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Device level 3D-ICs Through Membrane Projection Lithography Using CMOS Compatible Materials

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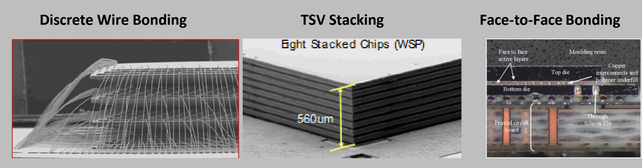
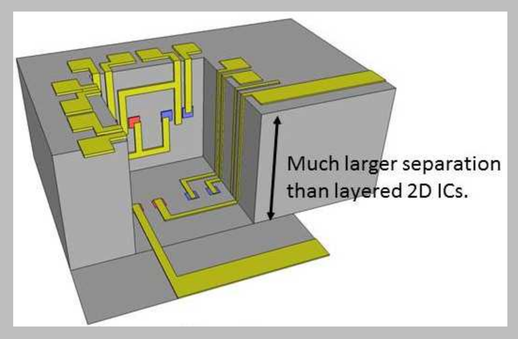
Oblique Angle Processing

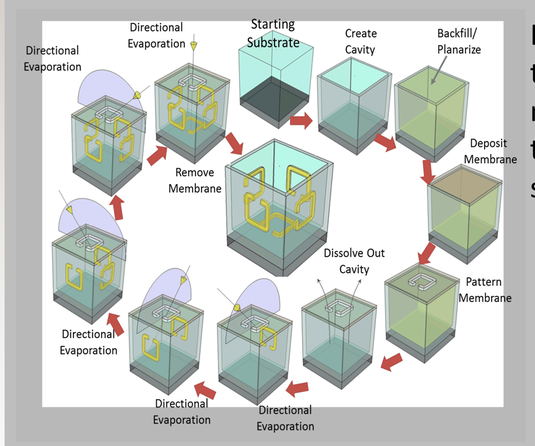
Traditional CMOS fabrication involves a top down vertical approach, with active regions parallel to the wafer surface. Performing standard semiconductor operations at an angle to the wafer surface results in three-dimensional structures with active regions fabricated in any axis relative to the wafer surface.

Traditional vs. MPL





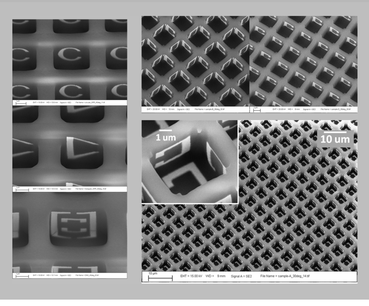
MPL- Fabrication

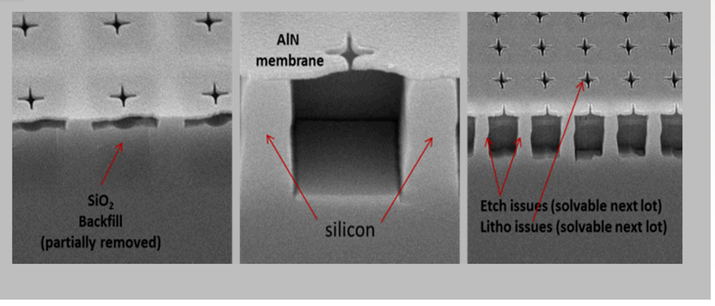


Membrane projection lithography (MPL) is used to create 3-dimensional unit cells in a silicon matrix. Processes can be projected obliquely through a suspended membrane to achieve specific patterns with a wide range of materials.

