Micronanics
Laser Solutions Centre

The Use of Lasers in Target Manufacture

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Micronanics Limited

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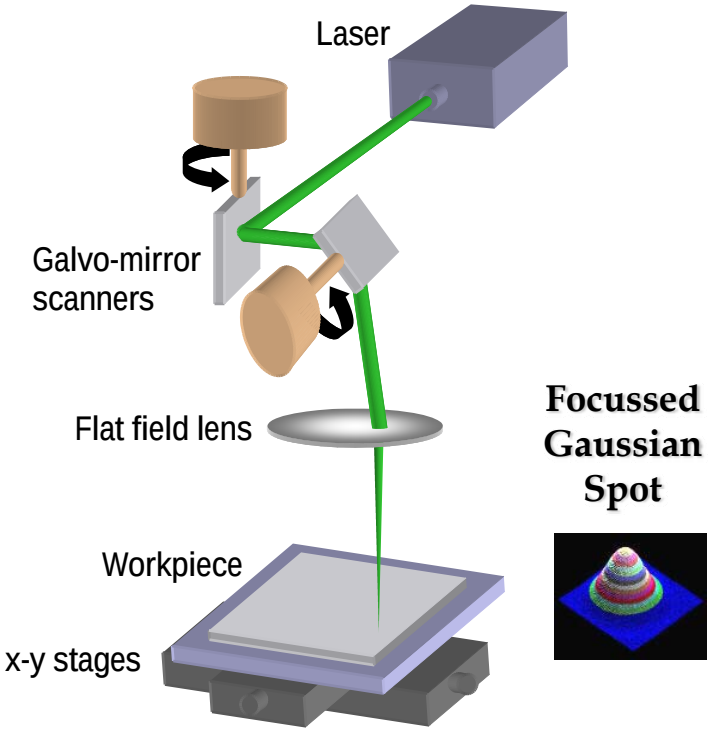
- Serial writing with focus spot
- Low M^2 (gaussian) laser beams
- High speeds - to 10m/sec
- Product designs CAD-CNC programming

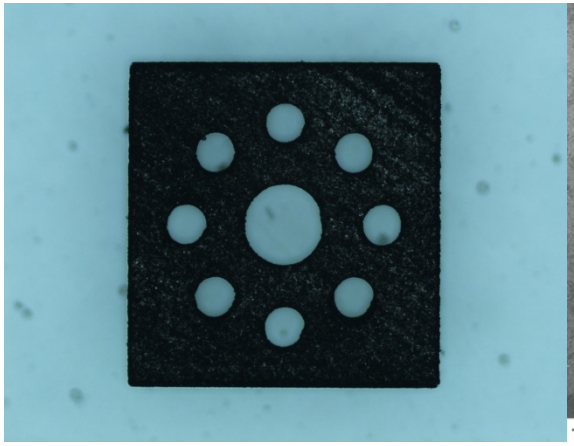


Industrial applications

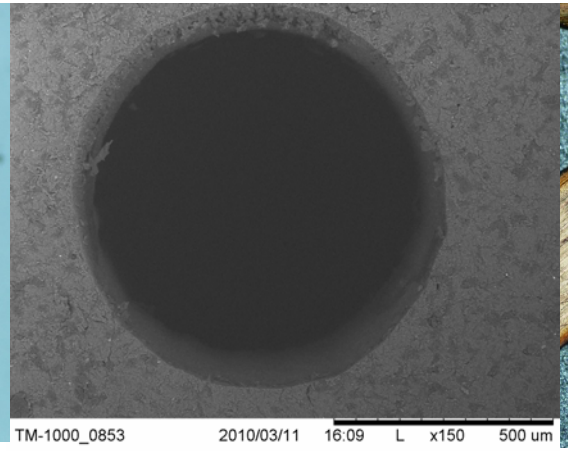
- MEMS prototyping
- Wafer cutting/ scribing/ drilling (Si, Sapphire, SiN)
- Circuit tuning, scribing and microvia drilling
- Probe card drilling
- Fuel injector drilling
- Solar panel and cell scribing
- Displays thin film scribing
- Aerosol atomizer drilling
- Gas sensor drilling
- Fibre stripping, cleaving & tip lensing

- 355nm Coherent Avia
- Machines most materials in a serial scribing fashion.
- CAD files (DXF) can be imported to allow rapid machining of complex patterns.
- Rapid part prototyping.
- Galvo-scanner and/or stages

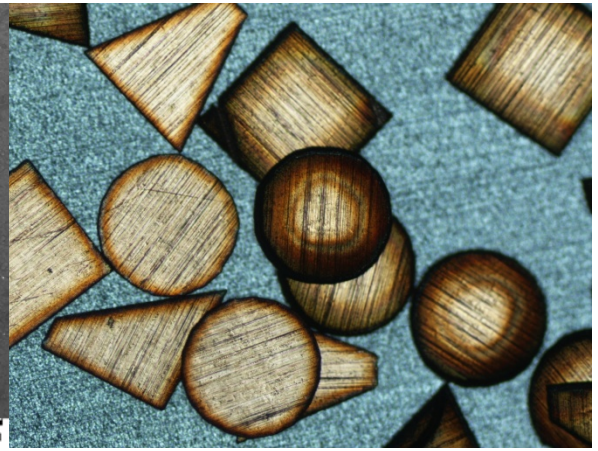
- Wide variety of materials can be processed
  - Metals (Stainless Steel, Copper, Brass, Aluminum)
  - Silicon, Ceramics, glass, polyimide
  - Almost any shape hole can be machined
  - Up to 500μm thick in most materials (>2mm in some)
  - High speed, little debris and small heat affected zone
  - Flexibility of CAD-CAM allows rapid prototyping and small batch manufacturing
  - Enables complex mask manufacture for Excimer systems



