High-Precision Processing of Glass for Various Applications

Ernestas Nacius

WOP | Workshop of Photonics., Lithuania

W O P

Laser processing solution provider

Exceptional expertise in glass processing

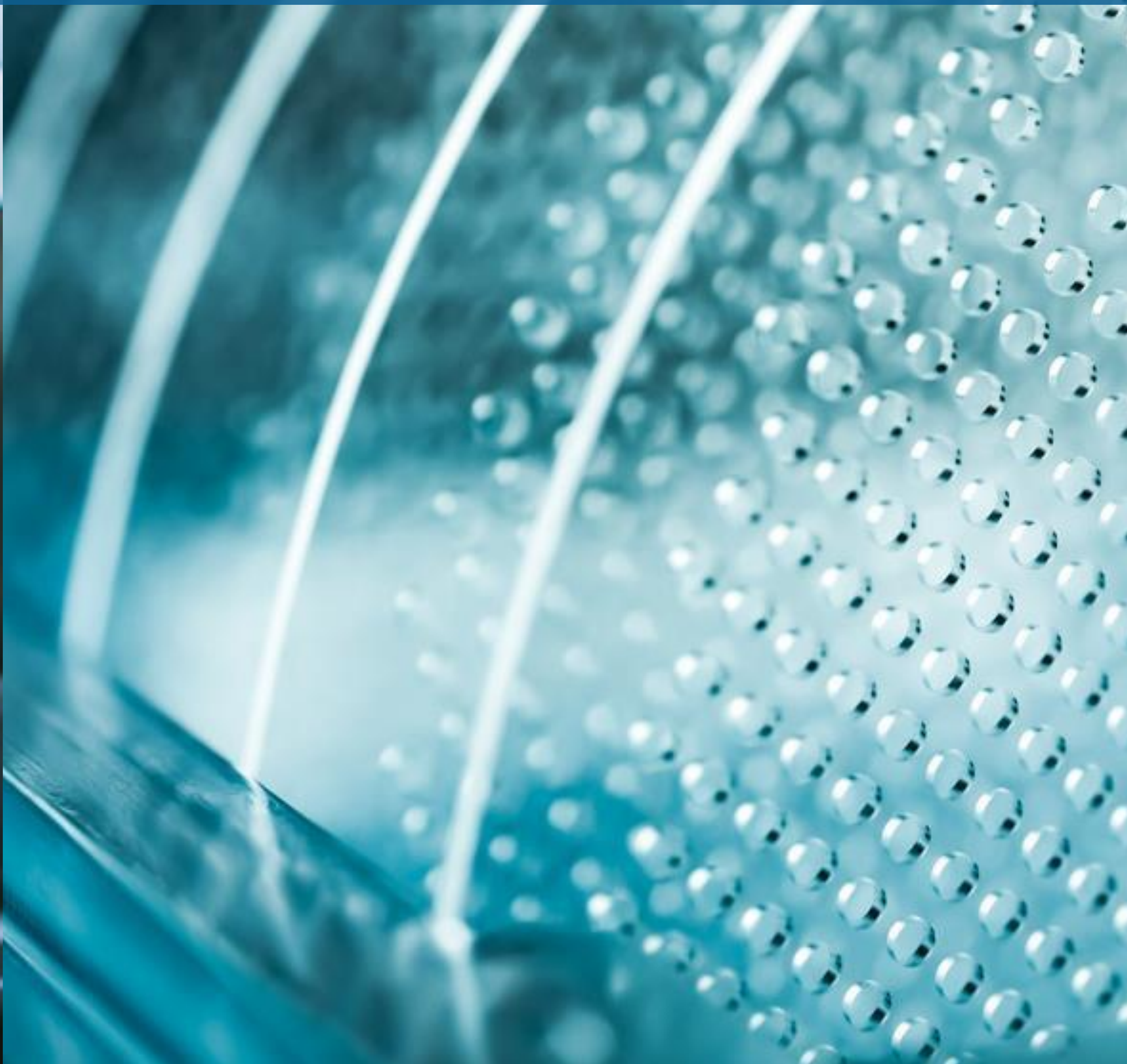
3 M holes in 45 minutes

W O P

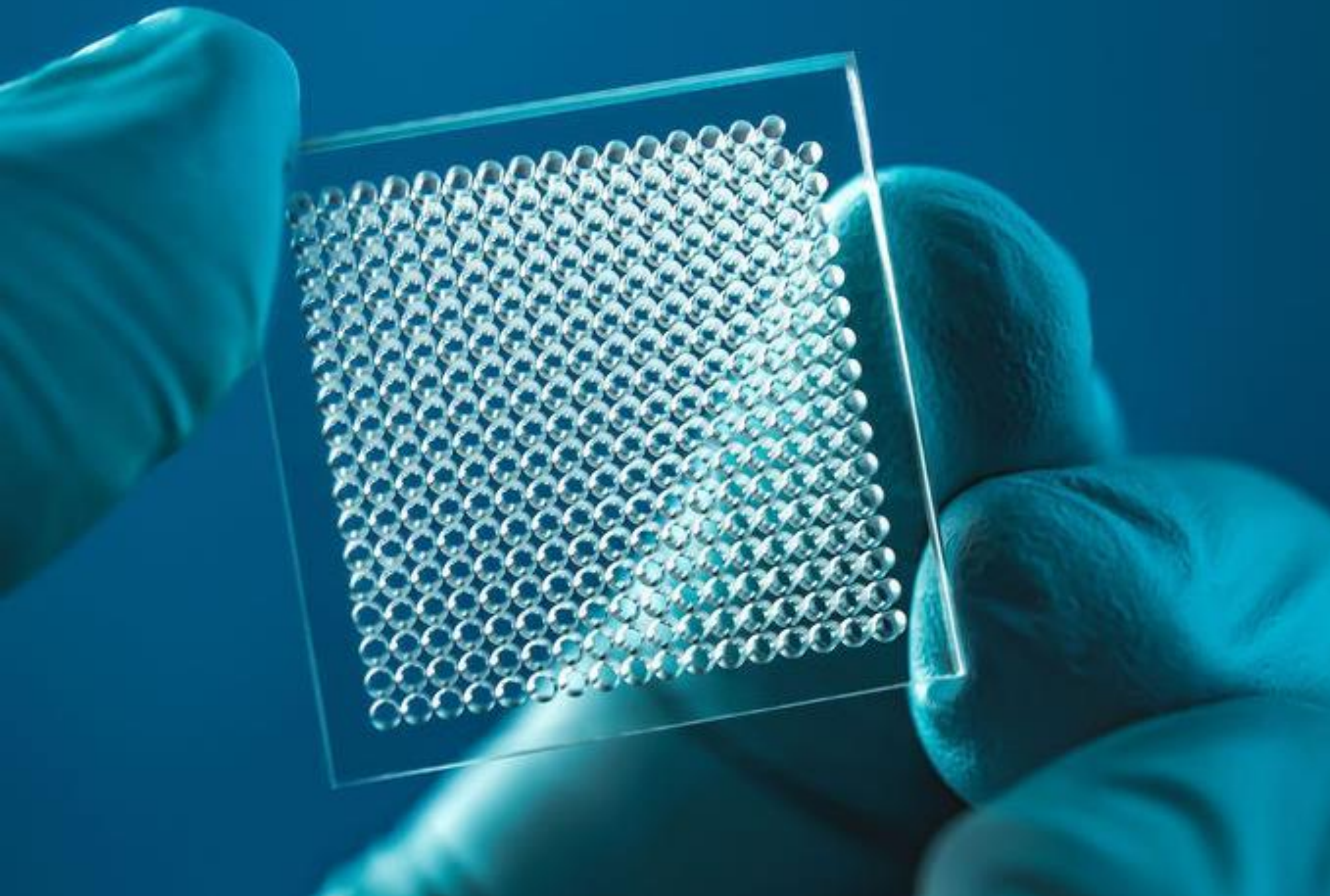
Solution development | R&D

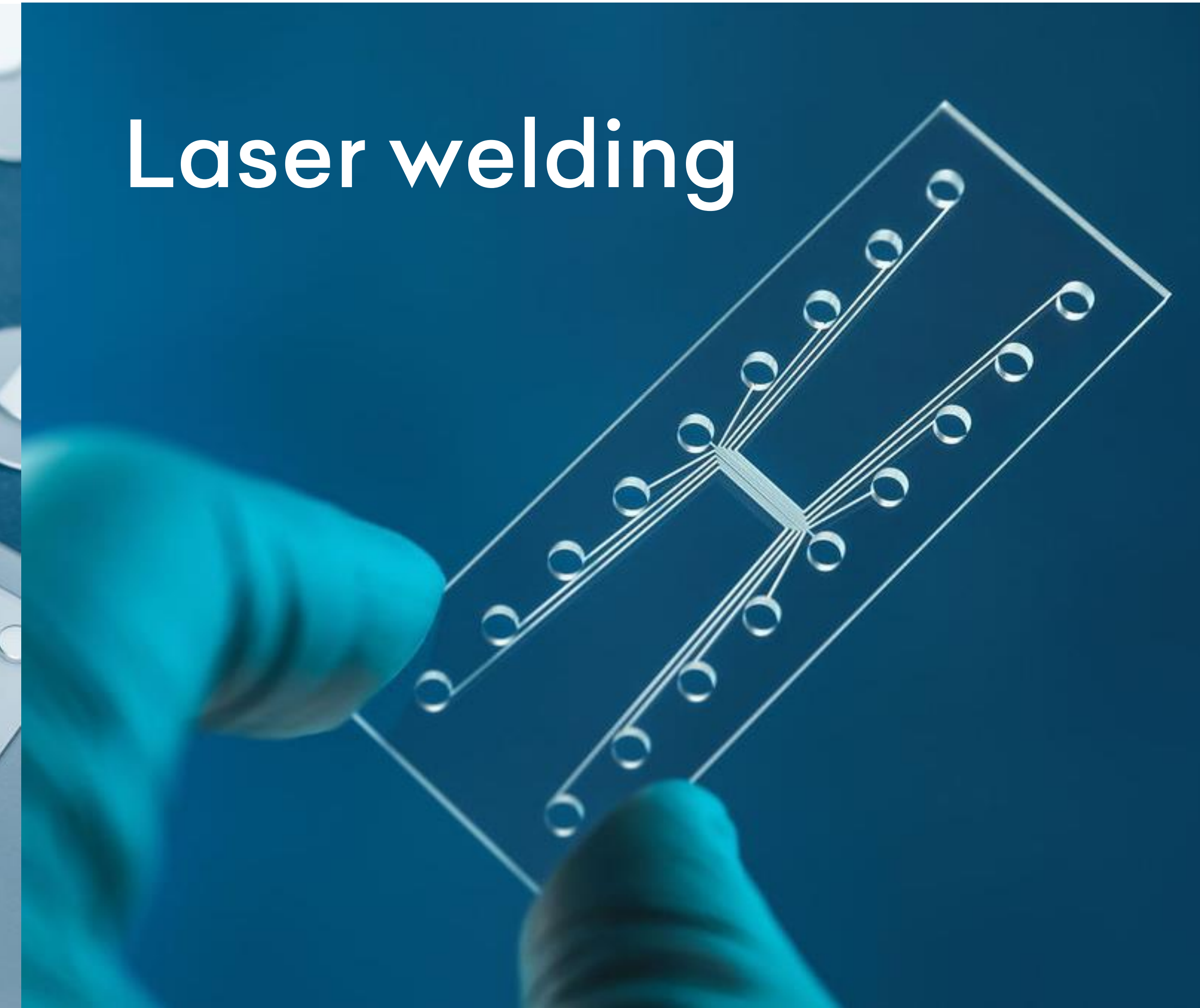
Contract manufacturing

Hardware | laser systems



