



Application of a FIB system to the micromachining of 3-D shapes

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Outline of talk

- Micromachining of shapes
 - hemispheres, atom probe specimens, cosines
- Tomography
 - for assessing the milled structures
- FIB preparation of sample for HREM
- Preparation of site specific plan view cross sections

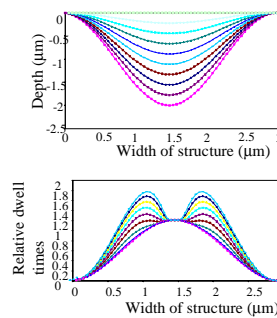
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Fabrication of 3-dimensional structures

- Machining of moulds and embossing tools for mass production.
- Build a structure layer by layer
 - micropumps, micropipes
- Maskless milling
 - sputter yield is dependent on the angle of incidence of the ion beam to the sample

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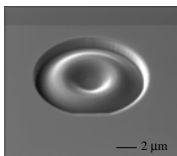
Milling of 3-D Structures



- Divide structure into layers.
- Calculate dwell time required at each pixel so that layer x-1 becomes layer x.
- Gradient at a pixel determined from surrounding pixels.

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Milling of 3-D Structures

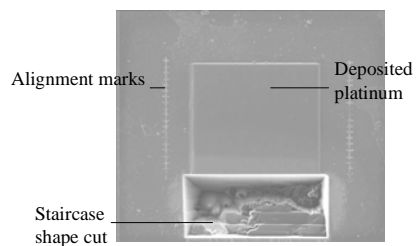


Volcano type structure
– ion beam profile also incorporated.

Match to intended structure ~ 30%. Error due to redeposition of sputtered material and magnitude of error is dependent on number of slices used.

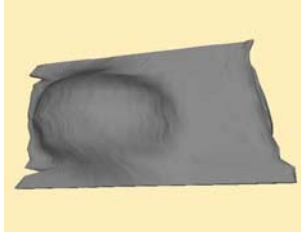
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Sequential cross sections



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Reconstructed shape



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FIB tomography can be used for

- Reconstruction of
 - FIB milled structures
 - grains, e.g. interfaces of friction welds
 - devices
 - nanoindents

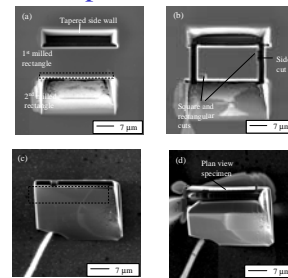
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Next Steps

- Looking to have a real time feedback during the milling to correct the milled shapes.
- If shape is suitable using AFM to determine milled surface and correlate this with intended structure.

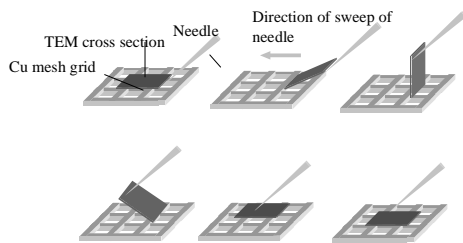
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Preparation of site specific plan view specimens



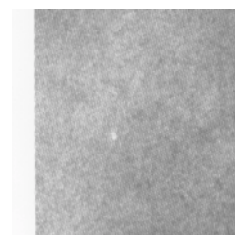
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Technique to BIB both sides



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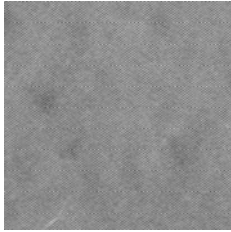
HREM lattice image of Si FIB cross section



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HREM lattice image of Si FIB cross section specimen after PIPS milling

2 kV, 2°



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