Pyrolytic Carbon

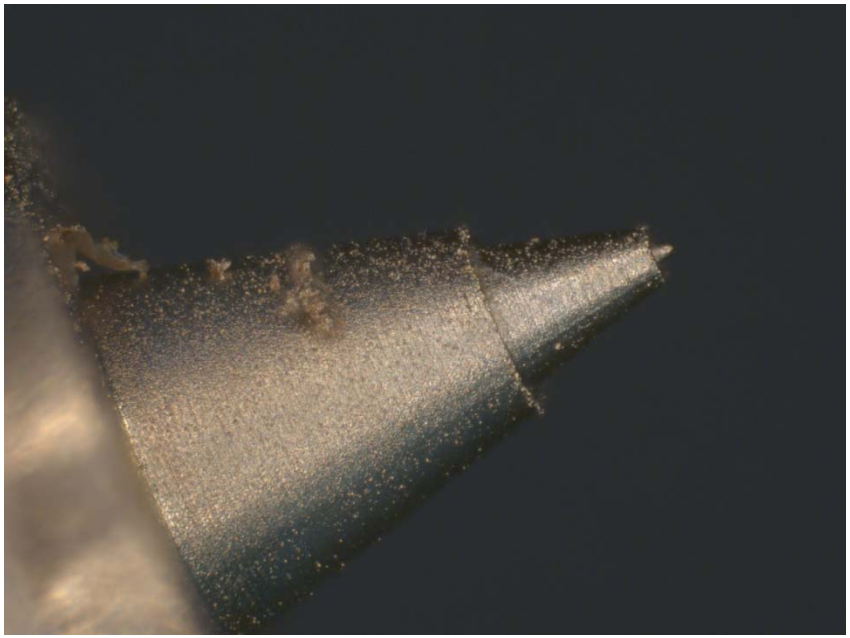


Kalrez® (Dupont)



Copper Targets

3 Metal Cone Slicing



Three metal layered cone
Required slicing to expose the three layers.
Precision cutting using DPSS laser, sliced layers of ≥5µm from the cone until the three layers exposed.

Scitech PRECISION

Work performed with **Scitech Precision Ltd**

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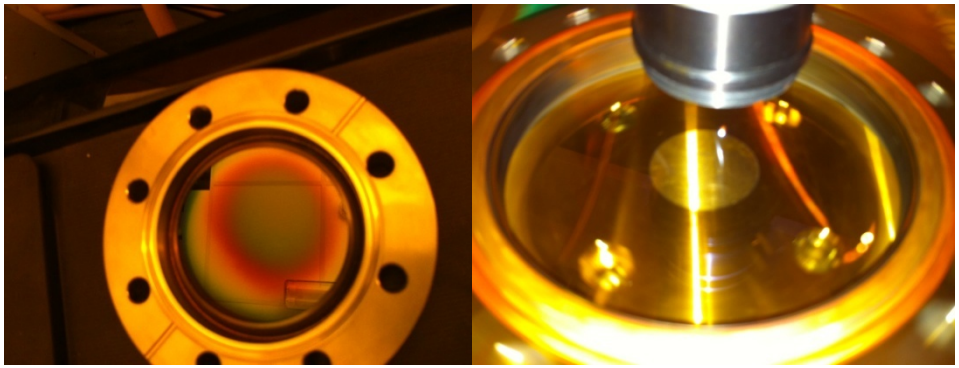
Macro System

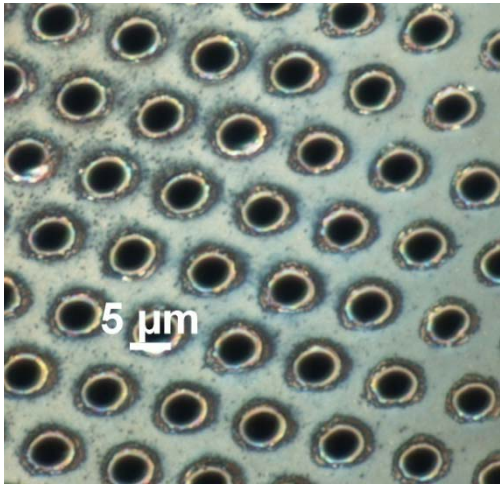
Variety of lenses from X30 – X1
Lens NA from 0.15 (X10)
Medium energy density
Suitable for materials such as diamond, sapphire, polymers, thin metal films ceramics except fused silica, fluorides (MgF2, BaF2) and limits on metal layers to ~100nm
Mask projection system allowing complex mask designs (lithography type masks as well as our own metal masks)
Offset alignment using camera system

Limitations

Exposure area. As large as 1:1 (10mm) for low fluence work but typically 2.5mm (X4) to 1mm (X10)

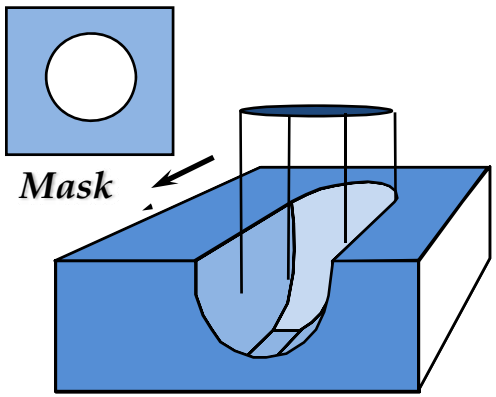


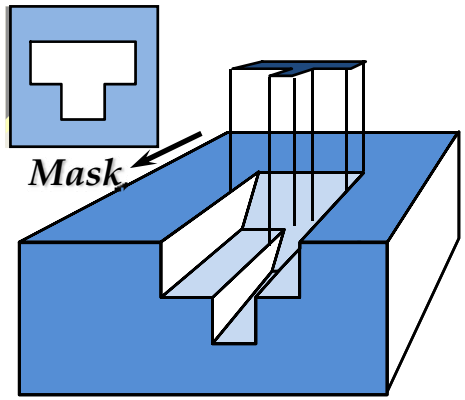
- 193nm Macro
  - Mask projection
  - Large area machining
  - Ideal for polymers, ceramics, diamond, sapphire
  - High resolution, micron level capability
  - Structured side walls, trenches.
  - Laser: Lambda Physik LPX220i

