafer demand will ramp up, triggered by commercialization of 0.1-micron technology. The actual timing will depend on the level of perfection of SOI technology, including cost-effectiveness. In conclusion, Gartner Dataquest predicts that demand will record a CAGR of 47 percent between 2001 and 2007 for a market size of 279 MSI in 2007.

More details on the SOI market conditions and the forecast results are discussed in a forthcoming Gartner Dataquest Focus Report.

**Gartner Dataquest Perspective**

The focal point of future SOI wafer market growth lies in 300mm, ultra thin film SOI wafer demand. And an ultra thin film SOI device integrates SOI technology with several leading-edge technologies to target maximization of device performance for high-speed and low-power applications.

As announced by leading device vendors, next-generation devices, including SOI, will use a gate material having high dielectric constant to control the increase in leak currents caused by thin gate dielectrics — an inevitable consequence of miniaturization of a process node.

Another leading-edge technology is "strained silicon," which introduces distortion in transistor channels to reduce dispersion of electrons, increase mobility of carriers and increase the device operating speed. Several companies, including Intel, have announced it. High mobility means a higher drive current, which enables the lowering of a gate voltage and the device's power consumption. Various implementation methods for strained silicon are under consideration, and the most promising method is to use the mismatching of lattice formed by the SiGe layer. This solution seems to be suitable for combination with SOI technologies, which are already being studied by several leading device vendors. Also, the Japanese semiconductor industry, which lags in development of SOI devices, is working on this through the "MIRAI" project that was initiated by the industry consortium.

As for thick film SOI wafer, vendors are exploring new applications beyond conventional devices, such as microelectromechanical systems (MEMS). For instance, ADI Belfast (former BCO Technologies), which is a micromachined product division of Analog Devices, fabricates and markets multilayered SOI wafer substrate materials (called "MultiBond") for 3D MEMS and optical MEMS applications. The multilayered SOI wafer substrate contains silicon single crystal layers, on which a micro system or an optical device for 3D MEMS/mechanical optical electrical mechanical systems (MOEMS) applications can be formed. Thus, this SOI substrate material is expected to
expand device applications, such as accelerators, pressure sensors, optical switches and optical wave guides in MEMS/MOEMS applications.

Up to now, the SOI wafer market has been achieving expansion with an increased level of perfection of SOI device technology and application. In the future, it will move to a new growth stage where market expansion is driven by integration with other leading-edge technologies. Gartner Dataquest believes that the future outlook for the market will hinge pretty much on key technology trends related to SOI wafer technology as well as the major trends in applications.

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This document has been published to the following Marketplace codes:

SEMC-WW-DA-0054

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