



LASER MICROMACHINING

A New Tool for Precision Engineers

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FOCUS ON MICRO & NANOTECHNOLOGY

- Major push in MNT sectors.
- DTI and RDAs investing heavily in supporting microfabrication.
- UK-LMC established in 2005 as the national Centre of Excellence for laser micromachining.
- Primary aim of UK-LMC is to provide laser micromachining services to UK industry and research:

- Commercial service - Fast Response - No Job Too Small

UK-LMC: wide customer base covering many sectors in UK and Europe.
Experience of working with large companies, SMEs, research centres.



The screenshot shows the homepage of the UK Micro and Nanotechnology Forum. The header includes the DTI logo and the text 'Global Watch ONLINE' and 'UK MICRO AND NANOTECHNOLOGY FORUM'. Below the header is a navigation menu with links for Home, MNT UK, Communities, The KTR Network, News, Patents, Regional, MNT EU, Awareness, Events, Resources, and Opportunities. The main content area features a large banner with the text 'Welcome to the UK MNT Forum' and several small images representing micro and nanotechnology. Below the banner are sections for 'Contact the UK MNT Network', 'The UK welcomes International collaborations', 'Latest News', 'Network News', 'Browse', and 'Featured Events'. The 'Latest News' section includes articles such as 'Cleared' carbon nanotubes become non-toxic, Nanotube circuit could boost chip speeds, and Thanks to the military. The 'Network News' section includes articles such as Nanotechnology II 'It's a Nano World' - Times Supplement and DTI announces £80m funding for collaborative R&D. The 'Featured Events' section includes 'Online Events' and 'Nanomed 2006: Nano Scale Science in Healthcare Applications'. At the bottom of the page, the URL <http://mnt.globalwatchonline.com> is displayed.



MNT is an umbrella covering many technologies – Precision is the key.

TYPICAL 'MNT' CUSTOMERS

REQUIREMENTS

- **Materials:** glass, polymers, silicon, thin metals, thin films, composites.
- **Features:** holes, slots, channels, complex shapes in 2D/3D parts.
- **Quality:** high precision, tight tolerances, precise control.
- **Dimensions:** ~1um to ~500um.

EXPECTATIONS

Produce desired features in selected materials to design specification and deliver high quality finished article.

Fast turnaround, competitive prices, 1off to larger numbers.

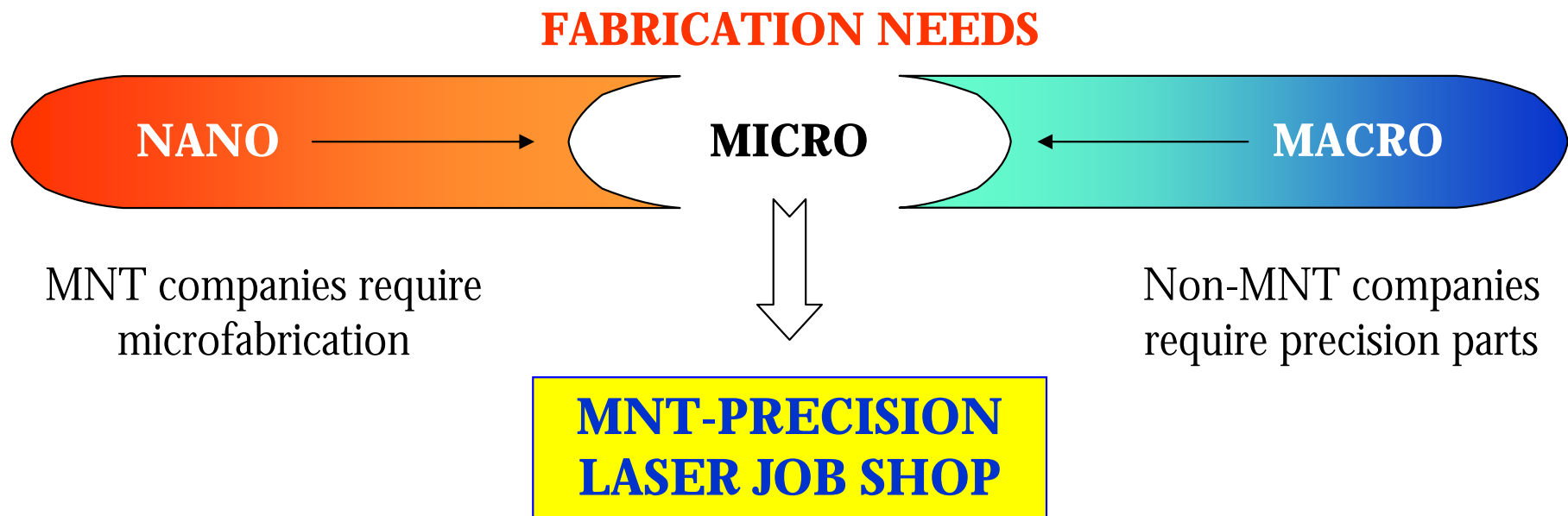
Novel designs and product ideas – make something for the first time.