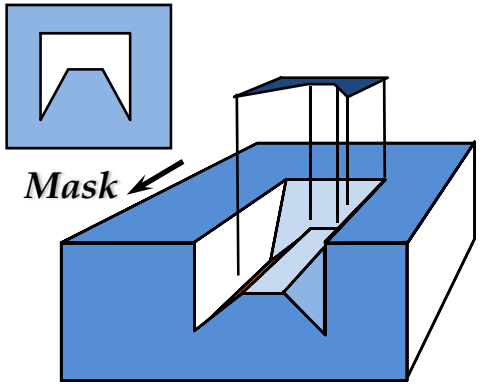


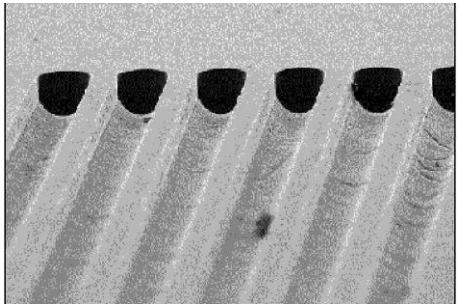
4um laser machined holes in sapphire

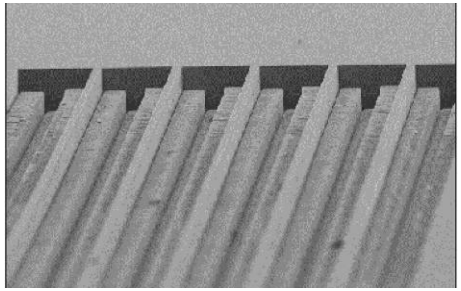
Mask Dragging: Profiles

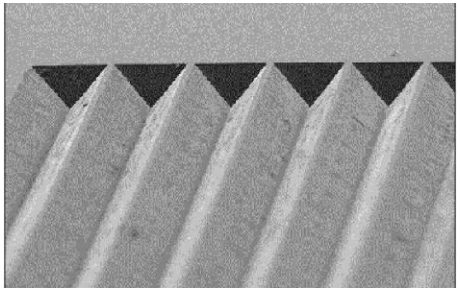




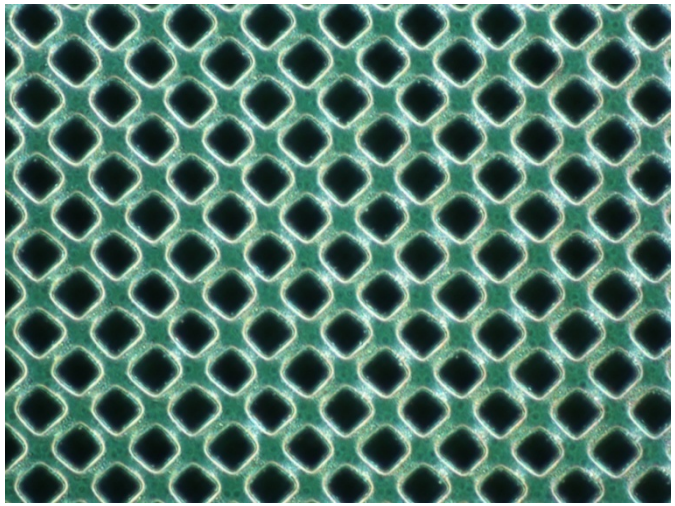




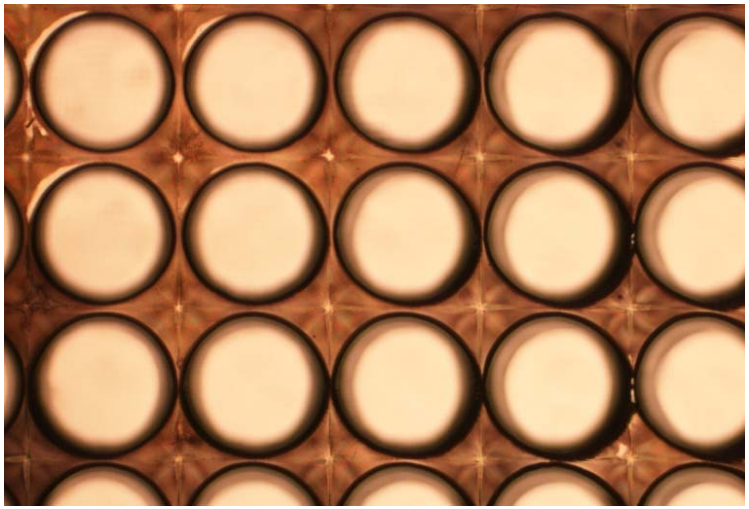




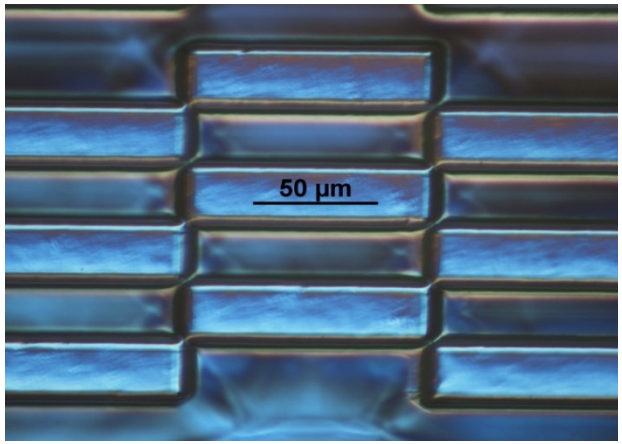
- A Mask can be complex, projecting thousands of features at the same time, similar to lithography.
- Direct machining



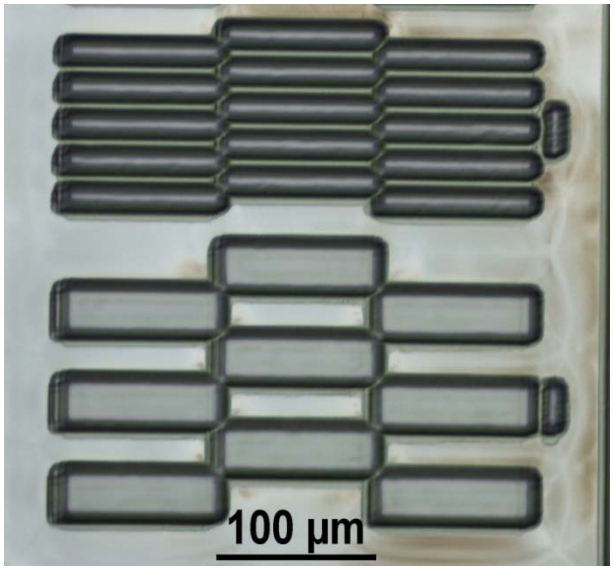
7um square holes machined in glass 1000's of holes /second