WOP glass technologies





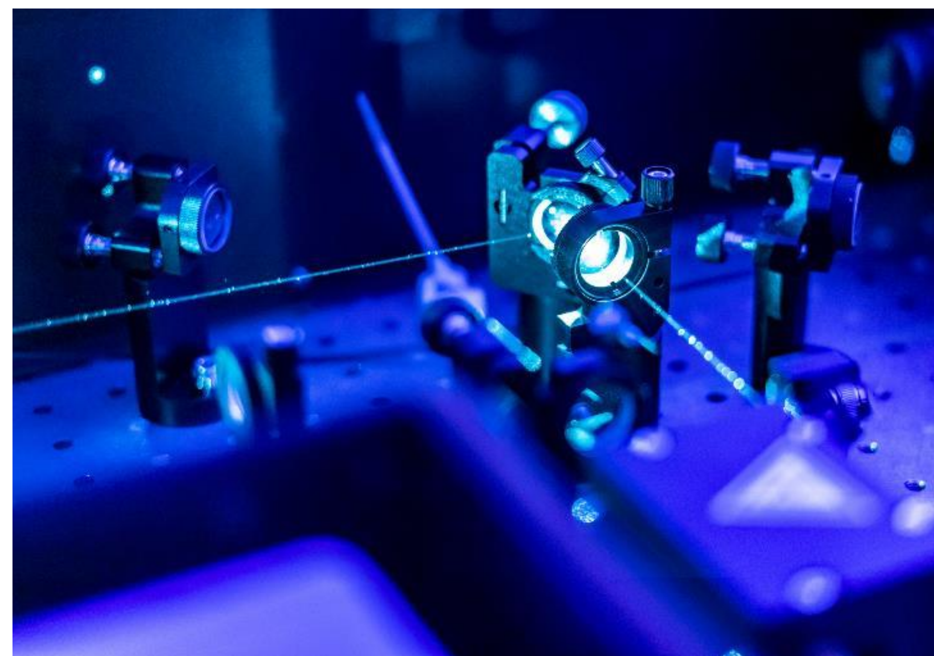
All glass types | All glass producers

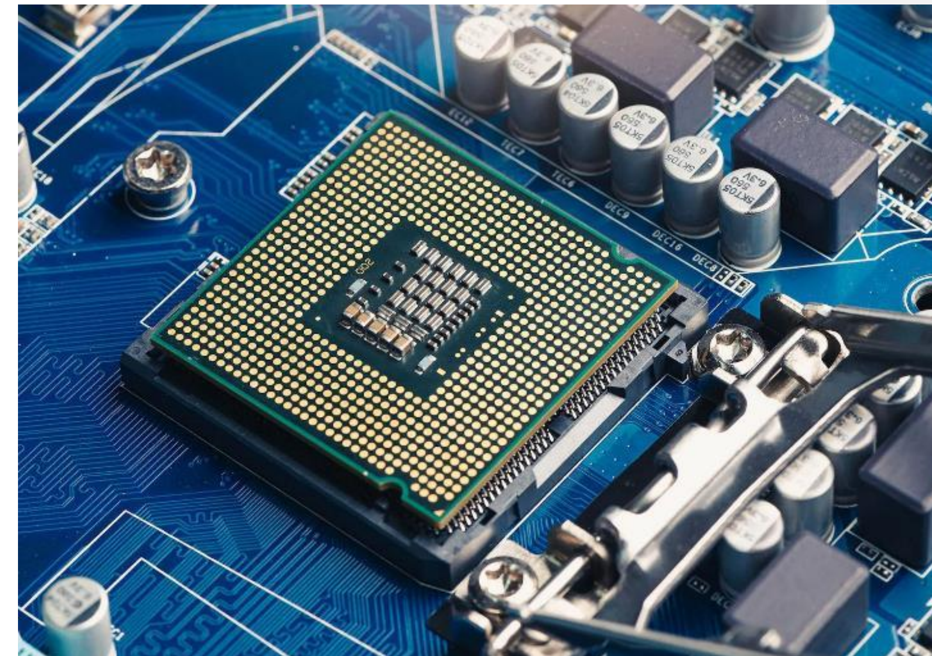
When choose our glass technologies?

W O P

In need for smallest feature size possible

In need for precision & quality





- Biotechnology & Medical
- Semiconductors
- Laser manufacturers
- Automotive
- Aerospace & Defense
- Universities and R&D
- Any others who need micro solution

