SEMI AROUND THE WORLD

Silicon Wafer Shipments Up 20 Percent in 2006

Worldwide silicon wafer area shipments increased by 20 percent in 2006 when compared to 2005 area shipments, according to the SEMI Silicon Manufacturers Group (SMG) in its year-end analysis of the silicon wafer industry. Revenues grew by 27 percent in 2006 compared to 2005 as a result of 300 mm contributing to an overall better product mix.

Silicon wafer area shipments in 2006 totaled 7,996 million square inches (MSI), up from the 6,645 MSI shipped during 2005. Revenues grew to $10 billion from $7.9 billion posted in 2005.

"2006 was a very robust growth year for the silicon wafer suppliers in terms of both units and revenue," said Volker Braetsch, chairman of SEMI SMG and corporate vice president of Siltronic AG. "This was driven in a large part by the increased demand for memory products in both the 300 mm and leading-edge 200 mm segments." •

Eleven New Technical Standards from SEMI

SEMI published 11 new technical standards applicable to the semiconductor, flat panel display (FPD) and MEMS manufacturing industries. The new standards, developed by technical experts from equipment suppliers, device manufacturers and other companies participating in the SEMI International Standards Program, are available for purchase in CD-ROM format or can be downloaded from the SEMI website, www.semi.org.

The newly released standards include a guide for equipment data acquisition, a test method for evaluation of line-edge roughness and linewidth roughness, and a communications specification for the MECHATROLINK protocol.

"The new SEMI standards documents will help provide the industry with solutions for critical challenges in factory automation, substrates, and metrics for manufacturing efficiency," said Bettina Weiss, SEMI director of International Standards. •

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PERSPECTIVES BY STANLEY MYERS, *President and CEO, SEMI®*

These Are the Good Old Days

AT ISS 2006, APPLIED MATERIALS CEO MIKE SPLINTER compared the business environment and profitability of the fashion industry to that of semiconductors. A year later, at ISS 2007, Lam Research president and CEO Steve Newberry made similar comparisons using the automotive industry.

Whatever sector comparisons are used, it is clear that our industry has changed significantly over the past decade. Like autos, it has matured. Growth rates are moving towards single digits and the silicon cycles are less volatile thanks to lower capital expenditure ratios.

Like fashion, semiconductors go out of style pretty quickly these days (that is, they have shorter product life cycles) and the market is driven by the whims of consumer demand. Currently, consumers account for 51 percent of semiconductor sales and that's expected to rise to 60 percent by 2010.

That's a far cry from the early 1990s when the silicon cycle was driven largely by corporate purchases of personal computers. A consequence of the earlier cycles was that smaller equipment suppliers found themselves under financial pressure to ride the volatile market swings and to provide global support for customers. As a result, the 1990s was a period of consolidation and market share gains by the bigger players.

One of the most volatile cycles of all, from 1999 to 2002, was driven by telecom infrastructure spending, the so-called "dot-com boom-bust." IDMs and foundries overspent on new fab capacity and there was significant excess inventory in the channels. For the equipment industry this cycle brought about continued consolidation due to declines in operating profits, demand for more complex technology and the need for global support capability.

To be sure, both device makers and equipment and materials suppliers learned many lessons from the dot-com cycle. The irrational capital spending of previous cycles seems to have gone away. The current cycle is also driven by multiple new market drivers, all related to the digital consumer, rather than one killer application.

Overall, these changes have been good for the equipment and materials industry. Since the dot-com cycle, we have seen a successful transition to new business models that have helped equipment companies maintain better profitability. And materials suppliers are benefiting from the volume-driven consumer business, which has propelled materials revenues to record highs in each of the past three years.

Looking ahead, equipment buying patterns are expected to change. Larger volume purchases will be made by so-called "gigafabs" that produce more than 100K wafer starts per month. Further, the customer base for equipment and materials suppliers will decline due to consolidation, joint ventures and manufacturing alliances. This in turn will mandate closer collaboration with the customer.

The other mega-trend over the past decade has been the migration to Asia. Asia now accounts for 43 percent of global capex spending and over the past 10 years the region has doubled as a percentage of worldwide capex. But it is not a hollowing-out of other regions. North America and Japan are still strong markets for equipment, and Europe is holding its own.

