Focused Ion Beam (FIB)

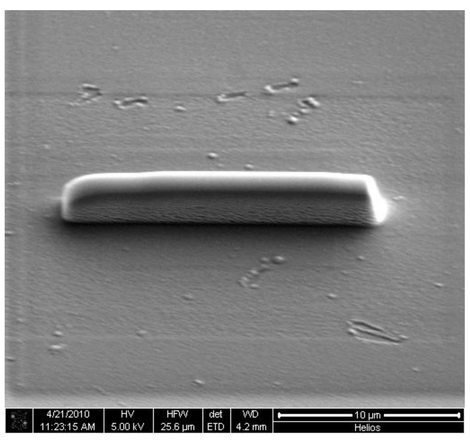
Focussed Ion Beam

- FIB uses a finely focused beam of gallium ions that can be operated at low beam currents for imaging and polishing or high beam currents for site specific sputtering or milling of materials in a precise and highly controlled manner down to nano-meter scales .
- Milling can be monitored in real time using the electron beam.
- Used in fundamental materials science and technological applications as it offers both high-resolution imaging and flexible micro-machining in a single platform.
- As an analytical tool, FIB is used as an in-situ sectioning tool in various materials ranging from hard ceramics to soft biological cells.
- Other applications include circuit editing and 3D eetrology in electronic industry and further developments to allow tomography in cellular and structural biology.

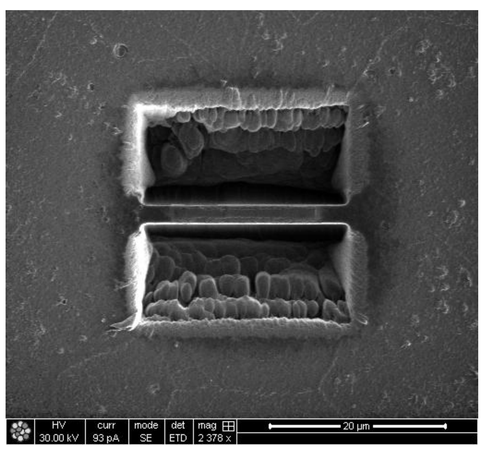
Image courtesy of FEI

TEM Specimen Preparation

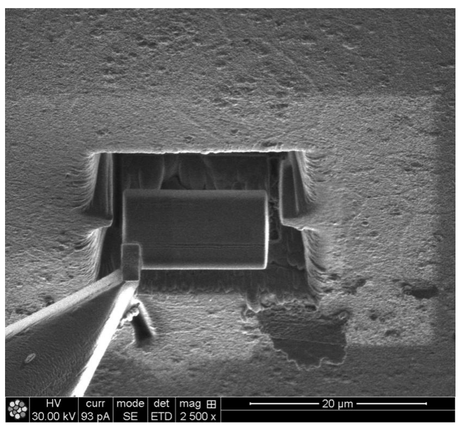
Lift-out is a technique whereby a membrane is produced in a bulk or thin film sample, then cut free using the FIB and removed for stand-alone examination in the TEM. The procedure comprises of a number of steps described below:



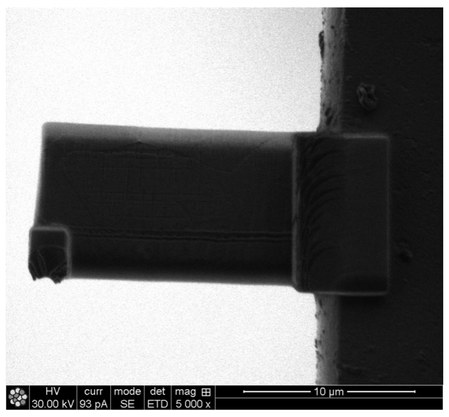
A particular region is located with the SEM. A layer of Pt is deposited to protect the feature of interest during subsequent milling.



The material surrounding the Pt strip is removed by FIB milling, leaving a 1 micron thick lamella containing the feature of interest protected by Pt layer.



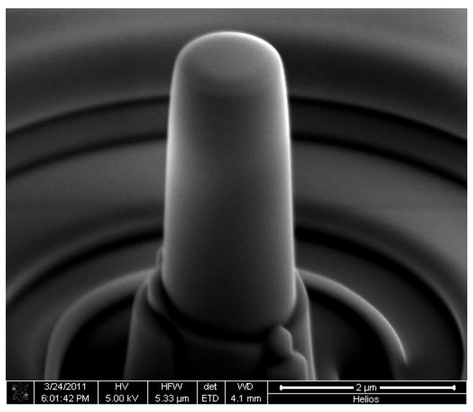
A micromanipulator needle is attached to the sample by Pt weld, then the lamella is cut free and lifted out of the milled trenches.



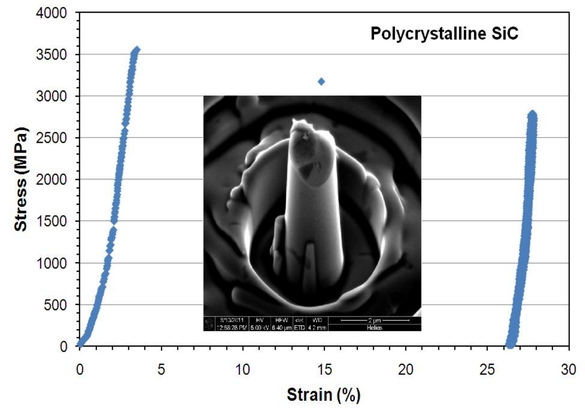
The sample is placed against a TEM grid and Pt welded, followed by cutting the bridge which links the lamella to the needle. The final milling and polishing of the sample is performed.

Grain-boundary Strength in SiC System

FIB is employed to fabricate micro-pillars structures in SiC which are subjected to uni-axial compression using a flat-punch nanoindenter. High current of Ga ions of 21 nA is used to mill a crater of 30 μm diameter in the material, leaving 6 μm diameter island in the centre.

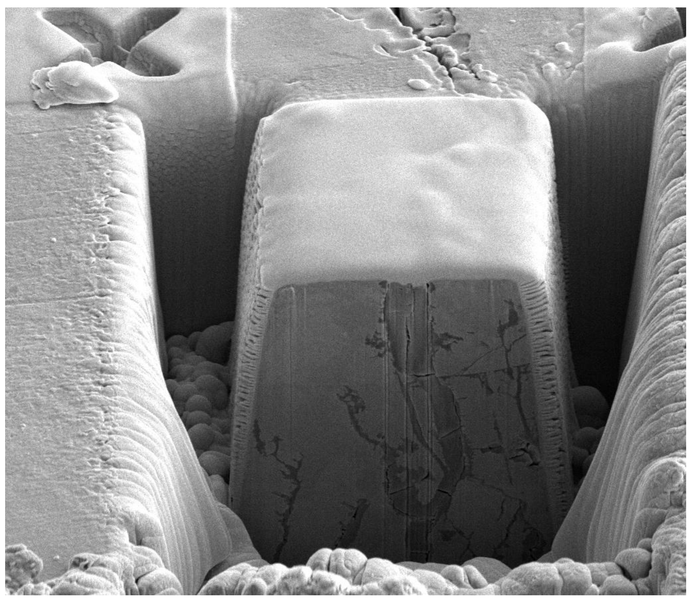


FIB-fabricated Micro-pillar



Micro pillar poly-crystalline SiC subjected to Uni-axial compression at 25°C

Slice and View of Corrosion Cracks in Stainless Steel



The FIB is also used for serial sectioning of 3D defects. These can then be reconstructed in to a tomograph. The example is a stress corrosion crack in stainsteel

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