Basic demands are similar to 'traditional' users of laser machining – except for smaller features, tighter tolerances and wider range of materials.



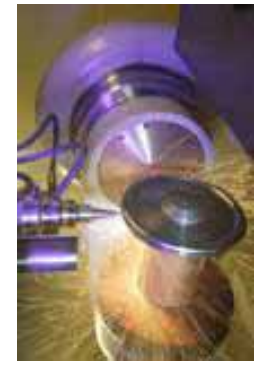
FABRICATION TRENDS

- 'Nano' tag on many products, fabrication of most parts on micro scale.
- 'Traditional' precision products are extending into the micro domain.





LASER JOB SHOPS



TRADITIONAL

- Well-established.
- >100 in UK.
- Highly competitive market.
- Integral part of supply chains.
- Pressures on pricing.
- Fast turnaround for 'standard' jobs.
- Mainly metal cutting & welding.

MNT-PRECISION

- Relatively new.
- ~6 in UK.
- Niche expertise areas.
- Diverse customers.
- Work gained by level of expertise.
- Delivery governed by complexity and novelty.
- Any material.

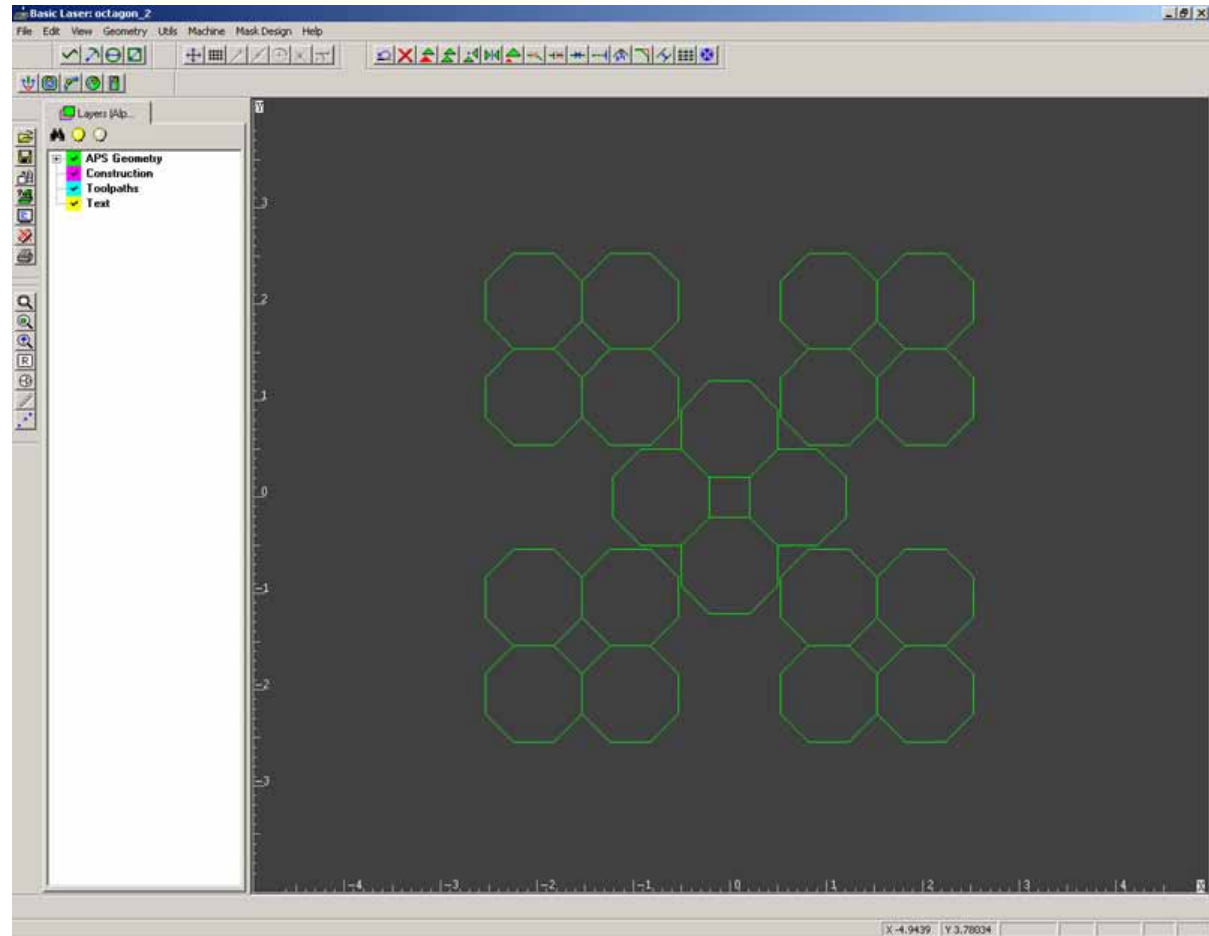
Operating model for traditional job shops can be applied to MNT-Precision sectors as demand grows.



