



CCLRRC

Rutherford Appleton Laboratory

R&D of Powder Blasting Micro-manufacturing of Space components

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Presenter Geoff McBride
Facility CMF

Introduction

- Powder Blasting @ CMF
- What is Powder Blasting?
- Powder Blasting Processing
- Line features
- Hole Profiles
- Bio-structures
- Gyroscope Lids
- Graphite
- Nanotruster
- Cooler
- StarTiger

Powder Blasting @ CMF

CMF Powder Blasting Facilities

- Powder blasting chamber
- Pre/post processing
- Mask aligners
- Metallization
- Bonding
- Dr Bob Stevens, Geoff McBride

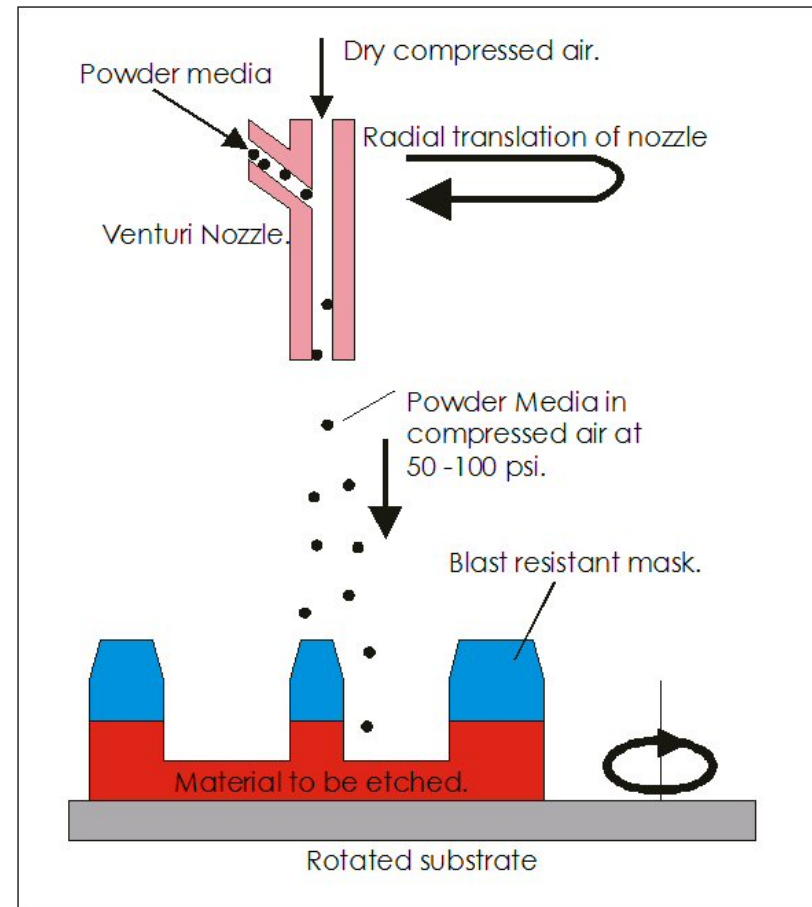
Projects

- Bioengineering [x 3 + 2]
- Aviation/Automobile [ongoing contract]
- X-ray detector front ends [x 2]
- Micro-fluidics [1]
- Laser target [1]
- Space components
 - Nano-thruster grids
 - Microcooler
 - StarTiger
- R&D is ongoing within project deliverables including next generation processing

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What is Powder Blasting?

- Etching patterns into substrates
- High velocity dry micro powder
- Where the substrate is exposed holes, tracks, and shapes are etched into the surface



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Powder Blasting Processing

- Substrates: Brittle materials glass, silicon, graphite, quartz and sapphire
- Two lithographic processes
 - Negative wet resist
 - Dry film positive resist
- Both cases the exposed areas of the substrate are powder blasted
- Post processing removes resist

Powder Blasting Processing

- Substrates are fixed to a rotating turntable within the chamber
- Gun rasters across the central axis of the table
- Air guns and extraction circulate the powder back to the collection hopper



Powder Blasting Processing

- Etch rate factors
 - Air pressure propelling the powder
 - Blaster gun raster/turntable
 - Powder size
 - Powder weight
 - Powder shape
 - Line width
- Resist etch rate 1:100 ratio