Perfect glass cuts

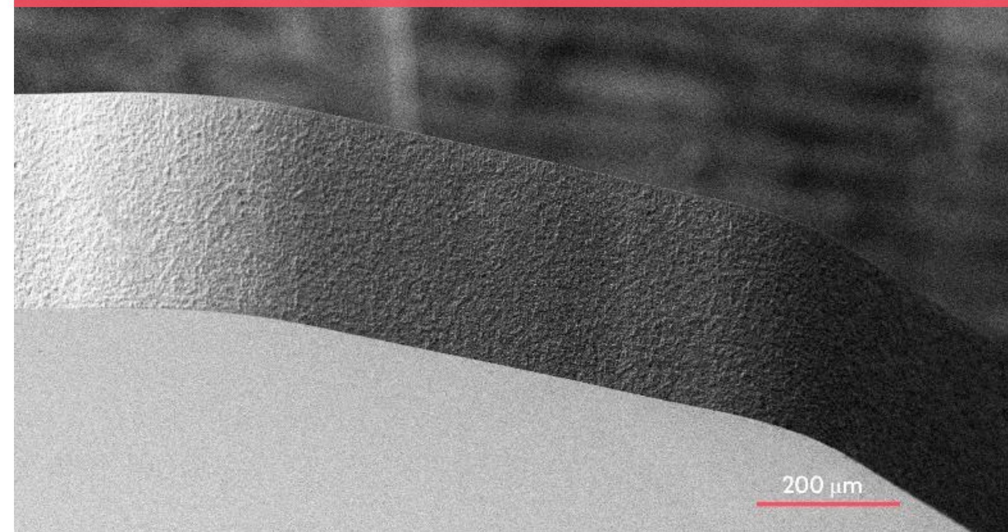
D236T glass, thickness 300 µm

Glass & sapphire cutting

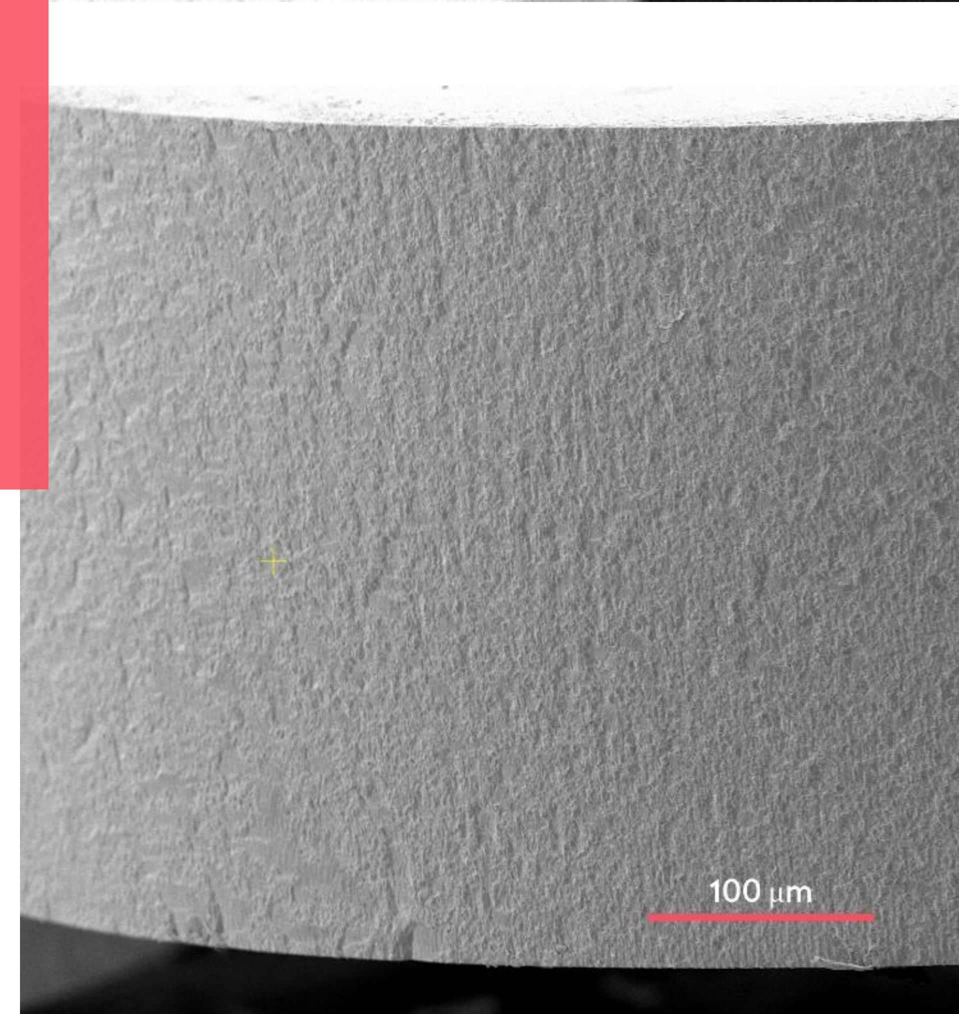