ROUTE TO MANUFACTURE - 1

DESIGN

- Material choice.
- Tolerances.
- Quality issues.
- Manufacturability.



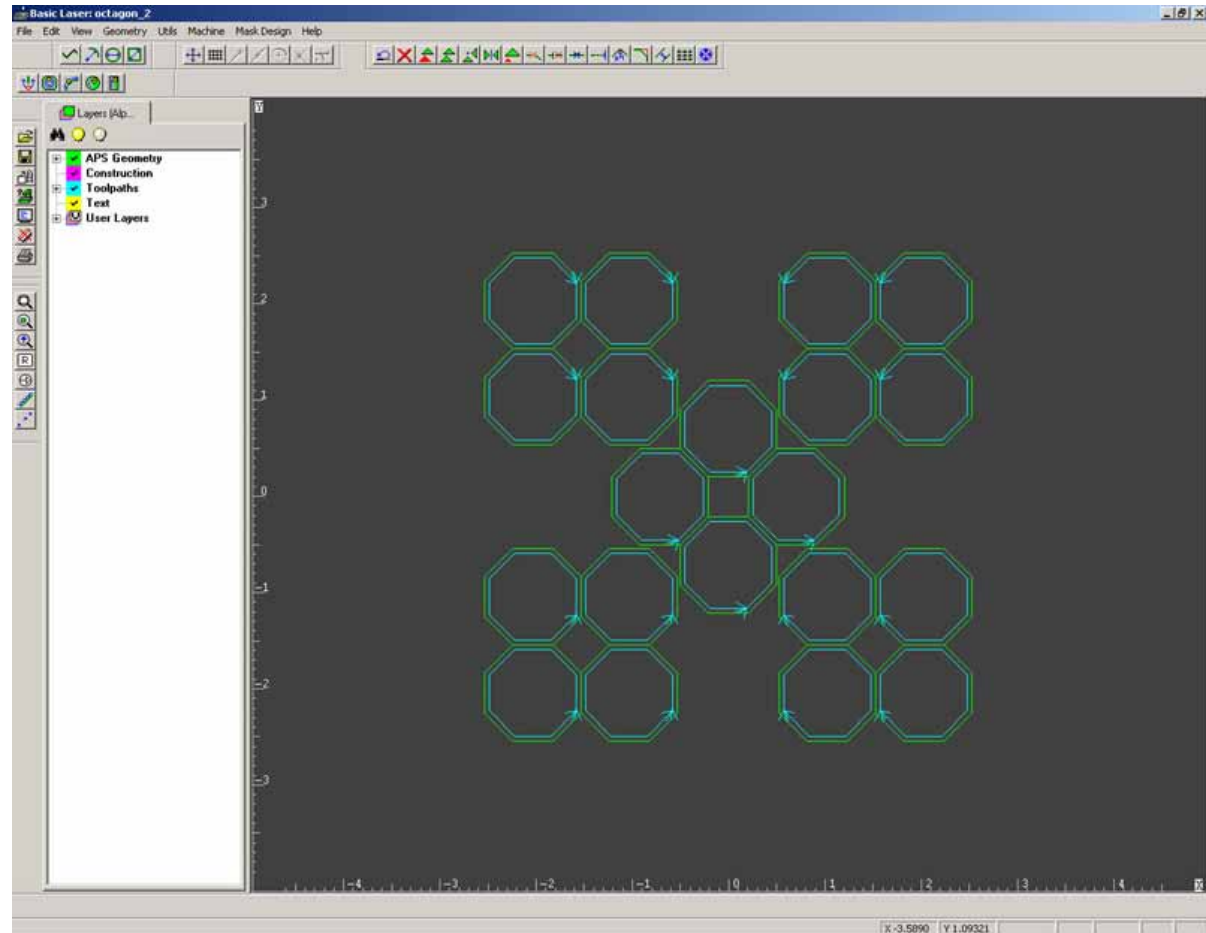
Design of part to be made



ROUTE TO MANUFACTURE - 2

CONVERSION

- Transfer design into suitable format.
- Account for laser machining process.
- Decide on type of laser and method of machining.