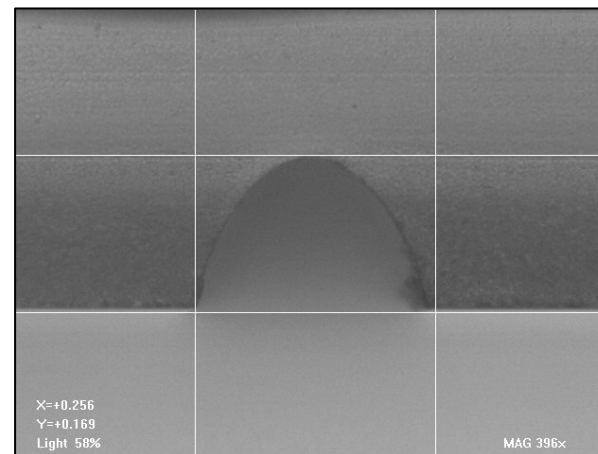
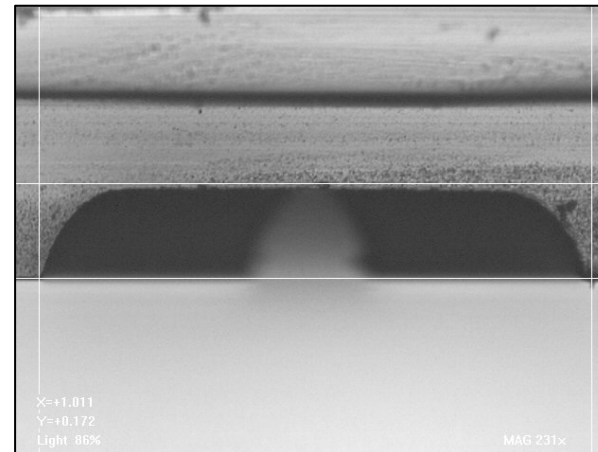
Line features

- Rough Edging
- Corner/junction depth can vary
- Wider lines etch faster
- 1400 micron etch for a 1000 micron line width realised