As our industry faces the business, market and technology challenges ahead, I am confident that equipment and materials suppliers will adapt to change and grow stronger. — *Stan Myers* •

SEMI ENVIRONMENT, HEALTH AND SAFETY STANDARDS

Suppliers and End Users Working Together To Improve Industry's EHS Performance

SHIFTING TECHNOLOGY, THE INCREASING NUMbers of fabs, rising energy costs, and other factors have made safety and environmental performance a major concern for IC makers and suppliers. Developing industry-wide standards to address environmental health and safety issues has long been a valuable activity of SEMI. Although its members are primarily manufacturing equipment and materials suppliers, IC makers work within the SEMI standards forum to collaborate with suppliers to develop and promote standards for manufacturing equipment.

SEMI standards establish consensus guidelines for environment, health and safety (EHS). When the semiconductor industry identifies a critical need that may not be addressed by codes or regulations, collaborative work is done within the SEMI standards environment to establish voluntary industry standards that will benefit all by reducing injury, increasing reliability, and improving operational costs. SEMI EHS guidelines are adopted by voluntary consensus. By harmonizing industry practices for EHS worldwide and by resolving non-competitive technical issues, these standards expedite commercial transactions.

Device manufacturers have been key contributors to EHS standards since the early days of this activity. All SEMI standards require intense collaboration across the industry to be successful. However, the adoption of EHS standards has had its unique challenges. For instance, providing safety regulations would conflict with SEMI's principle of voluntary consensus. To get around the regulatory issue, SEMI EHS guidelines specify outcomes, but not methods to achieve results. Due to wide industry acceptance of the SEMI S2 standard, however, SEMI EHS guidelines are moving toward regulatory application. In fact, some Authorities Having Jurisdiction (AHJs) have applied SEMI EHS guidelines as regulatory standards. In the future, SEMI's activity to pursue ANSI accreditation of its standards development processes will enhance the credibility of SEMI EHS standards, as well as facilitate AHJ recognition.

Key SEMI EHS Guidelines and Their Benefits

SEMI S2: Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

In the early 1980s, a number of device and equipment manufacturers began to recognize that there was no uniform standard for safely designing semiconductor manufacturing equipment (SME). End-user practice frequently required re-inspecting equipment after installation, which drove redesigning or enhancing with additional safety features, ultimately resulting in increased cost and added qualification time.

A SEMI task force of device manufacturers and equipment suppliers was organized to develop SEMI S2, a safety guideline that provides a set of performance-based EHS considerations for semiconductor manufacturing equipment. With the introduction of SEMI S2, equipment suppliers could anticipate and proactively design important safety features into equipment, rather than rely on inspection and costly retrofits to ensure equipment safety. The industry's total number of equipment safety incidents has steadily decreased since the advent of S2, even though the number of fabs and the complexity of manufacturing operations have increased.

SEMI S8: Safety Guidelines for Ergonomics Engineering of Semiconductor Manufacturing Equipment

When the industry converted to 200 mm wafer technology (and later 300 mm), ergonomic and human factors became important issues. Device manufacturers saw a need to design equipment that

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SEMI AROUND THE WORLD

Nominations for Akira Inoue EHS Award Due July 27

Nominations for the 2007 Akira Inoue Award for outstanding achievement in Environmental, Health and Safety (EHS) in the semiconductor industry are now being accepted. The award is presented annually by SEMI, and the recipient will be announced during the SEMICON® Japan exposition in December. The deadline for submitting nominations is July 27, 2007. Nominations may be submitted via the SEMI EHS website, www.semi.org/ehs.

The Akira Inoue Award recognizes individuals in industry and academia who have made significant environmental, health and safety contributions to the semiconductor industry and to society in general. The award honors individuals who show outstanding leadership in strengthening the industry's EHS performance, or individuals who are responsible for developing or implementing successful process, product or material innovations that improve the industry's EHS record.