Laser cut paths defined



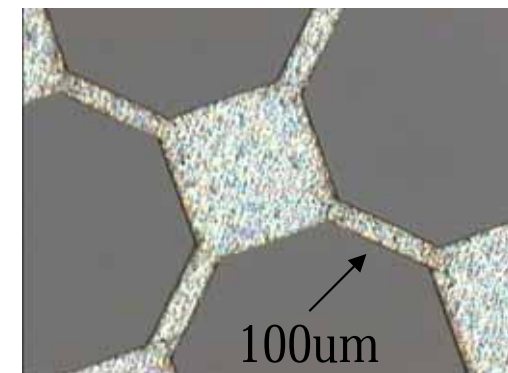
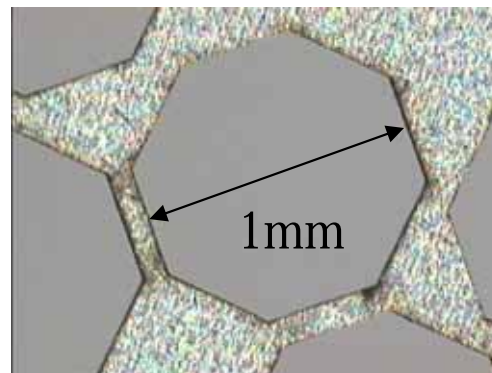
ROUTE TO MANUFACTURE - 3

MACHINING

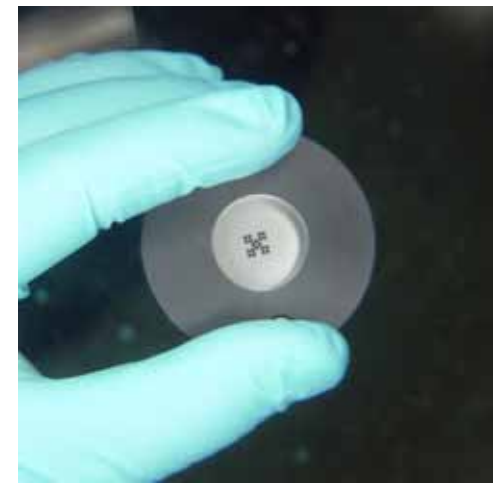
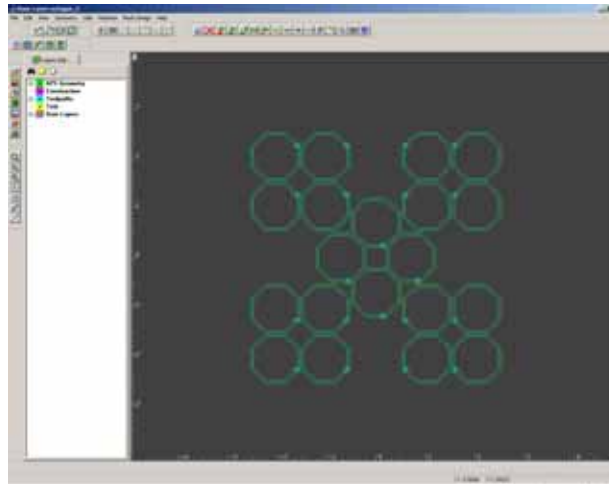
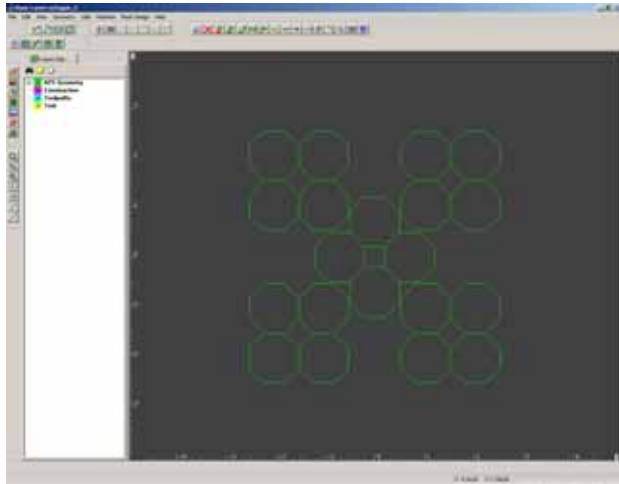
- Set-up laser tool.
- Optimise process for job requirements.
- Produce parts.