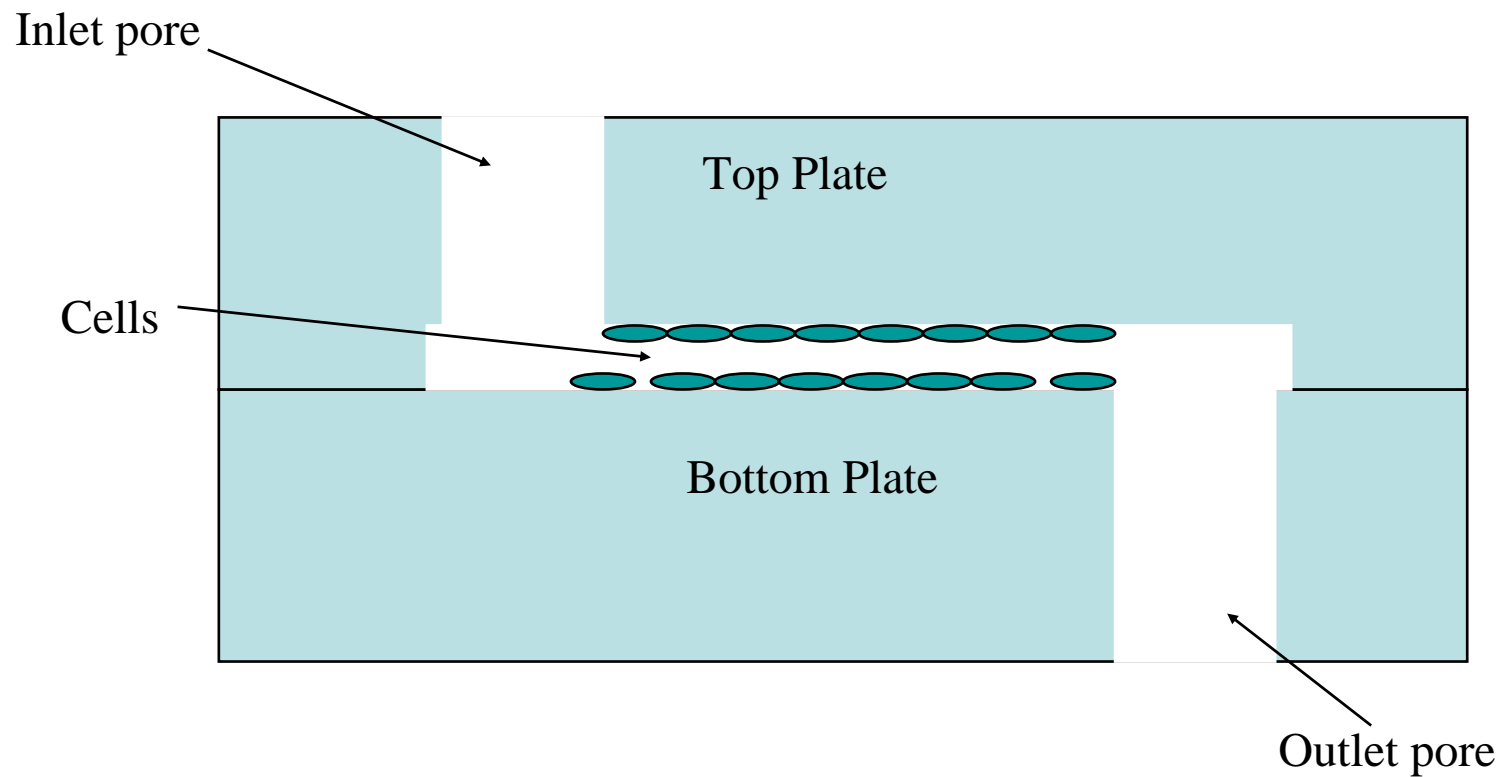
Hole Profiles

- Bath tub configuration
- Wider hole etches quicker
- Wall profile is curved ~70 deg
- Through holes of 500 microns realized

