Increased Process Stability for Selective Si P+/P- Etching

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Agenda

- Effects of Continuous and Interrupted Production
- Process Fluctuations
- Selective P+/P- Etch
- Counteracting process fluctuations (Inline Analysis & Inline Thickness measurement)
Continuous Production

- Optimized Processes
- Realistic lead times
- Continuous flow of information

How your production line feels like

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Interrupted Production

Standby Processes

Interrupted flow of information

Shortened / Increased lead times

How your production line feels like

Operators A B

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Process Fluctuations I

- Excessive etch
- Too little etch
- Incomplete or no oxide layer

Top Layer: Oxide layer

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Process Fluctuations II

 Mostly stable and tested conditions

\[ T \sim \text{const} \]

\[ T \sim RT \]

Varying process conditions

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Selective P+ / P- Etch

\[ S = \frac{E_{P+}}{E_{P-}} \]

**HF : HNO\(_3\) : Acetic**

**Bath Elapsed Time [secs]**

**P+ Etch rate [um/min]**

**P- Etch rate [um/min]**

**S > 40**

**S ~ 20**

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Etch Rate Correction

Etch time correction:

<table>
<thead>
<tr>
<th>Bath Life [min]</th>
<th>Etch rate [µm/min]</th>
<th>Correction Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>4,0</td>
<td>1,12</td>
</tr>
<tr>
<td>240</td>
<td>3,4</td>
<td>1,32</td>
</tr>
<tr>
<td>300</td>
<td>3,0</td>
<td>1,5</td>
</tr>
<tr>
<td>360</td>
<td>2,8</td>
<td>1,60</td>
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<tr>
<td>390</td>
<td>2,7</td>
<td>1,66</td>
</tr>
<tr>
<td>420</td>
<td>2,6</td>
<td>1,73</td>
</tr>
</tbody>
</table>

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Inline Analysis

- Concentration monitoring
- Out-of-spec Alert (e.g. accidental mixed chemicals)
- SECS/GEM \(\rightarrow\) SPC

Inline Analyzer

- Acetic
- HNO₃
- HF

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ATMSi- Inline thickness measurement

Etch time correction on the fly
ATMSi- Inline thickness measurement

Pre- & Post-Etch wafer profile 6” silicon

- Thickness monitoring
- TTV <0.2 micron
- SECS/GEM
Conclusion

Varying production volumes & Downtimes complicate stable production processes.

→ Advanced inline analytics & metrology increases process stability.

→ Providing instant data via SECS/GEM prevents expensive quality fluctuations → enabling fast interaction.

→ Improved TCO due to prolonged chemical usage (& reduced waste treatment).

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THANK YOU FOR YOUR ATTENTION