Finished part in 25um stainless steel



PRECISION JOB SHOP SERVICE



Complete service from design advice, process optimisation, production.

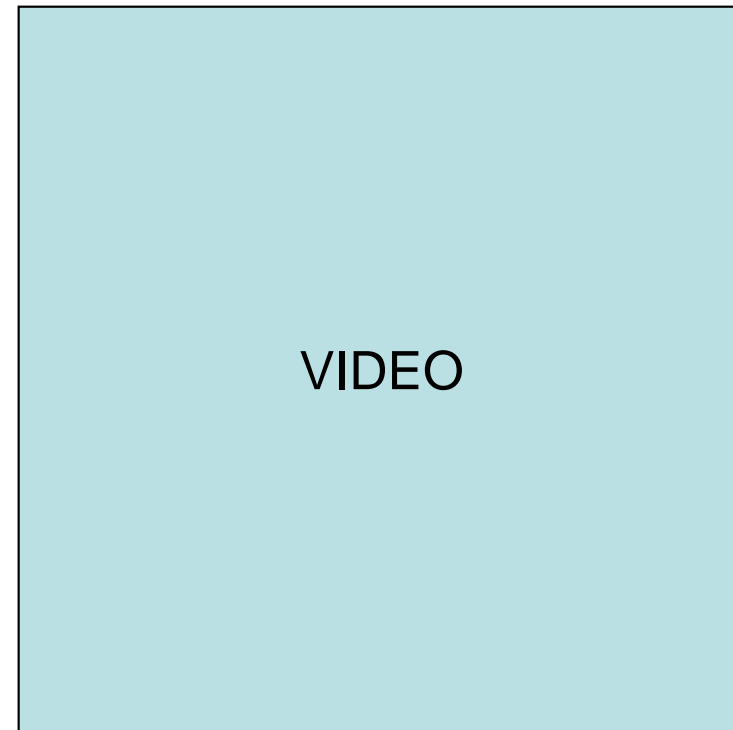
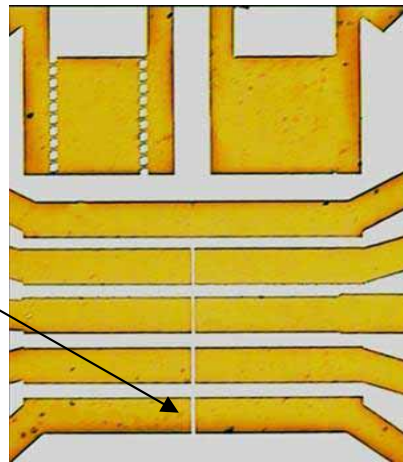
- Quote for work (price, deliverables, completion time).
- Deliver parts on time according to quote, including report on work with pictures of results.
- Service includes free advice on design and manufacturing options.



