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Solid State Technology

**New fabs fuel solid growth of chipmaking in China**

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In the five years since the beginning of 2001, China has accounted for 21% of the industry's fab construction. In the five years before that, however, Chinese fabs accounted for only 3% of industry's new construction. The beginning of this decade clearly marked a turning point in the development of chipmaking in China.

China's modern fab construction movement began in 1997 when the country launched Project 909, now called Hua Hong NEC, to kick-start chip manufacturing growth. By the end of 2006, construction will have started on some 41 fabs since Project 909, including four 300mm fabs, twenty-three 200mm fabs, and 14 fabs with wafer diameters smaller than 200mm (Fig. 1), an impressive launch by any standard.

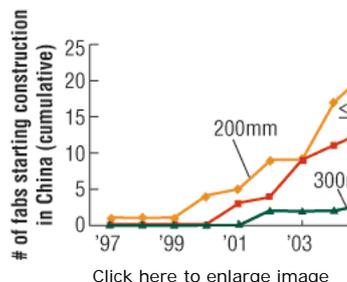


Figure 1. Number of fabs starting construction in China by year.

Not all fabs are created equal, however, and in China not all of the fabs that have made the transition from drawing board to groundbreak...

have been leading edge. Indeed, wafer size can be a rough guide to the level of technological sophistication, so the relatively small number of new 300mm fabs is instructive. Moreover, when China will have started construction on four 300mm fabs by the end of this year, the global industry will have begun work on 84. Thus, China represents just 5% of this total.

Conversely, looking at 200mm fabs for the same time period shows that China is over-represented, accounting for 60% of all such fabs. It also represents more than one-third of new worldwide fabs with wafer diameters smaller than 200mm.

**Fab location in China**

By far, the overwhelming majority of fabs built in China since 1997 have been in Shanghai. At the end of this year, construction will have started there on 15 additional fabs (Fig. 2), five of which are SMIC fabs (including the SMIC-Toppo joint venture). These SMIC fabs alone account...



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50% of Shanghai 's capacity, which represents 44% of China 's entire capacity. After SMIC, the next largest chip manufacturer in Shanghai is Hua Hong NEC, which has one fab online and another being equipped. Other recent major fab construction in Shanghai includes Grace Semiconductor, ASMC, TSMC, and BCD-Semiconductor (formerly SIM-BCD).

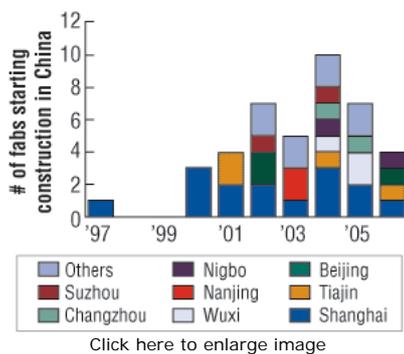


Figure 2. Number of fabs starting construction in China by location.

By the end of this year, seven fabs will have started construction in Beijing and nearby Tianjin. All three current Beijing fabs are 300mm SMIC fabs. SMIC currently has a frontend and a metalization fab online in Beijing and is expected to begin equipping its second 300mm fab there in 2006.

SMIC also has a 200mm fab in Tianjin, the former Motorola/Freescale MOS-17 fab, which it acquired and equipped in 2004. By the end of 2005, SMIC had nine fabs online and accounted for 38% of all capacity in China. Also in Tianjin is Rohm 's 150mm discrete fab, which started construction in 2002. Although not officially announced, Powerchip, the Taiwanese DRAM company, is planning to start work on a 200mm fab in 2006 in Tianjin.

In the city of Wuxi, north of the cities of Shanghai, Suzhou, and Changzhou, three new fabs are currently under construction. CSMC (Central Semiconductor Manufacturing Corp.), a foundry and subsidiary of China Resources Logic) is targeting first silicon for its first 200mm fab by year 's end. The company currently operates a 150mm fab in Wuxi. CSMC has a technology licensing agreement with Chartered Semiconductor, which in turn has an equity stake in the company. Wuxi is also home to the Hynix-STMicroelectronics joint venture, which is now constructing both a 200mm fab and a 300mm fab. By year 's end, the 200mm fab will be in volume production and the 300mm fab will be in first silicon.

Nanjing, Ningbo, Changzhou, and Suzhou are each home to two chip factories. Nanjing Gaoxin Semiconductor has two 150mm lines in Nanjing. In 2004, SinoMOS started construction on its first fab, and now plans to start construction on a second 150mm fab at the beginning of 2007.

In Changzhou, Nanotech Corp. broke ground in 2005 on a \$400 million 200mm fab that should be operational in the third quarter of 2007 using manufacturing technology licensed from Intel. Also in Changzhou, Prima Microelectronics plans to begin production at its first fab, a 150mm facility, by the end of this year and has future plans to build a 200mm fab in Changzhou.

In Suzhou near Shanghai, He Jian Technology brought its first fab online in 2003 after starting construction in 2001. Its second fab is scheduled to come online sometime this year.

At the end of 2004, SMIC started construction on three new fabs in Shanghai: Fabs 7, 9, and 10. Fab 9 is its joint venture with Toppan Electronics. In 2005, an estimated nine fabs started construction in China, which will have a total value of \$3.8 billion when fully equipped. It is expected that at as many as seven more fabs will start construction in 2006 with a total cost of \$3.7 billion when fully equipped; these include 200mm fabs by two Taiwanese companies, ProMOS and Powerchip. SMIC is also expected to resume work on its 300mm Fab 5 in Beijing.

### Will China 's fab boom last?

Clearly there is momentum to carry the Chinese chip industry forward. However, modern wafer fabs are enormously expensive to build and equip. While many companies have made the transition from drawing board to reality, others haven ' t. Among the latter was Huaxia in Beijing, which had plans for a \$1.3 billion 200mm foundry originally scheduled for 2002. Also held up in Beijing are Kangfu Semiconductor 's plans for a new fab originally planned by



Shougang Steel; this project has been searching for funding for some time, and it too may not make it to completion.

In addition to fab plans that don't materialize, there are many more that are delayed. Grace Semiconductor, for example, built a shell for a second fab at the same time it began work on its first fab. The second shell still sits empty. Grace also had plans to begin 130nm production last year, but these have been pushed back to later this year. Prima Microelectronics originally hoped to start production in Fab 1 in 2004 and also to begin construction on Fab 2 in 2004. It is now estimated that Fab 1 will start production in 2007. Shanghai Belling broke ground on its second fab in 2001, but has yet to complete construction. Hua Hong NEC acquired its fab in 2004 and only began equipping it in 2005.

In spite of these setbacks and delays, chip manufacturing in China has grown faster than in any other region in the history of the industry. The Chinese are nothing if not entrepreneurial. Even though some plans slip and others come to naught, the number of fab plans continues to grow. Examples include Keysi-STL in Shenyang, ACSMC in Zhuhai, and SIM-BCD (a second module for Fab 3) in Shanghai. Also in Shanghai, Grace Semiconductor still plans to equip its second fab, perhaps with 300mm equipment. Hua Hong NEC is rumored to be planning a 300mm fab, as is He Jian in nearby Suzhou. In addition, ProMOS and Powerchip now plan 200mm fabs in China.

China has started building fabs relatively recently. As long as its economy continues to grow at rates near 10% a year, the country will create investment opportunities. Chipmaking has been identified by the Chinese government as a strategic investment area, and Chinese companies will continue to build fabs there. As TSMC, Hynix, and STMicroelectronics are demonstrating, chip companies from other regions will follow.

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