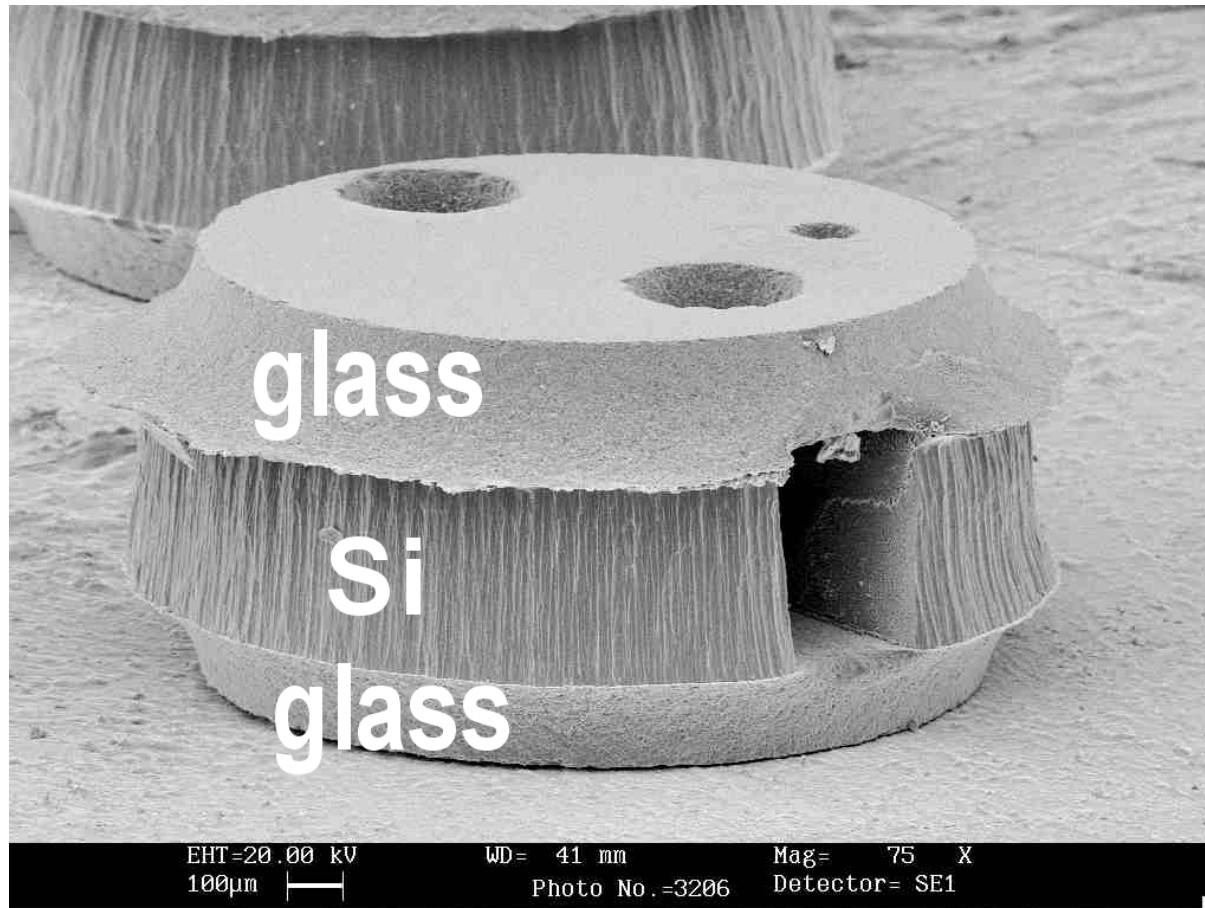


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Bio-structures



Bio-structures UroCath

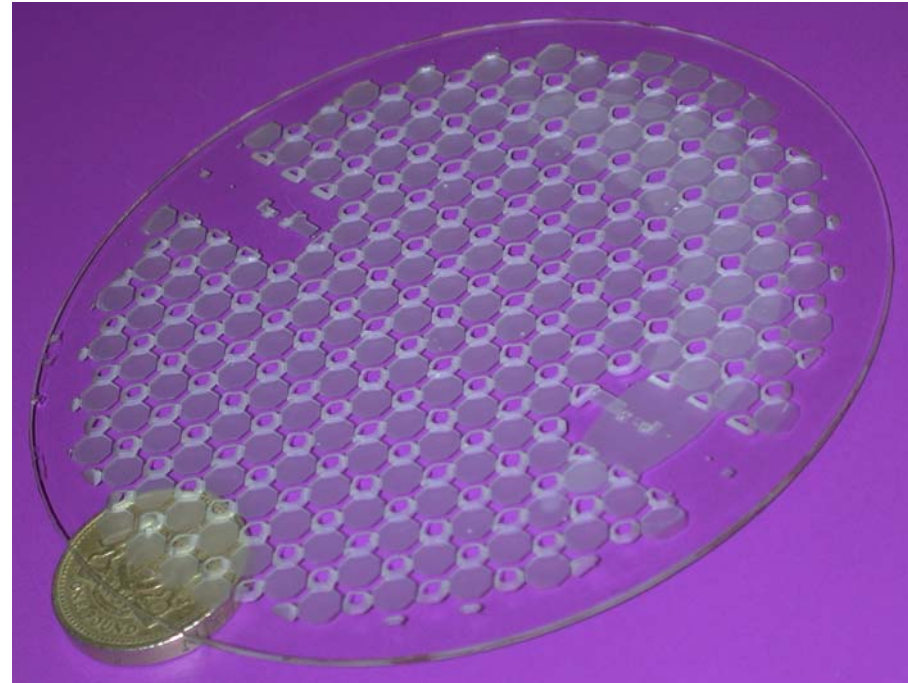


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Powder blasting: BAE Systems: MNT Gyroscope Lids