MICROELECTRODES SENSORS

Demetallisation of 30nm gold on glass.
Electrode pattern is ~4mm x 3mm

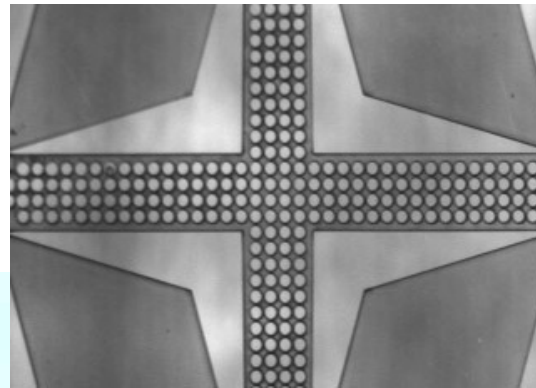
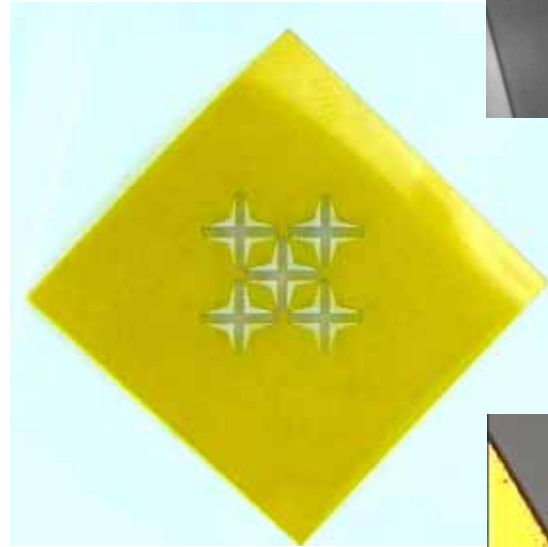
- High resolution patterning of complex features.
- Rapid, scalable technique for the production of multiple samples.



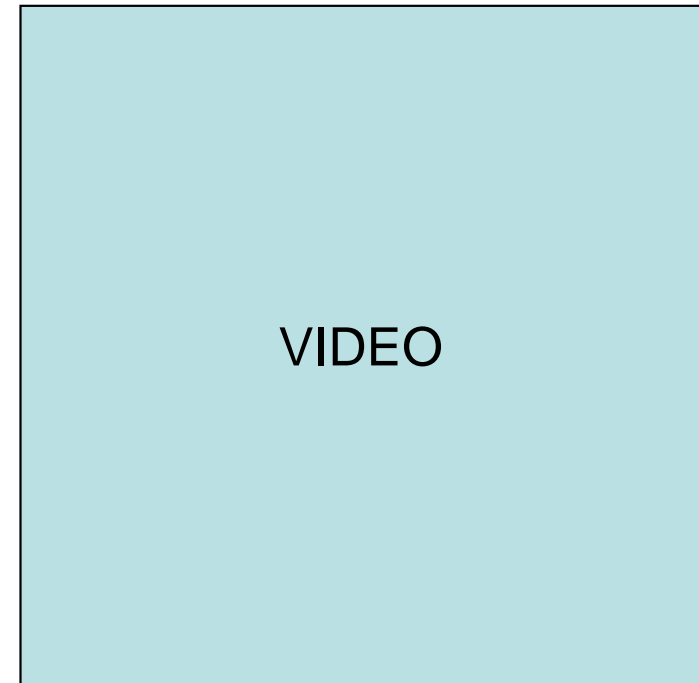
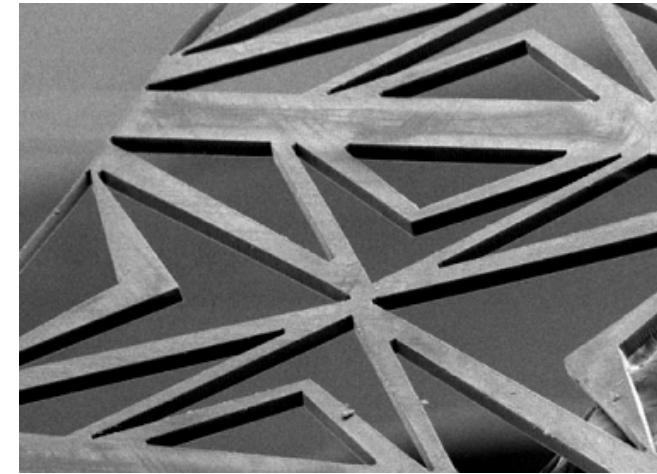
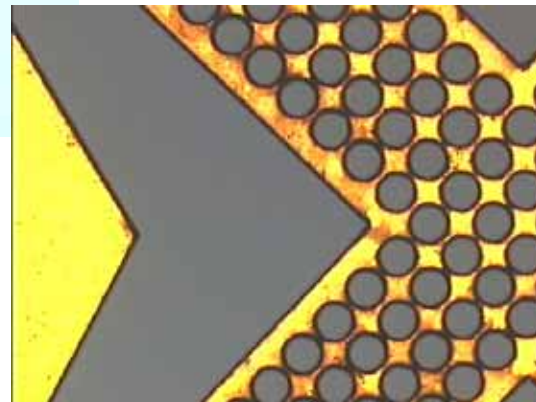
Sectors: Microelectronics, Sensors, Biotech