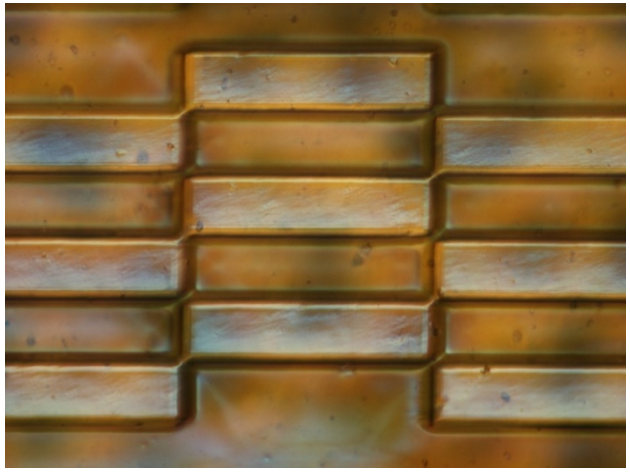
50um circular holes machined in polycarbonate



Peek



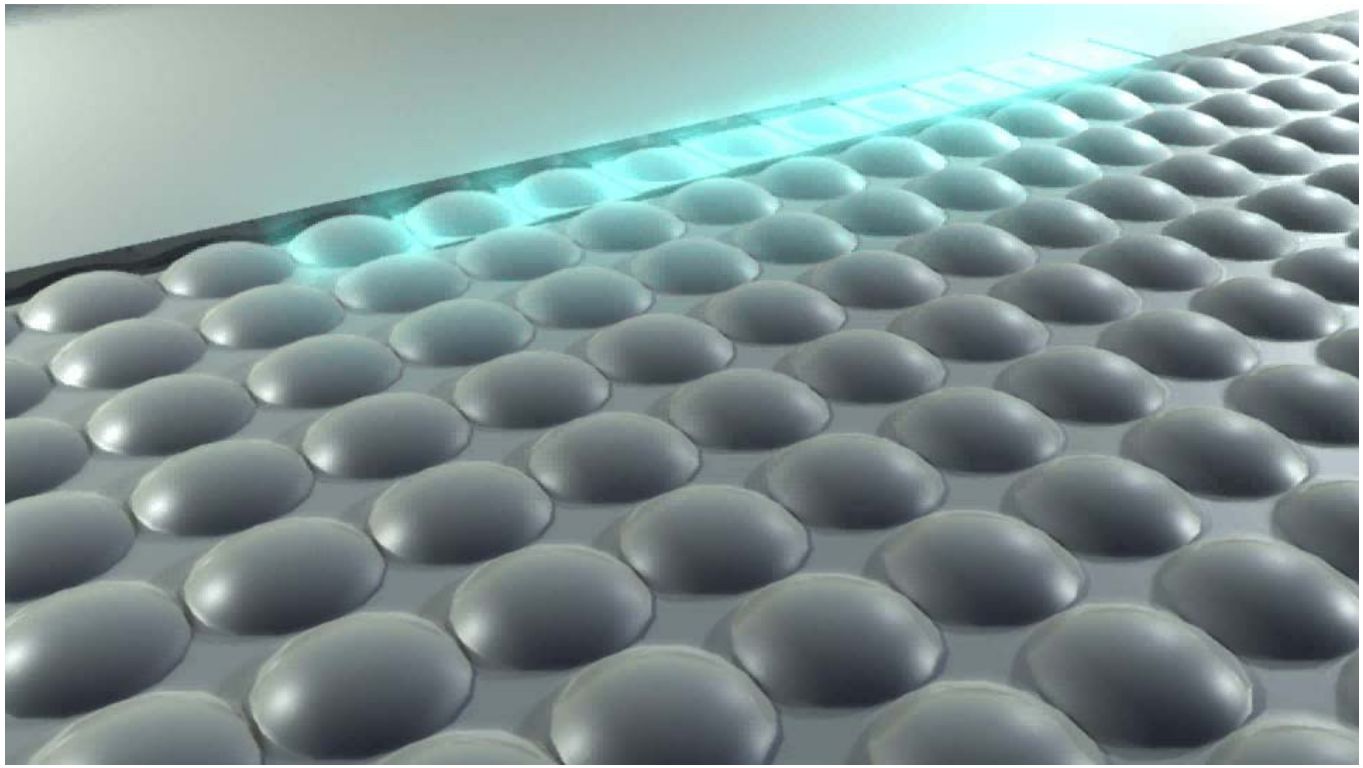
Polycarbonate



Kapton

193nm Excimer

Sequential Image Scanning (SIS)



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Micro System

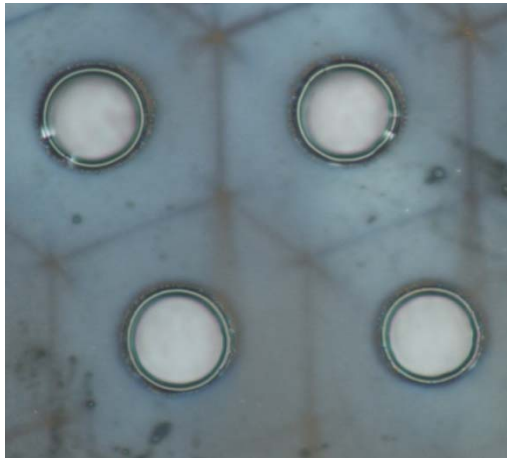
Details

- 3 Magnifications, X15, X25 and X36
- High NA lenses, resolution approaching 0.5um
- High energy density
- Suitable for materials such as diamond, sapphire, polymers, thin metal films ceramics
- Not suitable for fused silica, DUV transmissive fluorides (MgF2, BaF2) limits on metal layers to less than 200nm
- Mask projection system allowing complex mask designs (lithography type masks as well as laser cut metal masks)
- Real-time alignment and observation using through lens camera system

