2018 Semiconductor Equipment and Materials Market: Have we Reached an Inflection Point?

Lara Chamness, Senior Market Analyst, Manager, SEMI
Outline

• Industry Overview

• Equipment

• Materials

• Summary
Current SEMI Market Data Product Portfolio

- SEMI China IC Ecosystem Report – a new comprehensive report contains in-depth analysis of China’s wide-ranging IC manufacturing ecosystem within the global semiconductor industry. *New in October ‘18*

- SEMI FabView* New Update*
  - World Fab Forecast *Aug ‘18*
  - World Fab Watch *Aug ‘18*
  - Global 200mm Fab *June ‘18*
  - Outlook to 2022
  - Opto/LED Fab Forecast
  - Opto/LED Fab Watch
  - Customized Fab Reports

- Equipment Market Data Subscription *New Update*
  - Semiconductor Equipment Market Statistics *New Update* (WWSEMS)
  - New Equipment Forecast
  - Mass Flow Controller Market Statistics *New Update*

- Material Market Data Subscription *New Update*
  - Photomask Characterization Report
  - Silicon Reclalm Wafer Characterization

- Device Packaging and Testing Market
  - Worldwide OSAT Manufacturing Sites Database *Sept, 2018*
  - Global Semiconductor Packaging Materials Outlook *May ‘18*
  - China Semiconductor Packaging Market Outlook *May ‘18*
Industry Overview
3 Eras of Demand

Source: VLSI Research, ISS US January 2018
Explosion of Data Generation

Source: Applied Materials, SEMICON West July 2018
Semiconductor Industry Revenues
2017 Soars Past $400 billion

Source: SIA/WSTS historical year end reports
Total Equipment Revenue vs. Total Material Revenue Trends

Source: Equipment: SEMI/SEAJ

“ Irrational Exuberance”

300 mm ramp

200 mm ramp

Source:

13-16 NOV 2018
MUNICH,
GERMANY
## 2018 Semiconductors Forecasts – Upward Revision

<table>
<thead>
<tr>
<th>Source</th>
<th>Early Year Forecast Average</th>
<th>Mid-Year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSTS</td>
<td>Nov-17, 7.0%</td>
<td>Aug-18, 15.7%</td>
</tr>
<tr>
<td>Gartner</td>
<td>Jan-18, 7.5%</td>
<td>Jul-18, 14.0%</td>
</tr>
<tr>
<td>IC Insights</td>
<td>Nov-17, 8.0%</td>
<td>Mar-18, 14.0%</td>
</tr>
<tr>
<td>VLSI-IC</td>
<td>Jan-18, 7.7%</td>
<td>Jun-18, 14.9%</td>
</tr>
<tr>
<td>IHS Markit</td>
<td>Jan-18, 7.4%</td>
<td>Jul-18, 14.9%</td>
</tr>
<tr>
<td>Cowen LRA</td>
<td>Jan-18, 5.9%</td>
<td>Aug-18, 16.3%</td>
</tr>
</tbody>
</table>

**Early Year Forecast Average = 7.3%**

**Mid-Year Average = 15.0%**

Source: August 2018, SEMI
2019 Semiconductor Forecasts

- Gartner (Jul 18), 7.0%
- WSTS (Aug 18), 5.2%
- Cowan LRA (Aug 18), 5.0%
- IC Insights (Mar 18), 4.0%
- IHS Markit (Jul 18), 4.0%
- IDC (Sept 18), 0.7%
- VLSI-IC (Jun 18), -3.4%

Source: September 2018, SEMI
Trade Dispute – U.S. and China

Recent Developments

- Earlier this year, there was the ZTE ban
- US has set a 25% tariff on $50 billion of Chinese goods ($34B since early July and $16B started on Aug. 23)
- On Sept 17, U.S. released the final $200 billion tariff list that will be subject to a 10% tariff, effective Sept 24 (& will increase to 25% on January 1)
- China has responded in equivalent manner; placing tariffs on $110 billion worth of goods and has restricted Micron sales into China
- On Oct. 30, DOC restricted U.S. companies from selling equipment, software, and materials to Jin Hua Semiconductor on the grounds of national security

Impacts

- The trade war will further strengthen China’s resolve to develop local semiconductor capability and accelerate China’s technological development
- The trade war will have supply chain managers to adjust their sourcing and production strategy in order to diversify the risk
- MNCs may need to reconsider their future (capacity) investments in China
Equipment Trends
Fab Investment by Regions – *Korea and China Drive the Growth*

### Fab Equipment Spending by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>Change (%) 2018 to 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td></td>
<td>$4.8</td>
<td>$5.2</td>
<td>$5.7</td>
<td>24%</td>
</tr>
<tr>
<td>China</td>
<td>$6.7</td>
<td>$7.4</td>
<td>$9.2</td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Europe &amp; Mideast</td>
<td>$3.5</td>
<td>$3.7</td>
<td>$3.9</td>
<td>$4.0</td>
<td>-</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>$8.5</td>
<td>$8.8</td>
<td>$8.9</td>
<td>-</td>
</tr>
<tr>
<td>Korea</td>
<td>$8.1</td>
<td>$8.6</td>
<td>$14.0</td>
<td></td>
<td>-16%</td>
</tr>
<tr>
<td>SE Asia</td>
<td>$2.1</td>
<td>$2.2</td>
<td>$2.4</td>
<td>$2.4</td>
<td>-8%</td>
</tr>
<tr>
<td>Taiwan</td>
<td></td>
<td>$4.4</td>
<td>$6.0</td>
<td>$7.1</td>
<td>15%</td>
</tr>
<tr>
<td>EMEA</td>
<td></td>
<td></td>
<td>$2.4</td>
<td>$2.0</td>
<td>-25%</td>
</tr>
</tbody>
</table>