W O P

Quality of cut

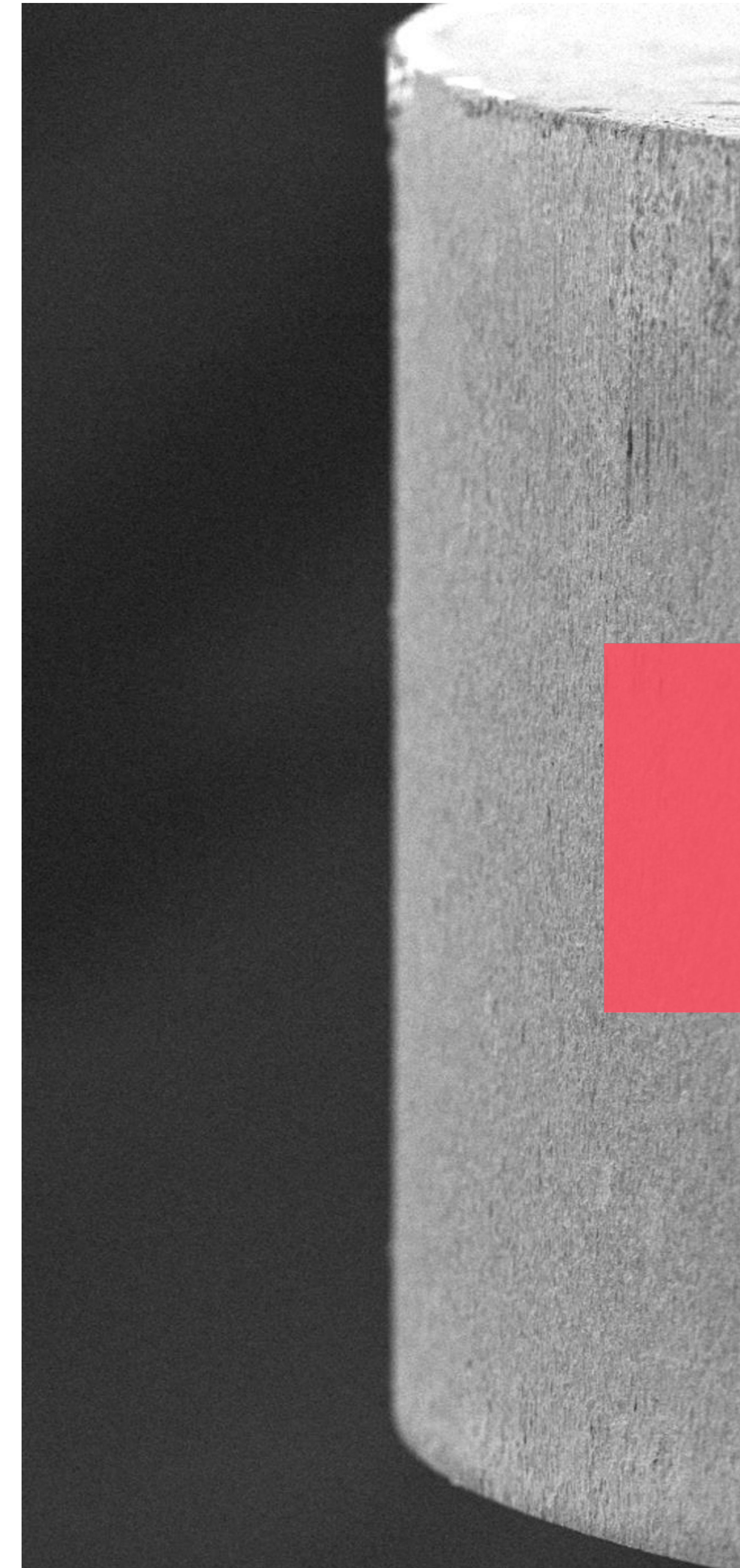
- Cut width less than 1 µm
- Low chipping <20 µm
- No post-processing required