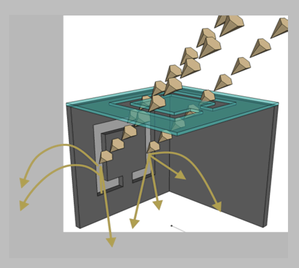
- **Plasma Etch**
- **Ion Implant**
- **Physical vapor Deposition**

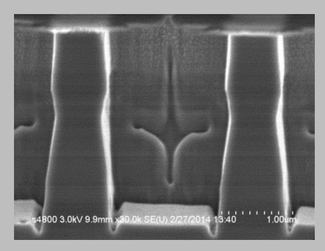
Material Identification

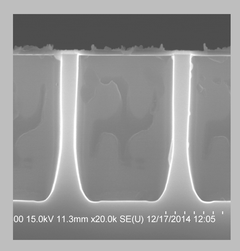


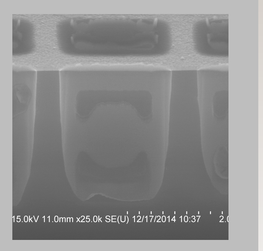


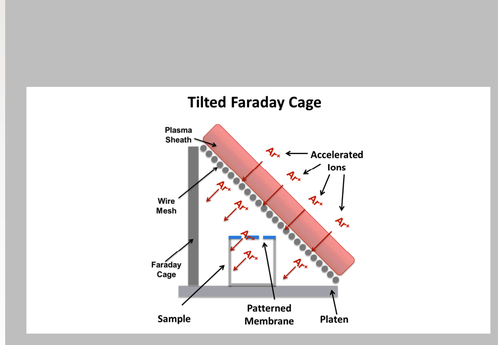
Angled Plasma Etch

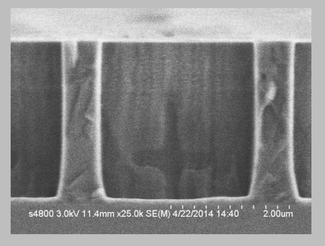


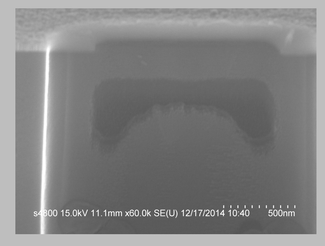






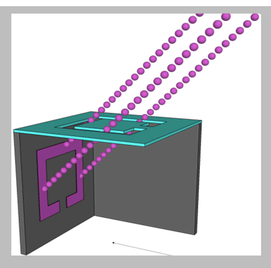


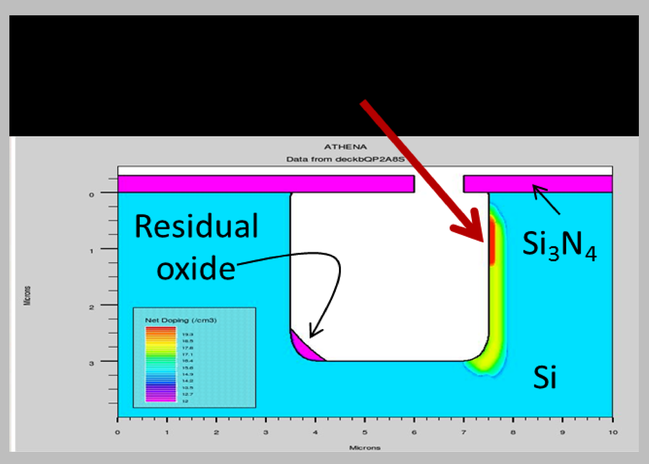




The use of an angled faraday cage redirects ions

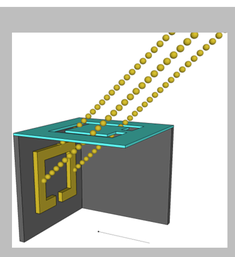
Patterned Ion Implant

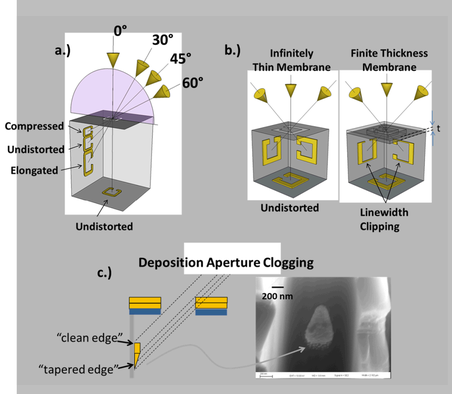