Limitations

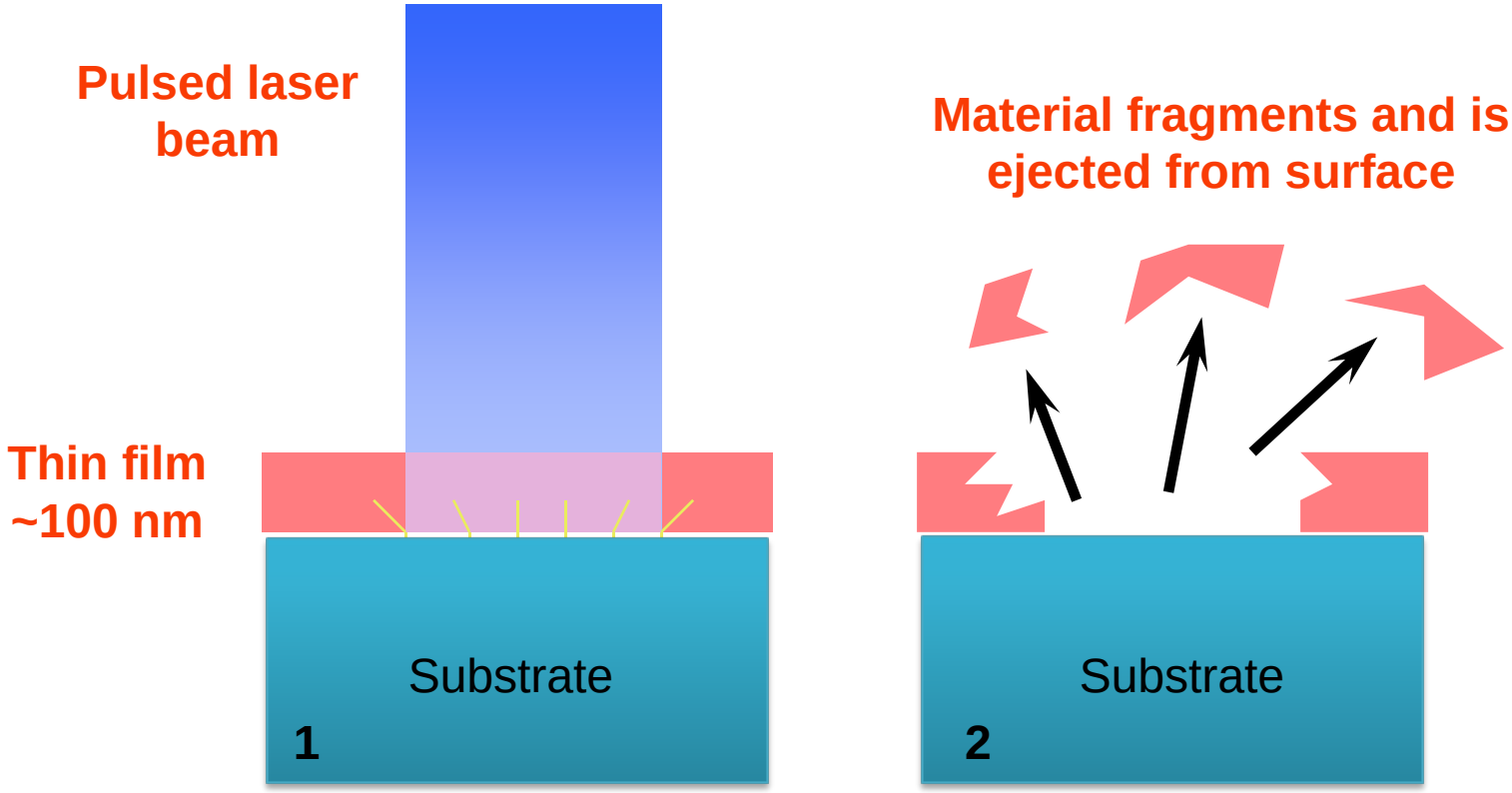
Exposure area. Mask area approx 10mm (X15=~660 microns, X36=~270um)

- 193nm Micro
  - Mask projection system capable of individual site machining or repair using direct backlit alignment
  - High NA lenses X15, X25 and X36 available
  - High Fluence >20J cm^{-1}
  - Lambda Physik Compex 205i
  - Areas up to 660um diameter



14um holes in Sapphire

Laser Interaction With Thin Films



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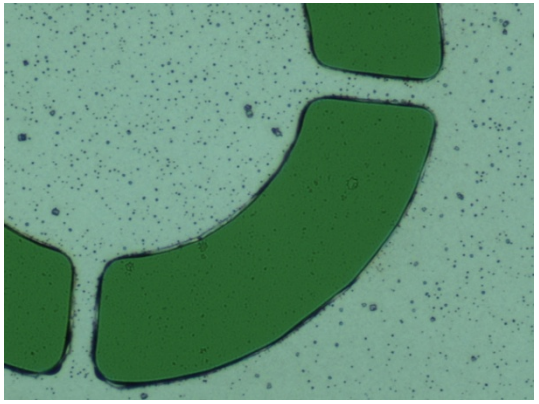
Lift off Films

Aluminium 100nm
Laser cut metal masks projected onto lift off film
1 Shot process

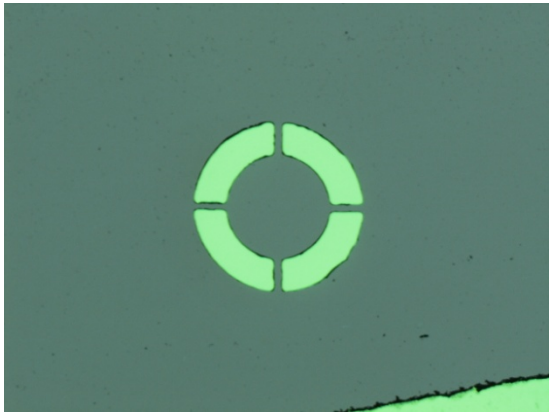
Fast delivery, from CAD to patterned film can be less than 12 Hrs
3 Step laser process.
1. Mask
2. Projection
3. Profiling

