Pioneering 300:
Less is More in Semiconductor Production

In the world of semiconductor manufacturing, there exists a constant demand for faster, more powerful integrated circuits at lower prices. Typically, this is achieved by decreasing the physical geometry of the chips, which produces more chips out of the same amount of wafer space while increasing the performance of each chip. However, improving productivity by reducing circuitry size requires increasingly demanding and cost intensive technologies. Moreover, the demand for faster and more efficient integrated circuits continues to grow despite reducing the line geometries of the chip surface. Using wafers with a larger diameter means that more integrated circuits can be manufactured more cost effectively.

When full-scale production of integrated circuits first began, the semiconductor wafers on which chips were produced were about 3 inches (75mm) in diameter. As chip production advanced over time, the industry shifted first to 4 inches (100mm), to 5 inches (125mm) and then to 6 inches (150mm) by the late 1980s. Each advance required considerable research and capital investment to ensure reliable production facilities and robust processes. In the early 1990s, line geometries of integrated circuits dropped below one micron (one-millionth of a meter) and manufacturing processes became even more complex. The move from 6 inches (150mm) to 8 inches (200mm) was much more difficult than previous transitions. The production process itself became a more automated process and clean room requirements were more strict. Semiconductor equipment manufacturers had to redesign their equipment and systems to ensure consistent quality and repeatability in manufacturing.

Today, the semiconductor manufacturing industry is faced with an even more daunting task. Continuous miniaturization has seen chip geometries shrink to 0.14 micron, one-fifth of the size ten years ago. Developing new, smaller chips that achieve higher performance requires very high investments in development and manufacturing. To achieve the appropriate cost-per-chip ratio in the near future, it is necessary once again to increase the available space on a wafer. The move to 300mm (about 12 inches), will allow manufacturers to produce up to 2.5 times as many chips per wafer.

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(December 2001)

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Recognizing the significant costs and difficulty in moving to 300 mm wafers, and having learned from problems in moving to 200 mm manufacturing, semiconductor manufacturers are working together to ensure the capability of the semiconductor industry to convert to 300 mm wafers as efficiently as possible.

Global Cooperation: International Sematech (I300I) and SELETE

To keep the cost of development down for each company, semiconductor manufacturers have joined consortia to work on the challenge together. International Sematech is the Austin, Texas-based worldwide consortium of chipmakers and equipment manufacturers that evaluates equipment and international standards for 300mm-production. Infineon along with 11 other leading semiconductor manufacturers from the USA, Europe and Asia are members of this consortium. In Japan, research is conducted by Semiconductor Leading Edge Technologies (SELETE), a joint venture founded by Japanese companies. Other supporting research groups include Japan's J300 consortium of companies, the European Semiconductor Equipment Assessment (SEA) and Micro-Electronics Development for European Applications (MEDEA+).

Semiconductor300 – The Infineon / Motorola Pilot-line

Infineon and Motorola collaborated to build the world’s first fully integrated 300 mm-pilot-line. Infineon’s Dresden facility offered excellent expertise and good technical infrastructure for such a project. The aim of the development joint venture was an improvement in production efficiency. Following the successful start of the Dresden pilot-line for 300 mm silicon wafers in February 1998, Infineon started delivering the world’s first 300 mm products in September 1999, a 64-Mbit DRAM. The development work was completed by the end of 2000. Infineon finished the new 300 mm-fabmodule in 2001 and is ramping up the 300 mm-production in December 2001. With the 300 mm-process technology, Infineon aims to achieve a significant cost reduction per chip. In comparison to 200 mm-technology, around two and a half times as many chips can be accommodated on the larger silicon wafer, representing cost savings of 30 per cent.

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