MICROMACHINING OF POLYMERS



150um holes

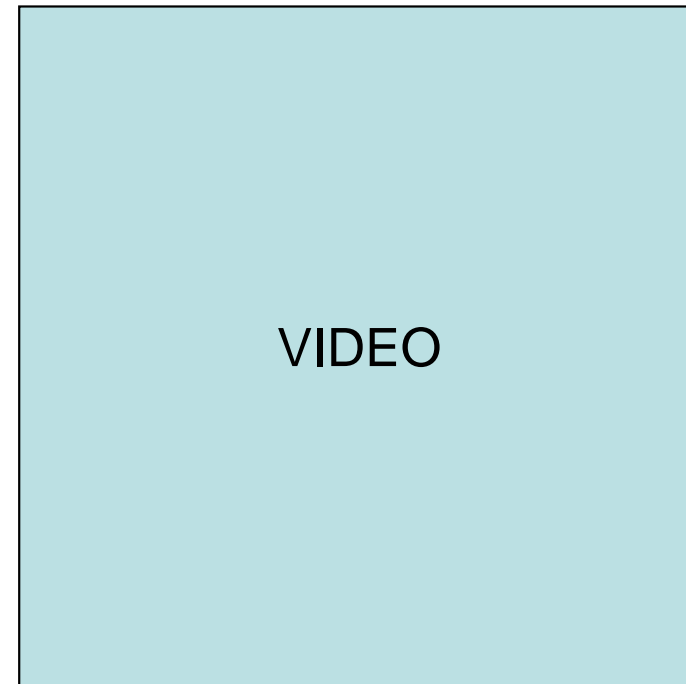
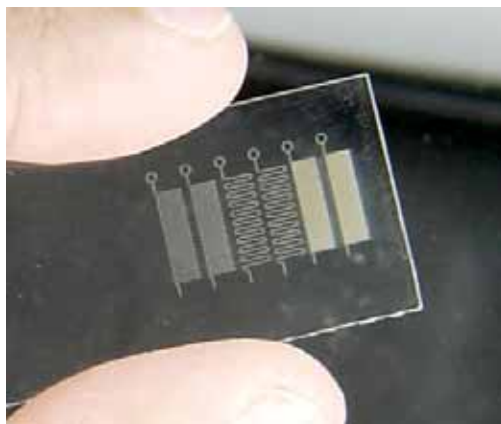


Sectors: Biomedical, Electronics

MICROFLUIDIC DEVICES

50 μ m wide x 45 μ m deep
microchannels in polycarbonate

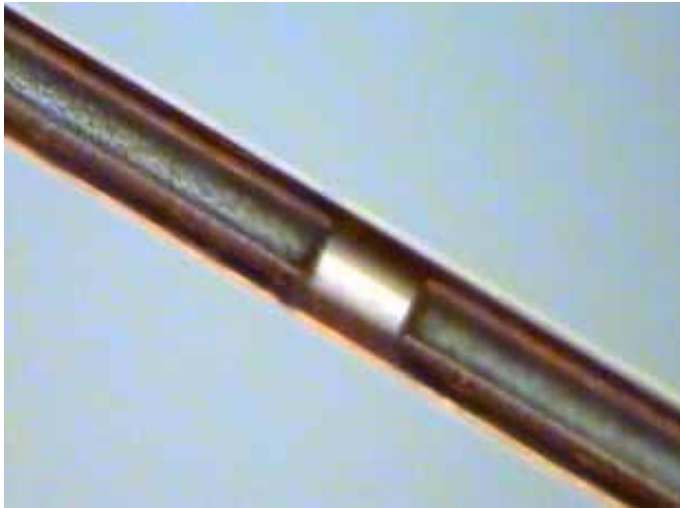
- Ideal for rapid evaluation of different designs.
- Highly flexible technique.
- No requirement for new masks for each stage.