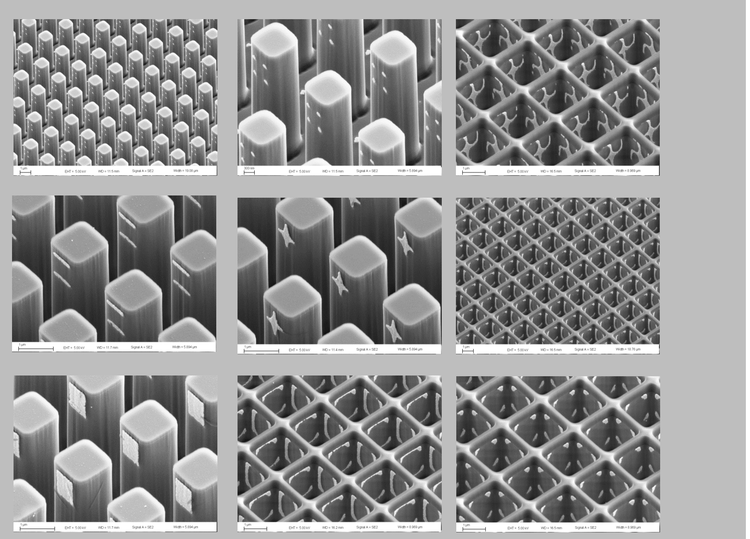


Results of 2D process simulation demonstrating feasibility of MPL-based angled implant through a thin suspended membrane.

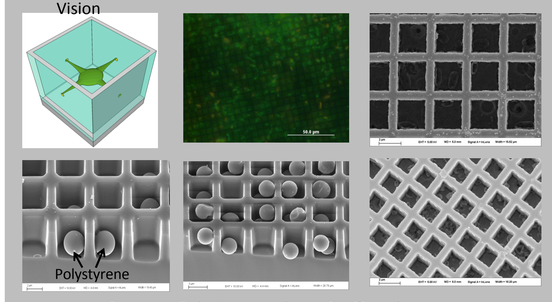
Angled deposition





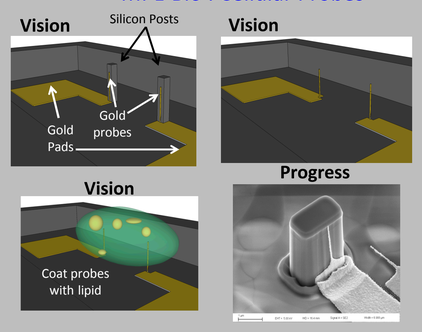


MPL-Bio : Cellular Localization



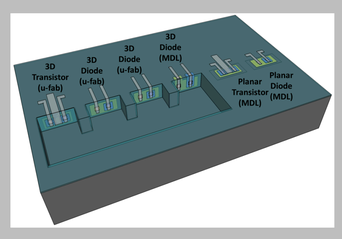
Progress: Polystyrene spheres in silicon boxes

MPL-Bio : Cellular Probes

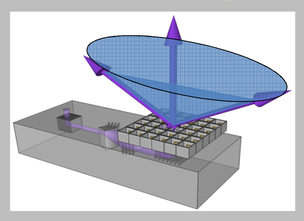


Future Work

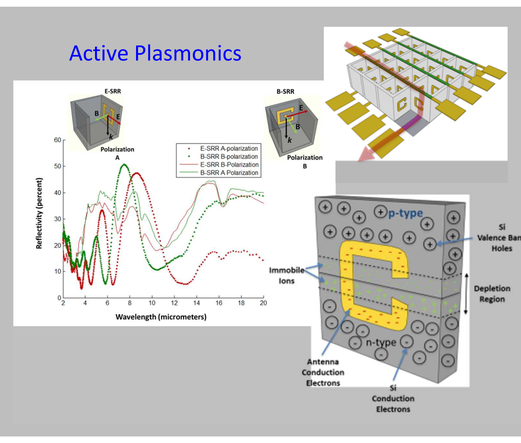
3-D PN Junctions



IR Beam Steering



Active Plasmonics



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