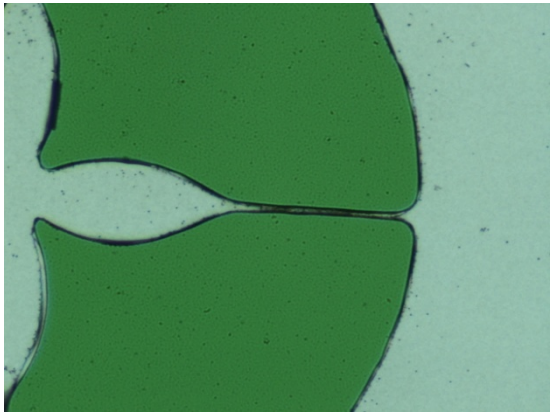
Features to 2um achievable

Fast and Low cost process compared to other techniques



14um arm





2um arm

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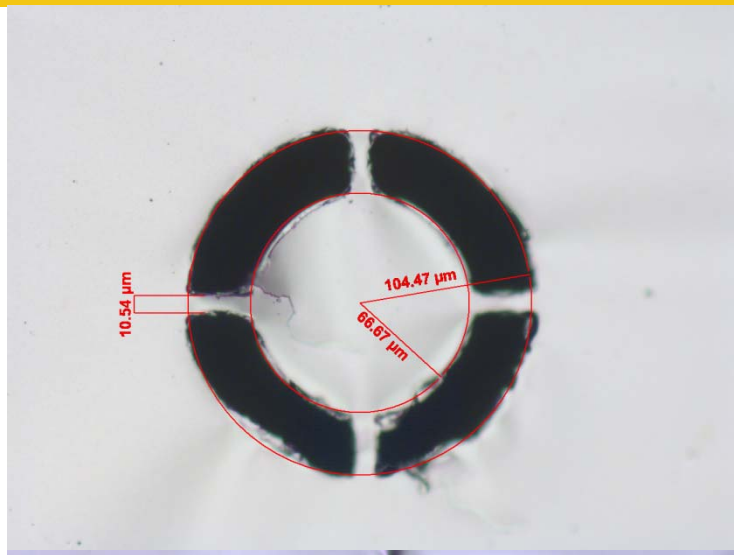
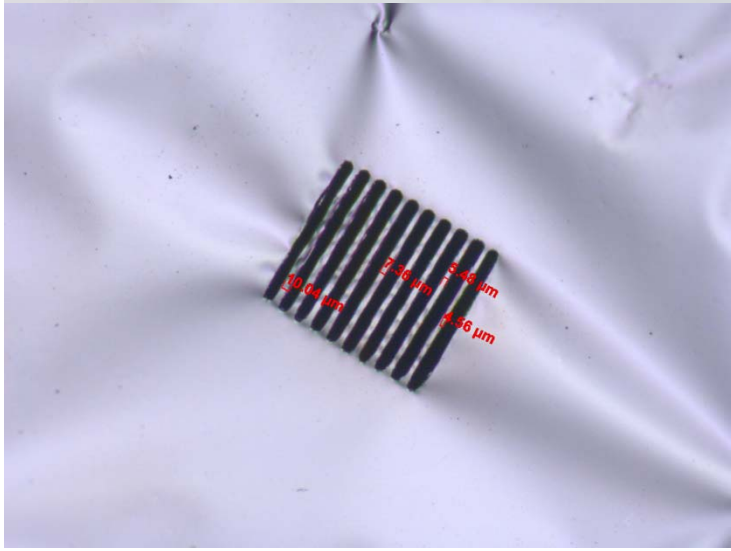
Lift off Film Targets 100nm Aluminium

Material:-100nm aluminium film





These targets have been successfully mounted, features mounted so far extend down to 5um

