Focused Ion Beam (FIB) Technique

The FIB Instrument for Front and Backside IC Modifications

- **A FIB Can...**
  - Mechanical Removal of material by Ga+ Ions (~30kV), locally controlled (Beam ~ 5 nm), Beam scan over Structure programmable
  - Gas-Assisted Etching
  - Gas-Assisted controlled local depositing of metal conductors and insulators

- **Gas-Assisted Etching with FIB**

<table>
<thead>
<tr>
<th>Milled Material:</th>
<th>A1</th>
<th>W</th>
<th>SiO2</th>
<th>Si3N4</th>
<th>Polyimide</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dielectric preferential</td>
<td>~1X</td>
<td>12X</td>
<td>~7X</td>
<td>~8X</td>
<td>~4-15X</td>
<td></td>
</tr>
<tr>
<td>Metal preferential</td>
<td>10-30</td>
<td></td>
<td></td>
<td>~2X</td>
<td>~3X ~12X</td>
<td>~12X</td>
</tr>
</tbody>
</table>

Gas-Assisted Etching of Si:

\[
\text{Si} + 2 \text{XeF}_2 \rightarrow \text{SiF}_4 + 2 \text{Xe}
\]

- **FIB Basics**
  - Like a SEM, but with a Ga+ ion source
  - Beam can be rastered in defined patterns
  - Material removal by sputtering
  - Imaging by capture of charged secondaries
  - Ability to selectively deposit and etch

- **Coaxial Photon-Ion microscope**

- **Endpoint Detection**

- **100nm FIB Placement Accuracy**

  CAD and IR registration for accurate edit placement

  Precision alignment algorithm similar to lithographic techniques