**Source:** Prelim. World Fab Forecast Reports, October 2018, SEMI

**Disclaimer:** The forecast is based on current announcements and is subject to change depending on actual execution.
Monthly Trends - Equipment, Silicon, & Semi Units

YoY (through September)
+21% Equipment
+8% Silicon
+9% Devices

Note: Index is based on 3-month moving average, Base = January 2014

Source: SEMI Equipment Market Data Subscription, November 2018, SEMI SMG, November 2018, WSTS Bluebook, October 2018
### Year-to-Date Equipment Billings

#### Worldwide SEMS Billing Trends
(U.S. Dollars in Millions)

<table>
<thead>
<tr>
<th>Region</th>
<th>2018 Year-to-Date (September)</th>
<th>2017 Year-to-Date (September)</th>
<th>Y/Y % Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>$3,309</td>
<td>$2,632</td>
<td>25.7%</td>
</tr>
<tr>
<td>Japan</td>
<td>$6,805</td>
<td>$4,530</td>
<td>50.2%</td>
</tr>
<tr>
<td>North America</td>
<td>$3,869</td>
<td>$4,006</td>
<td>-3.4%</td>
</tr>
<tr>
<td>Korea</td>
<td>$14,906</td>
<td>$13,306</td>
<td>12.0%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$7,365</td>
<td>$8,602</td>
<td>-14.4%</td>
</tr>
<tr>
<td>China</td>
<td>$10,533</td>
<td>$6,457</td>
<td>63.1%</td>
</tr>
<tr>
<td>ROW</td>
<td>$3,245</td>
<td>$1,986</td>
<td>63.4%</td>
</tr>
<tr>
<td>Total</td>
<td>$50,031</td>
<td>$41,519</td>
<td>20.5%</td>
</tr>
</tbody>
</table>

- Billings through September for these regions are already higher than their respective 2017 totals

Source: SEMI Equipment Market Data Subscription, November 2018
Quarterly Equipment Billings Trends by Region

Source: SEMI Equipment Market Data Subscription, November 2018
SEMI® 2018 Fall Equipment Forecast
By Market Region

- Most regions will see healthy growth in 2018, except for Taiwan, Korea, & N. America
- 2018 may end higher while 2019 could be flat
- Korea will remain the largest equipment market through 2020
- China expected to come out strong in 2019 but trade tensions loom

New front-end and back-end equipment. Totals may not add due to rounding

Source: Equipment Market Data Subscription, November 2018, SEMI
Materials
• 2018 will surpass the market peak set in 2011
  • Wafer Fab materials set record level in 2017
  • Growth is driven by silicon in 2017 & 2018
• Packaging materials market is facing headwinds
Silicon Wafer Market
Recovery in Aggregated Average Selling Price

Annual Silicon Wafer Trends

- Peak revenues back in 2007
- Several year period of declining ASPs while shipments increased
- 2017 rebound in ASPs to propel +17% revenue growth
- Even with rebound in pricing, ASPs remain well below 2007 peak

Source: Materials Market Data Subscription, August 2018, SEMI
Packaging Trends and Transitions

- Wire bond is not dead….but industry evolving to increased packaging and assembly at the wafer level
- Memory industry at an inflection point in interconnect technology
  - Leadframe to organic substrate packages
  - WB to FC
- FO-WLP is a disruptive technology
- Traditional model:
  - Wafer is processed in fab
  - Wafer sent to assembly facility for singulation, assembly, and test
- New model:
  - Some wafers stay at the foundry for packaging and assembly
  - Some OSATs install wafer processing (“like”) equipment to create package on the wafer
Summary

• Semiconductor Industry Outlook
  – Solid growth forecasted for 2018 and 2019
  – Longer term prospects are positive as technology innovation advances

• Fab Investment & Equipment Market
  – 3D NAND, DRAM, Foundry investments are key drivers to spending
  – Total Equipment forecast +10% in 2018 and +3% in 2019
    – Trade tensions between China-US present significant downside risk to 2019

• Materials
  • +9% in 2018 – new record!
  • +3% in 2019
POLICIES - INVESTMENTS - TECHNOLOGY - CAPACITIES

• 25 new fab construction projects
• Leading segments: Foundry, DRAM and 3D NAND
• Enhanced technology and advanced capabilities in Packaging and Test
• New development in equipment and materials segments

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Worldwide OSAT Manufacturing Sites Database

- Over 120 companies and 300 facilities
- Over 90 facilities offering leadframe CSP
- Over 25 bumping facilities, including 20 with 300mm wafer bumping capacity
- More than 45 facilities offering WLCSP technology
- 92 facilities in China, 89 in Taiwan, 39 in Southeast Asia
Automotive, IoT (Internet of Things), and mobile applications are driving the need for devices such as power, analog, MEMS and Sensors in 200 mm manufacturing. Data report with forecast to 2022.
Global Semiconductor Packaging Materials Outlook to 2021

• Insight to technology trends, market size and forecast
• Key package offerings and technologies, supplier market share
• Improve business analysis and empower with verified, validated, and credible data

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