Lift off procedure and mounting performed by Scitech Precision Ltd

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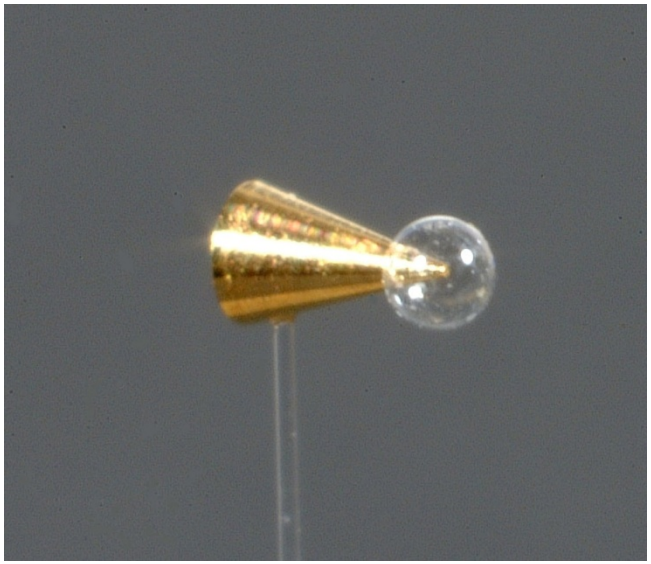
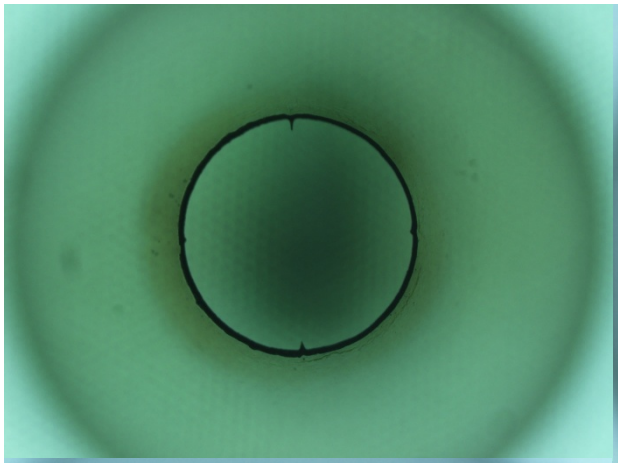
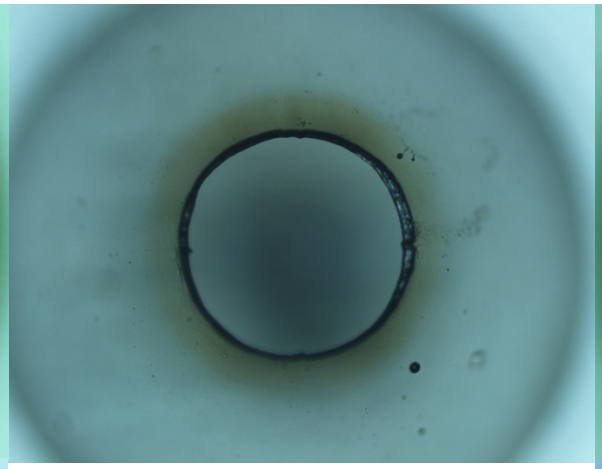
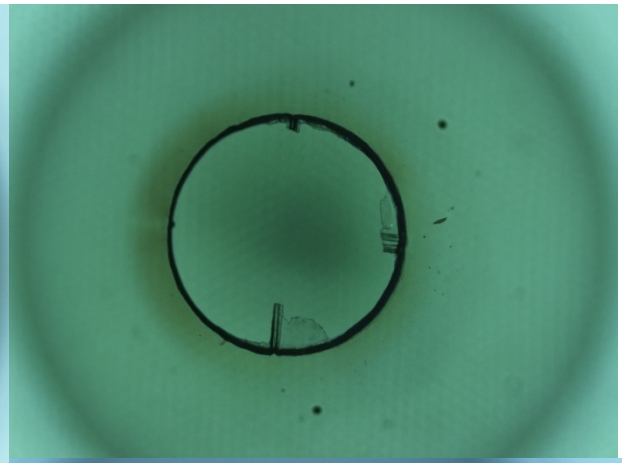
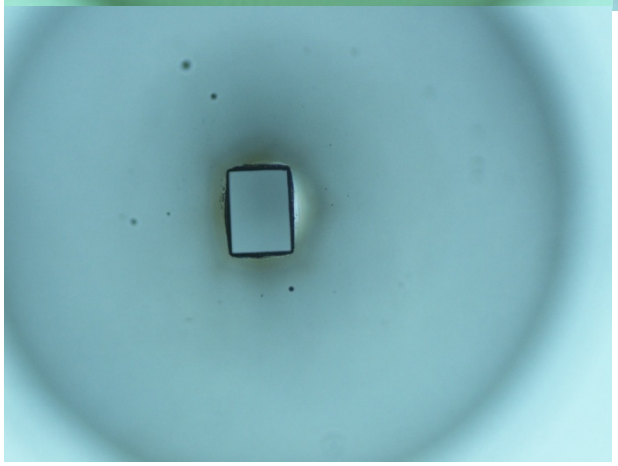
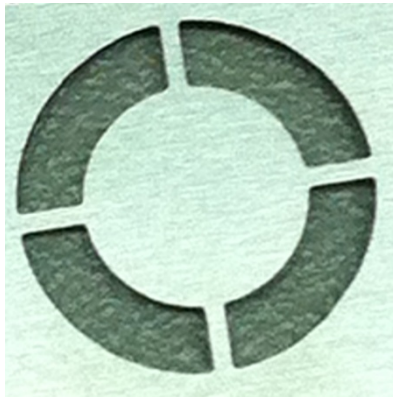
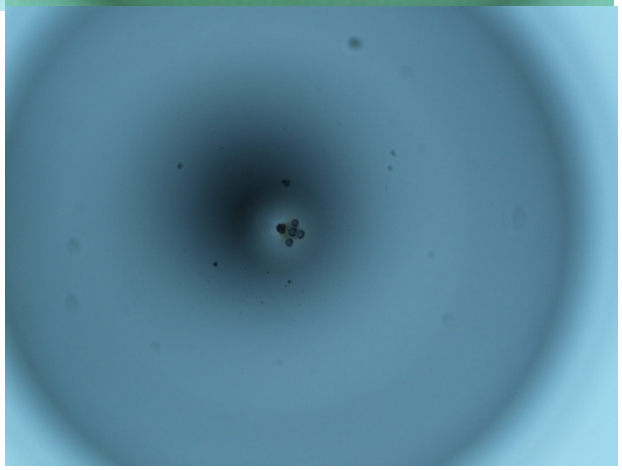


Sphere and Cone assembly Courtesy STFC

Metal mask example



5 x ~10µ holes

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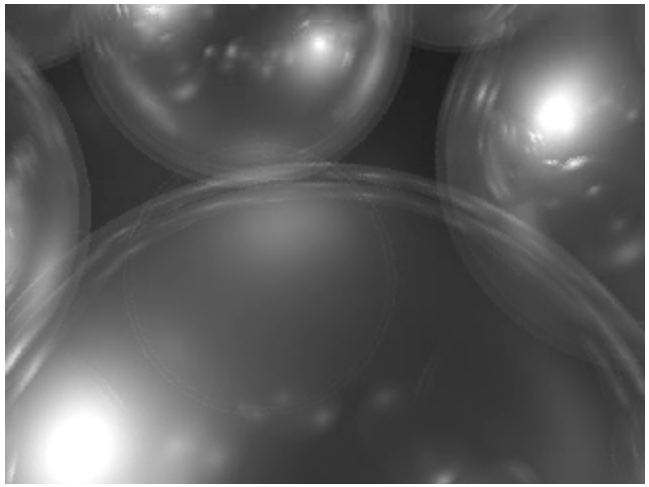

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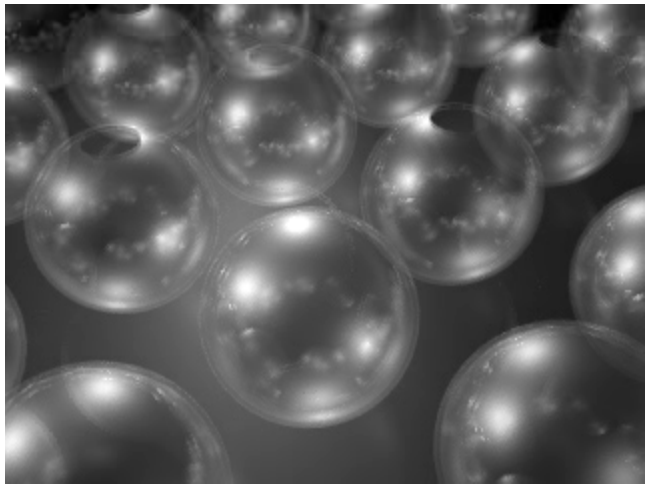