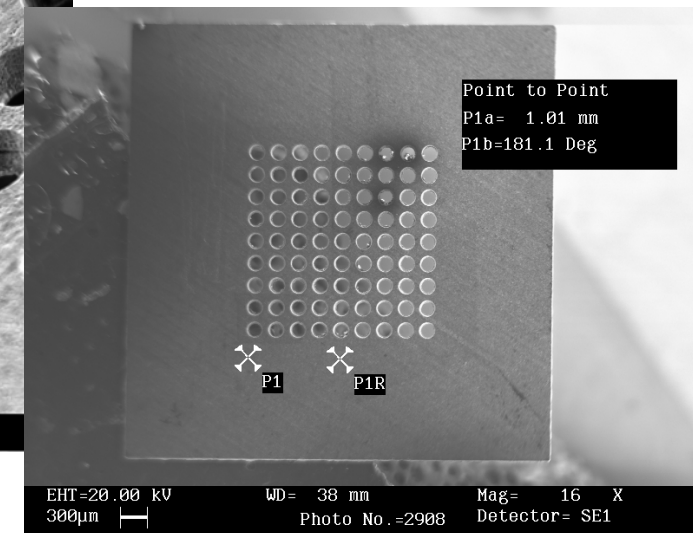
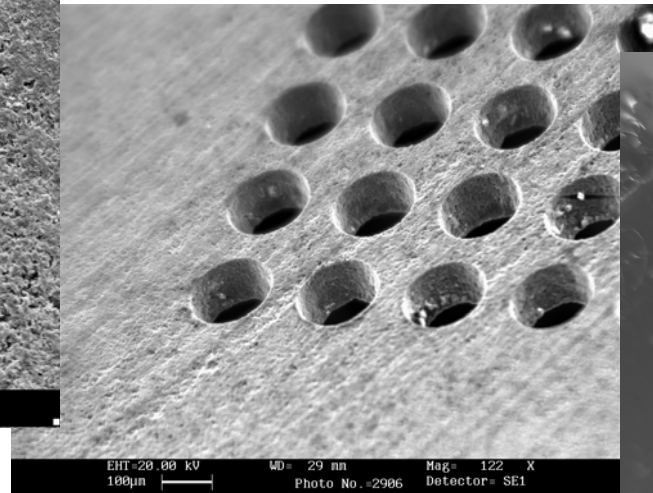
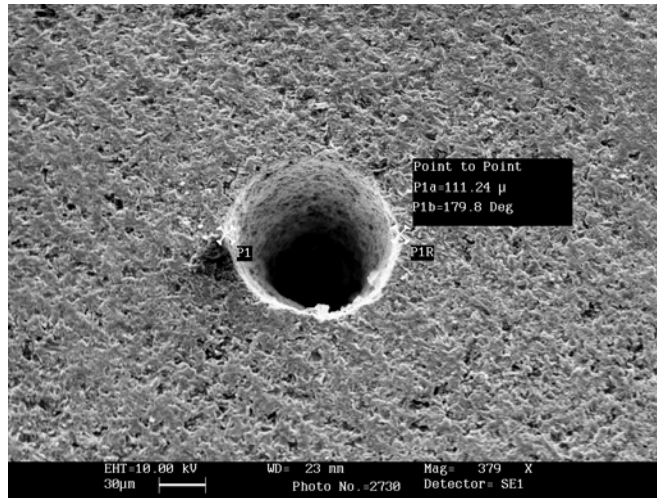
Chrome coated Pyrex7740 wafer
with resist cavity mask defined



Final product.
BAE System Gyroscope Lid

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High Density Graphite Structure