Past award winners include Chang-Gyu Hwang, president and CEO of the Semiconductor Business of Samsung Electronics; Gerald Ermentrout, vice president and general manager of the Electronics Division, Air Products; and Isao Uchigasaki, chairman of the board, Hitachi Chemical. •

NANOTECHNOLOGY

Nanotechnology in BRICs

THE EMERGING MARKETS OF BRAZIL, THE RUSSIAN Federation, India and Mainland China (BRIC) are looking to nanotechnology not only to solve some of their most pressing development problems, but also to leapfrog their nascent tech industries into the next century. Energy storage, production and conversion; agriculture productivity enhancement; water treatment and remediation; disease diagnostics; and drug delivery are the top five nanotechnology challenges and opportunities for developing economies.[1] Competencies in nano materials, nano bio and nano tools (particularly metrology) are viewed as critical, along with multi-disciplinary cooperation, to find solutions to these global problems.

Funding Levels and Progress in Nanotechnology for BRICs*

Developing Economy	2007 Investment Forecast (US$M)	Nanotechnology Progress
Brazil	50–75	Moderate
Russian Federation	400	Slow
India	250–350	Strong progress
Mainland China	400–500	Leader

* These investment forecasts include semiconductors. Source: SEMI, February 2007

China Leads in Building Public Awareness

China is the leader in terms of funding and progress with emphasis in nano materials, coatings and textiles for industrial or construction applications, environmental remediation, nano bio and nanoelectronics. The central and local governments are encouraging the adoption of nano-enabled products, with government buildings being some of the early adopters of self-cleaning coatings, composites and OLEDs. This has helped to educate consumers on the benefits of nanotechnology and, as a result, there is a very positive public perception of nanotechnology in mainland China.

India Leads in Education

While India was a little late in developing a government sponsored nanotechnology plan, it appears to be making an aggressive push to catch up. Google Trends reveals that the most searches on nanotechnology in 2006 came from India. Areas of emphasis include aerospace, materials, bio/pharma, textiles and automotive. There are over 1,000 nanotechnology professionals in India, with masters of science or higher degrees and 17 universities with nanotechnology curricula. "India will be disruptive in commoditizing nanotech education," according to IDG Ventures, a group focused on investing in nanotech companies in India.

Footnote 1: Peter A. Singer, et al., "Harnessing Nanotechnology to Improve Global Equity," Issues in *Science & Technologies*, Summer 2005.

Start-Up Companies Beginning to Emerge

More than a dozen start-up companies focused on nanotechnology have been identified. Some are merely a name and web site while others are manufacturing real products. The carbon nanotube suppliers in China, for example, are expected to be some of the world's largest in the coming years.

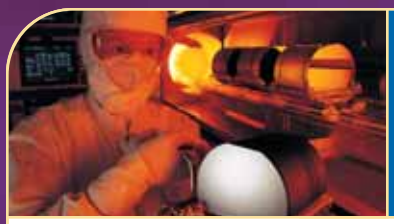
Nanotechnology Start-Up Companies in BRICs

Company	Product
21st Century NanoTechnologies, Inc.	Carbon nanotubes
Analytical Instruments Solutions	Characterization instruments
Beijing Na Chen S&T	Carbon nanotubes
Innovations Unified	Carbon nanotubes
Monrad Nanotech	Carbon nanotubes
Naga Nanotech	Raw materials for nano particles
NanoCarbLab	Carbon nanotubes
Nanospring	Nano materials
Ponto Quantico Nano Devices	Nano bio
Qtech Nanosystems	Atomic manipulation
Shenzen Chengyin Technology	Nano particles
Shenzen Nanotech Port	Carbon nanotubes
Sun Nanotech	Carbon nanotubes
Times Nano	Carbon nanotubes
Velbionanotech	Nano bio
Yaohua Nano-Tech	Nano particles
Yash Nanotech	Nano materials

Source: SEMI, February 2007

The potential of nanotechnology to solve pressing development challenges in BRICs offers an optimistic outlook for the future. While only small progress has been made to date, the rate of progress is expected to increase as governments and industry are focusing strategies on critical issues. As Brazil, the Russian Federation, India and mainland China develop expertise in nano materials and characterization, these regions may look to nanoelectronics for growth opportunities. •

This article is a summary of a feature article in *Nano News from SEMI*, February 2007, an e-newsletter for SEMI members. If your company is a SEMI member and you would like to receive the e-newsletter, visit http://www.semi.org/nano or contact Ms. Lubab L. Sheet, senior director Emerging Technologies, SEMI at Lsheet@semi.org or 1.408.943.6921.



