The Coming of High Volume MEMS Manufacturing in China

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China’s MEMS Consumption

5-year compound annual growth rate (CAGR) of 12.1%. Growth is driven by an expansion of China’s manufacturing capacity for MEMS-integrating products: mobile phones, automotive electronics, and consumer electronic devices-MEMS microphones, accelerometers and gyroscopes. *SOURCE: IHS iSuppli October 2011*
SWOT Analysis of MEMS in China

**Strengths** – IC wafer fab and fab equipment vendors, access to capital, labor pool is large and labor rates in most of country are still relatively low. Universities are ramping up MEMS graduate programs.

**Weakness** - No high volume MEMS fabs, particularly with larger wafer sizes. MEMS foundries with small wafer sizes are just getting started. Lack of MEMS start ups like in the US and Europe.

**Opportunities** - China imports billions of dollars of MEMS chips and wafers each year. Consumer, cell phone and automotive markets are huge and growing.

**Threats** - Labor rates and real estate prices are rising and are relatively high in Shenzhen and Shanghai where IC fab and packaging growth occurred.
Wafer Fabs in China

More than 20 IC fabs are running 200mm and 300mm wafers in China, and about 30 fabs using 150-100mm wafers

- Intel, SMIC, Samsung, TSMC...
MEMS in China- 2012

To date only 4” & 6” MEMS fabs have been started in China. MEMS are being packaged in China- gyros, accelerometers, pressure sensors, bolometers, microphones.

No high volume single crystal silicon MEMS fab is running in China. TMT & APM in Taiwan are the closest regional MEMS fabs using 200mm and 150mm wafers respectively.
Support for Fab Equipment

IC fab equipment suppliers have had maintenance support-people & parts inventory as well as some training centers- in China for more than a decade. The MEMS fab equipment suppliers for wafer bonders and DRIE are now in Taiwan and/or China. A large inventory of used 200mm fab equipment is available in China.
Historical Leveraging of IC Processing by MEMS

History – IC vs MEMS. MEMS has always leveraged photolithography, thermal, wet etch and film dep from IC fabs

Formerly the key defining MEMS wafer process equipment were wafer bonding and DRIE

Recently the IC industry has begun tapping into MEMS process equipment capability for 3-D integration.
Blurring of the Line Between MEMS and IC Fabs & Processes

Wafer Bonding – SOI manufacturers use bonders and CMP

450mm wafers and equipment are under development for ICs – including wafer bonders

DRIE is being used for TSV, 3D ICs
Wafer Size – MEMS-200,300,450mm

High volume MEMS wafer size lags IC wafer size by 1 generation, often due to the used equipment availability - which has been key for many MEMS fabs. A 4-8 year lag in wafer size conversion has been seen with 150mm and 200mm wafers. MEMS fabs started using 200mm wafers 5 years ago.

With the blurring of IC & MEMS processes this may accelerate. MEMS to CMOS bonding & TSV may dictate this.
MEMS Wafer Suppliers in China

Local wafer manufacturers in China are present for 100-300mm silicon, glass, epitaxy, SOI and SOI with buried cavity wafers.
Fostering the MEMS Market in China

Hanking is pushing to make MEMS foundries more widely available in China starting with MUMPS China in 2012.

MUMPS (Multiple User MEMS Process ) is a low cost method of getting new MEMS designs fabricated.
Hanking’s Commitment to Sensors

In Liaoning province

Hanking is developing a 127 acre industrial park in Fushun, China, dedicated to MEMS-based sensor products.
Semiconductors in Liaoning Province

Intel’s 300mm fab in Dalian, Sysilicon 150-300mm SOI fab in Shenyang, NEMI 100mm MEMS pressure sensors in Shenyang. Local universities and trade schools are doing a good job of training fab technicians and engineers.

Liaoning has not seen the engineering labor competition and wage increases that Shenzhen and Shanghai have been experiencing.

Great local support from the local Liaoning and city officials.
Hanking MEMS Strategy

200mm wafer fab transitioning to 300mm MEMS Foundry

Packaging and industrial partners for high MEMS content system design and assembly
China MEMS SWOT Revisited & Conclusion

Hanking is addressing the Weaknesses and Threats to the Chinese MEMS manufacturing industry by:

1. Building a large wafer diameter MEMS fab in China.
2. Locating this facility in Liaoning province to hold down labor, taxes and construction costs.
3. Bring up MUMP China to get more internal Chinese fabless MEMS companies started, growing and working their way through the MEMS development process.

**Conclusions:** Because of market demand, Hanking and other companies will soon service the Chinese market with an internal supply of high volume MEMS chips and products.