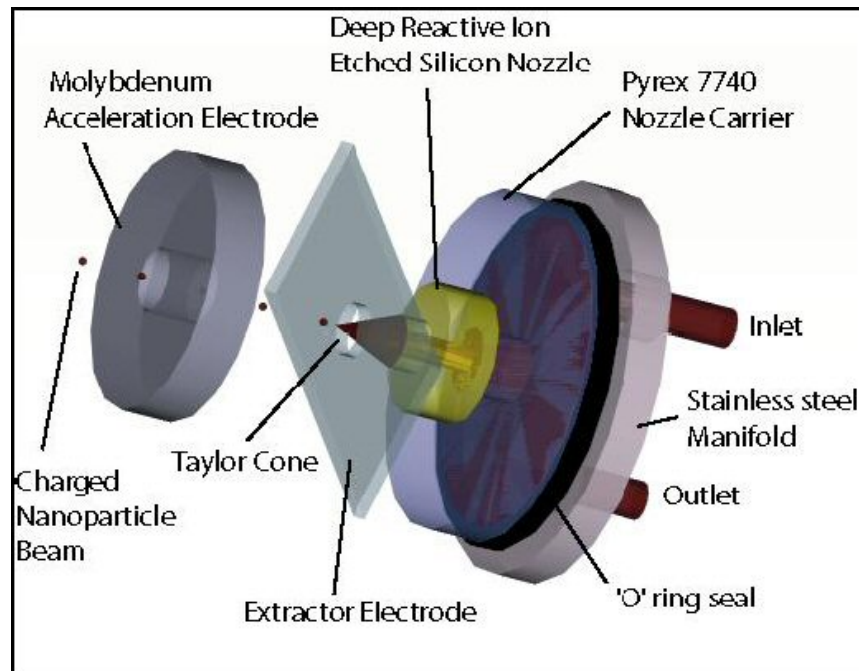


Applications.

Ion Optics.
Miniature Fuel Cells
Tissue Scaffolds

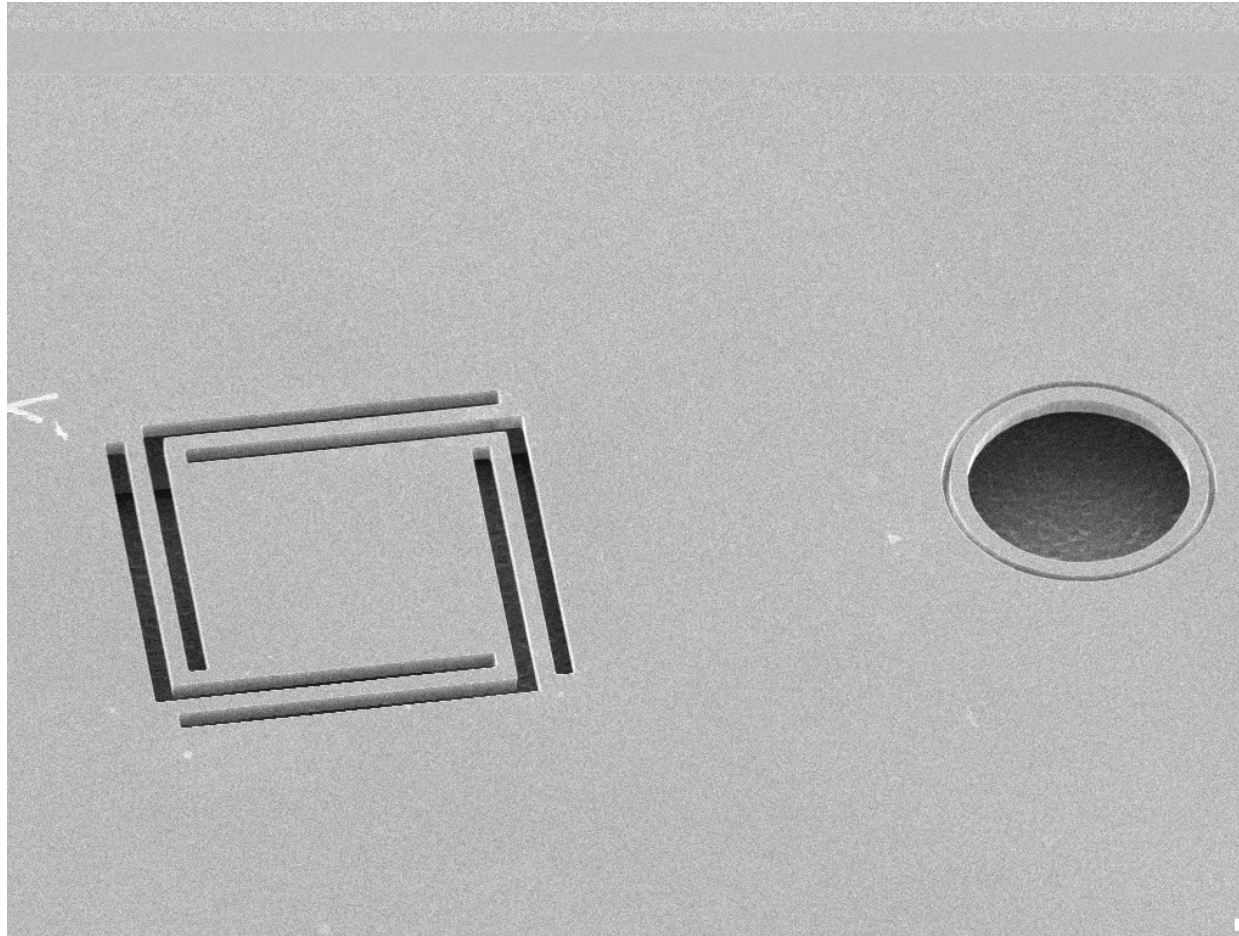
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Nanothruster



