Our 5th Annual Perceptions Survey – 2016
Masks & Equipment total 68.5% of responses

What part of the semiconductor ecosystem is your primary focus?

- Equipment: 26.0%
- Materials: 1.4%
- Chip design: 9.6%
- Masks: 42.5%
- Chip manufacturing: 6.8%
- EDA/IP: 2.7%
- Research: 1.4%
- Other: 9.6%

Thank you to the 73 luminaries and members for your responses (~30 companies represented)
Thanks for Watching Our Videos
87% would recommend the Fine Line Journal Videos

Would you recommend the eBeam Initiative Fine Line Journal videos?

- Yes: 87%
- No: 10%
- I don't watch them: 3%

n = 67
68% Say Multi-beam HVM by end of 2018
3 month change from 2015 Survey results

By the end of which year do you believe that multi-beam technology will be used for HVM mask writing?

- 2014 (n=51)
- 2015 (n=61)
- 2016 (n=69)

% of Respondents

Year

2016 4%
2017 29%
2018 35%
2019 or later 32%

68%
No Change in Multi-beam Purchasing Trend
Some responded 100% for 2018 and beyond

What percentage of new mask writers purchased worldwide will be multi-beam writers in each year?

<table>
<thead>
<tr>
<th>Year</th>
<th>2015 Avg % (n=56-58)</th>
<th>2016 Avg % (n=66-69)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>12%</td>
<td>11%</td>
</tr>
<tr>
<td>2017</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>2018</td>
<td>36% 35%</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>48% 49%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>57% 58%</td>
<td></td>
</tr>
</tbody>
</table>
Resists likely to be ~2X slower in 2 years
Median response around 1.8X slower than today

For HVM production masks intended for production wafers, how much slower will the nominal dose of the slowest resist be at the end of 2018 compared to today?

- ≥2.3X: 10%
- 2.2X: 33%
- 1.7-1.9X: 12%
- 1.4-1.6X: 26%
- 1.1-1.3X: 14%
- No change: 5%
- <1X: 0%

Median: 1.8X

n=42
Almost Everyone Predicts Dose Modulation

97% predict dose assignment by end of 2018

For VSB mask writers, what per-shot dose modulation beyond nominal dose will be assigned during the mask data preparation phase by the end of 2018?

- 1.9-2.1X: 32%
- 1.6-1.8X: 14%
- 1.1-1.5X: 27%
- 2.2-2.5X: 14%
- 2.6-3.0X: 3%
- >3.0X: 8%
- 1.0 (no dose assignment): 3%

n=37
Dose Modulation Debate for Multi-beam
67% predict per-pixel; 31% per-shape

What form of dose modulation will be used with multi-beam mask writers?

- 67% per-pixel dose modulation
- 31% per-shape dose modulation
- 2% no dose modulation

n = 45
Actinic Inspection Predicted...Sometime

21% predict “never” in this year’s survey

By the end of which year do you predict actinic pattern inspection for EUV will be used in high volume manufacturing?

% of Respondents

Year

2016 2017 2018 2019 2020 or beyond Never

n= 61
EUV Confidence Over Others Increased
EUV confidence at 60% overall

Please rate your confidence that the following lithography solutions are used for at least one manufacturing step of at least one production chip being manufactured in the world by the end of 2020:

<table>
<thead>
<tr>
<th>Lithography Alternative</th>
<th>2015 Weighted Avg (n=56-61)</th>
<th>2016 Weighted Avg (n=68-73)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUV</td>
<td>62%</td>
<td>60%</td>
</tr>
<tr>
<td>DSA</td>
<td>41%</td>
<td>27%</td>
</tr>
<tr>
<td>CEBL</td>
<td>36%</td>
<td>28%</td>
</tr>
<tr>
<td>NIL</td>
<td>45%</td>
<td>39%</td>
</tr>
<tr>
<td>eBDW</td>
<td>26%</td>
<td>23%</td>
</tr>
</tbody>
</table>
NIL Rivals EUV for Memory in Perception
NIL confidence at 40% for Memory

Per application segment, please rate your confidence that the following lithography solutions are used for at least one manufacturing step of at least one production chip being manufactured in the world by the end of 2020:

- **Logic**: EUV (56%), DSA (14%), NIL (8%)
- **Memory**: EUV (44%), DSA (27%), NIL (40%)
- **Microprocessors**: EUV (56%), DSA (13%), NIL (10%)
EUV Pessimism is the Lowest in 5 Years
Only 6% responded with “never” in this year’s survey

% of Respondents indicating EUV will never be used in HVM

<table>
<thead>
<tr>
<th>Survey Year</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (n=42)</td>
<td>11%</td>
</tr>
<tr>
<td>2013 (n=49)</td>
<td>22%</td>
</tr>
<tr>
<td>2014 (n=52)</td>
<td>35%</td>
</tr>
<tr>
<td>2015 (n=64)</td>
<td>15%</td>
</tr>
<tr>
<td>2016 (n=73)</td>
<td>6%</td>
</tr>
</tbody>
</table>
Exciting Times Ahead

• Multi-beam for masks
• Dose modulation
• EUV and NIL
• And how will EUV masks be inspected?
Thank you to those who participated in the survey!

Feedback and questions for future surveys welcome – send to jan@williscalibra.com