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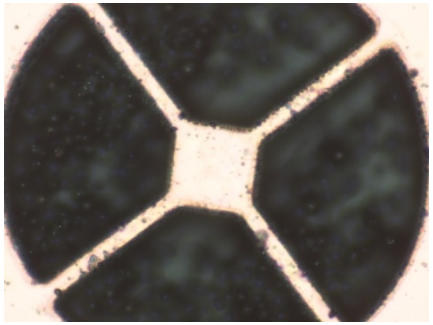
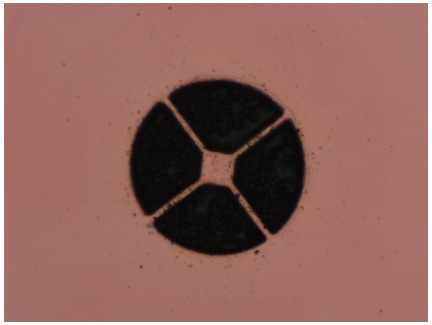
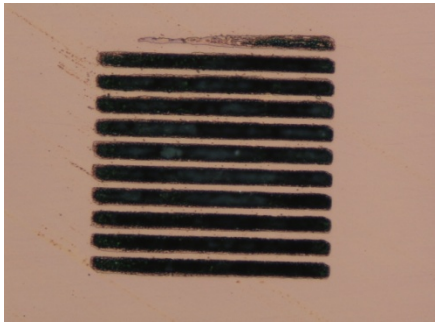
Dielectric Coated Laser Mirrors

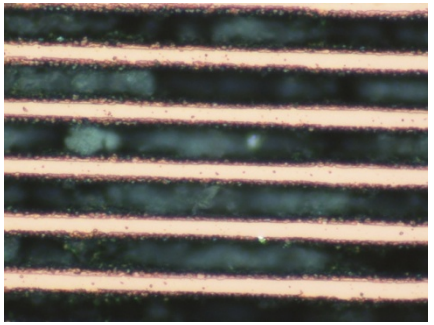
Micro system machining of mirror coatings

- Sub 5µ resolution
- Dielectric coating intact









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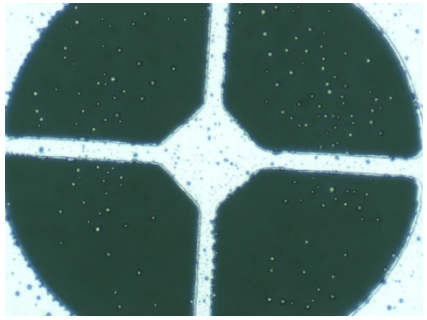
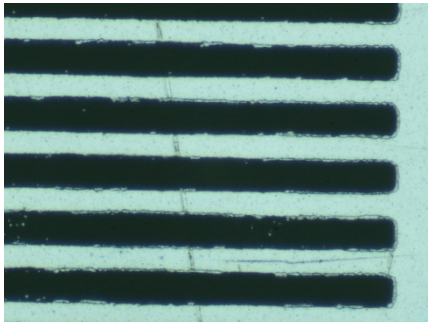
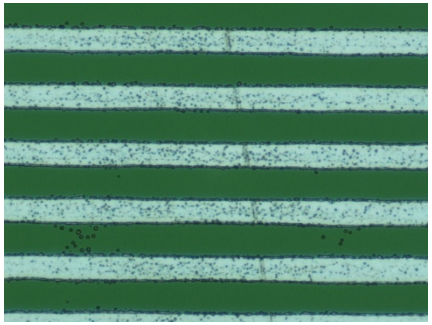
Aluminium Coated Laser Mirrors (MgF2)

Micro system machining of Aluminium coatings

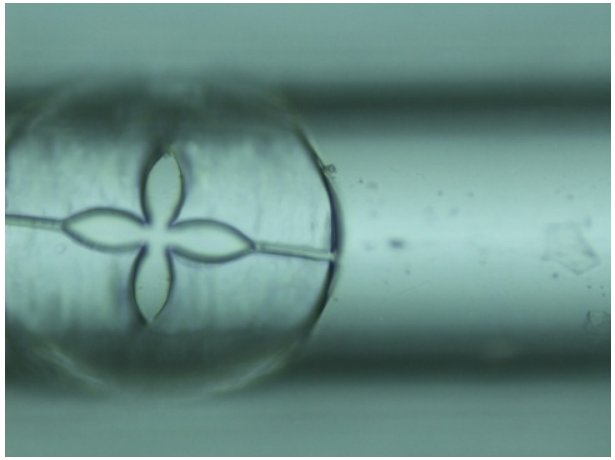
- Sub 5µ resolution
- No damage to base material



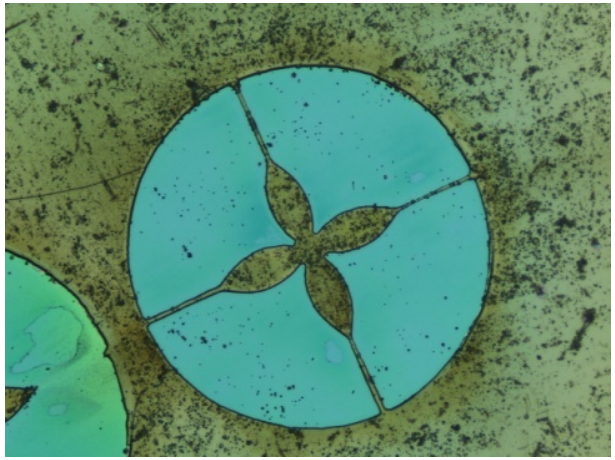




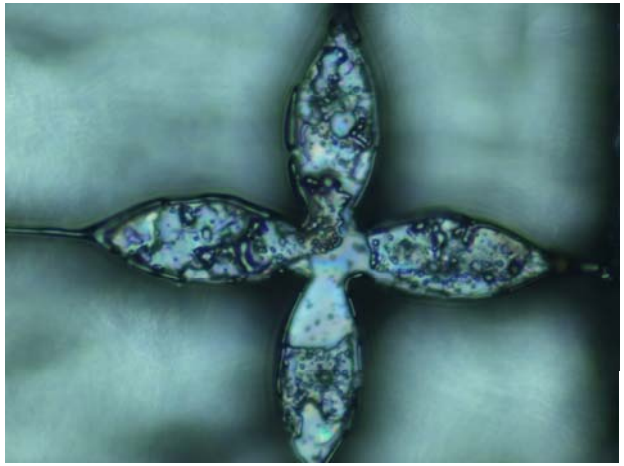
Other Materials



Fibre optics and cladding



Kapton and most polymers



CdWO4

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Slot together targets?

Micronanics Limited offers a variety of services:

- **Contact R&D**
- **Proof of Concept**
- **Micro-machining Services**
- **Production**
- **Laser Based Bespoke Solutions: Products and Machines**
- **Technical Animations**
- **Investigations into specialist material processing**

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