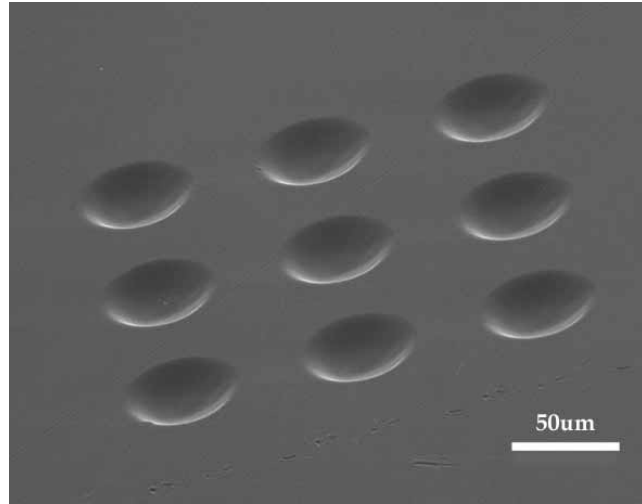
Sectors: Medical, Biotech, Nanoparticles



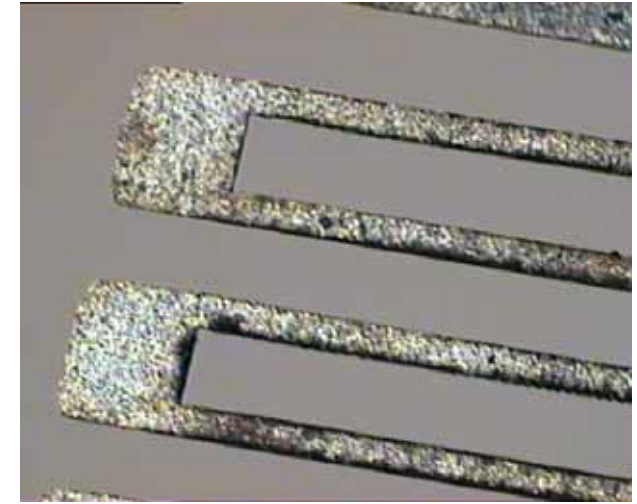
MACHINING EXPERTISE



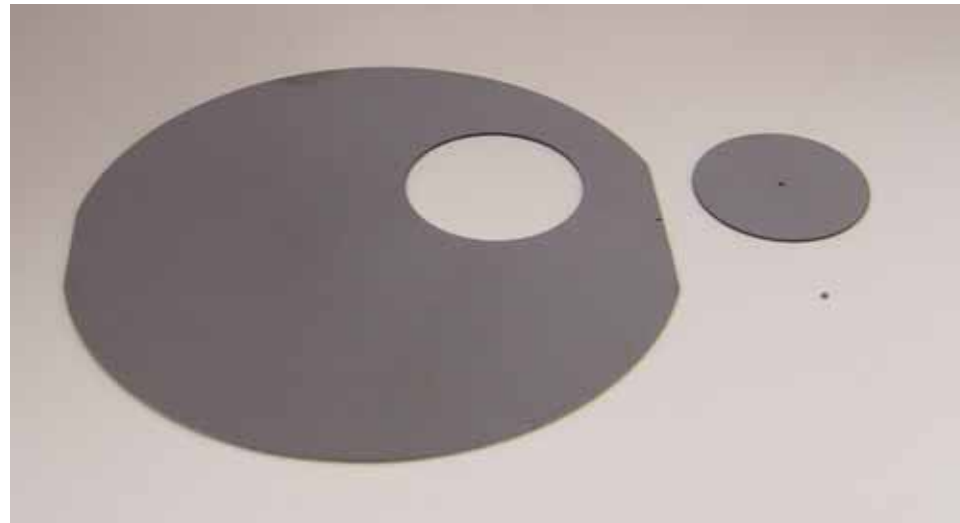
Slots in $\varnothing 125\mu\text{m}$ fibre



$\varnothing 50\mu\text{m}$ microlenses in polymer



50um wide bars in nickel



Cutting of 6" silicon wafer

Precision tasks,
Standard service



SUMMARY

- Precision engineers can now expect the same laser micromachining service as that provided by 'traditional' laser job shops.
- Fabrication demands and needs of MNT and Precision users are very similar.
- Traditional laser job shop model can be applied to the MNT-Precision sectors.
- Ease of access and high-quality service provision are extending the uses of lasers into new areas.

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