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MST Compressor for Joule-Thompson Cooler

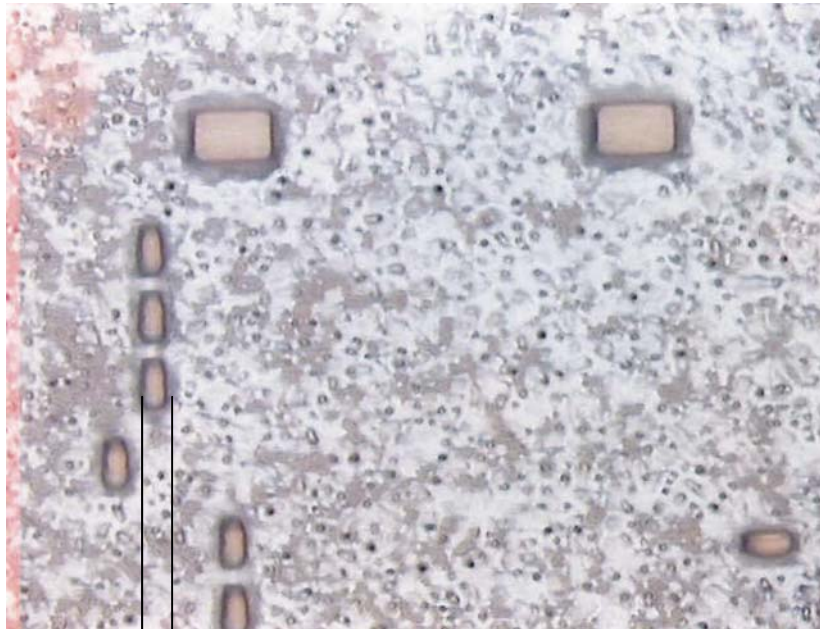


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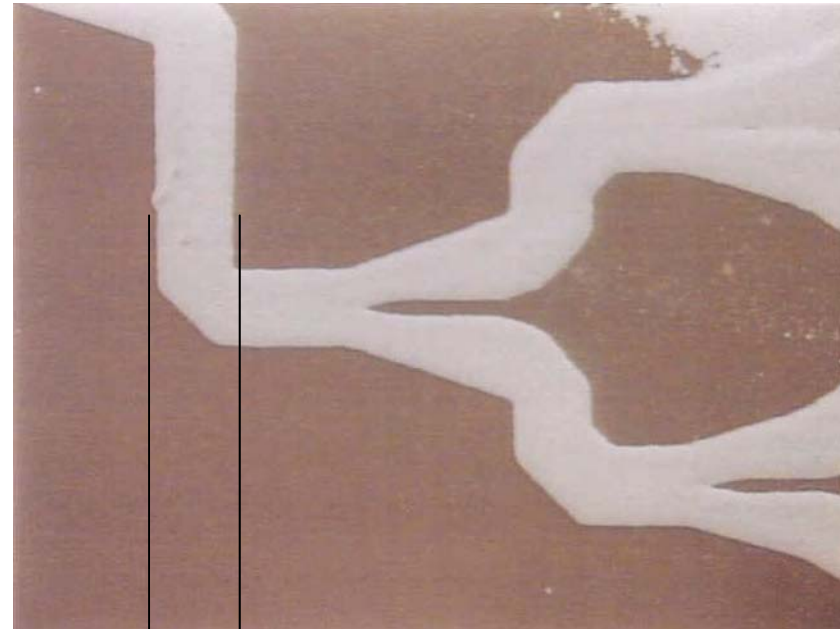
Powder Blasting

StarTiger

Early R&D for via holes and wave guide array



200 μm



880 μm

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Future & Conclusion

- Line width reduction
- Deeper structures
- Multilayer structures
- Other materials
- Powder blasting facility development

Contact

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