SEMI EHS STANDARDS *continued*

was easily operable and suited to the users' physical abilities. Once again, a SEMI task force comprised of industry experts from suppliers and device manufacturers was formed to design an EHS guideline to "promote compatibility between the user and the equipment in the manufacturing environment." The result was SEMI S8, a guideline containing ergonomic principles for the design, operation, maintenance, and service evaluation of SME.

SEMI S10: Safety Guideline for Risk Assessment and Risk Evaluation Process

As a framework for risk assessment on SME equipment, SEMI S10 helps SME suppliers and buyers identify hazards, and consistently estimate and evaluate risk. SEMI S10 provides a common risk assessment process for suppliers and end users in assessing equipment design and offers a method to determine appropriate responses to given levels of risk. End users provided important data during the development of S10, which was used to determine appropriate levels of risk tolerance.

SEMI S14: Safety Guidelines for Fire Risk Assessment and Mitigation for Semiconductor Manufacturing Equipment

SEMI S14 helps SME suppliers assess the fire risk of their equipment and identify ways to categorize and mitigate these risks. SME purchasers can use SEMI S14 guidelines as an assessment tool for analyzing and comparing the "described risks of various equipment designs." SEMI S14 applies to equipment located in cleanrooms and areas in recirculation airstreams.

SEMI S22: Safety Guideline for the Electrical Design of Semiconductor Manufacturing Equipment

In response to the rising cost of electrical compliance, IC makers and suppliers again collaborated to develop SEMI's first guideline specifically addressing the electrical design of SME. SEMI S22 provides a set of design-based electrical safety considerations for semiconductor production equipment. Before SEMI S22, equipment suppliers were faced with an array of design standards intended mainly for large industrial or communications equipment. By using the design, construction, and testing principles of SEMI S22, SME suppliers can address basic product electrical safety concerns relevant to this industry.

SEMI S23: Guide for Conservation of Energy, Utilities and Materials Used by Semiconductor Manufacturing Equipment

Rising energy costs and the increased awareness of environmental performance, as illustrated by the United Nations' Kyoto Protocol, have made energy conservation a critical issue for the semiconductor industry. One of the EHS Committee's most important conservation efforts has been its work on the SEMI S23 standard, which is a tool for analyzing energy, utilities and materials on semiconductor manufacturing equipment. The standards describe methods for measuring and reporting energy use and provide insight on energy, utilities, and materials conservation for SME suppliers. The successful development of SEMI S23 was a collaborative effort between ISMI and the equipment supplier community. To promote the acceptance and drive the proliferation of SEMI S23, ISMI recently completed an S23 Application Guide, which is available to all as a SEMATECH public document.

Conclusion

From equipment safety to risk assessment to energy conservation, the development of critical safety standards for the semiconductor industry has been vital to the sustained growth of the larger electronics industry. SEMI standards activity provides an important forum where device manufacturers can work effectively with equipment suppliers and other end users in a pre-competitive environment to identify and develop standards addressing critical EHS requirements. In the future, SEMI standards will remain a leader in forming standards for energy and resource conservation, including the development of energy rating standards and the promotion of SEMI S23. Standards will continue to make good business sense—for the electronics industry's workers, manufacturers, shareholders, and the environment. •

About the Author

James Beasley is ISMI's ESH Technology Project Manager, with responsibility for the consortium's Supplier ESH Leadership and Green Fab sustainability initiatives. Beasley has over 25 years experience in semiconductor manufacturing, facilities equipment engineering, specialty gas and chemical management, and Environmental, Safety and Health, (ESH). Beasley is a LEED Accredited Professional with the United States Green Building Council, and serves as co-chair of the SEMI North American EHS Standards Committee.

CALENDAR OF EVENTS

APRIL 2007

April 23–25
Strategic Business Conference (SBC) 2007
The Meritage Resort
Napa Valley, California
www.semi.org/sbc

MAY 2007

May 8–10
SEMICON Singapore 2007
Suntec Singapore International Convention and Exhibition Centre
Singapore
www.semi.org/semiconsingapore

JUNE 2007

June 11–12
ASMC 2007
Stresa, Italy
www.semi.org/asmc

June 18–19
SEMI Forum Japan
Osaka, Japan
www.semi.org/sfj

JULY 2007

July 4–6
FPD Expo Taiwan 2007
Taipei World Trade Center
Taipei, Taiwan
www.semi.org/semicontaiwan •