D236T glass, thickness 300 µm

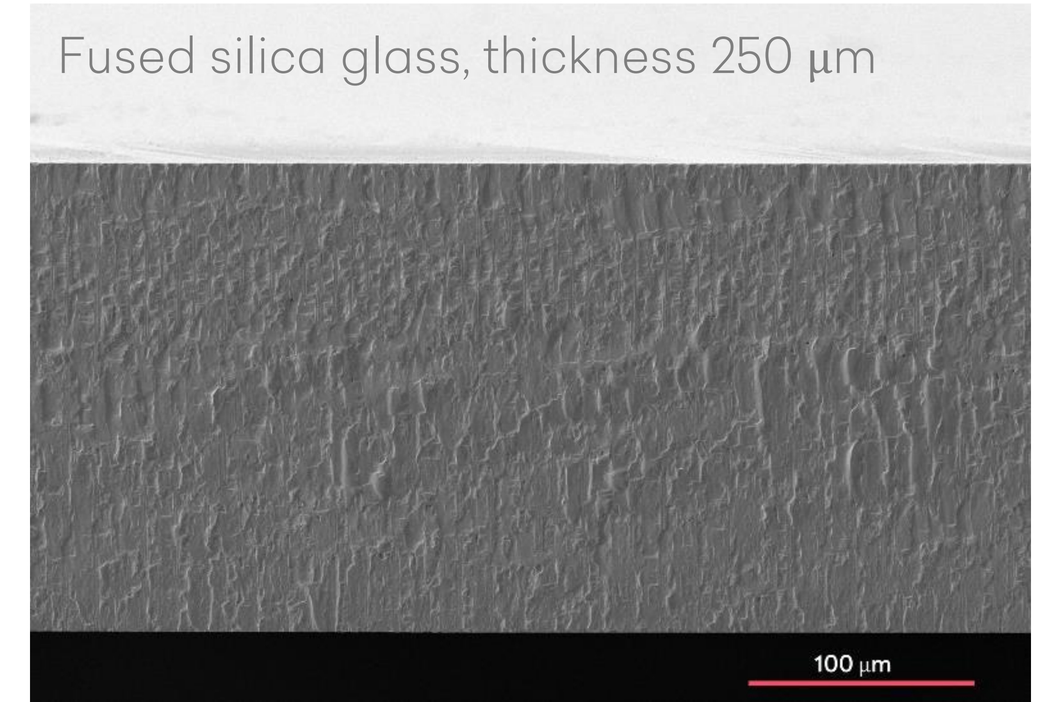


Sapphire, thickness 400 µm



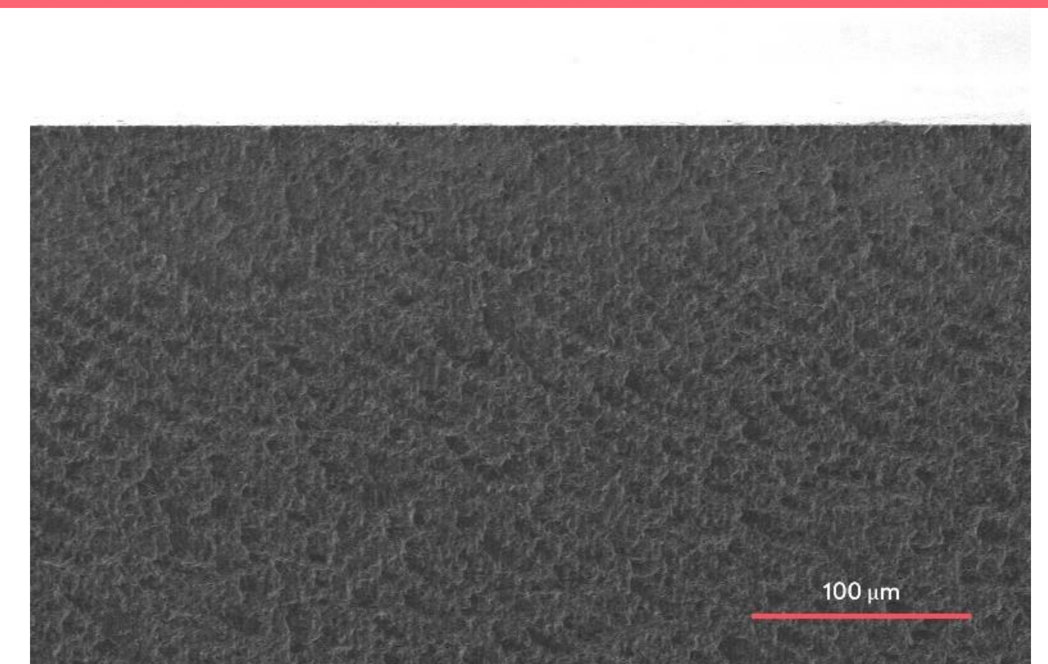
Sapphire, thickness 700 µm

Fused silica glass, thickness 250 µm



Type of glass

- Tempered
- Non tempered
- Sapphire

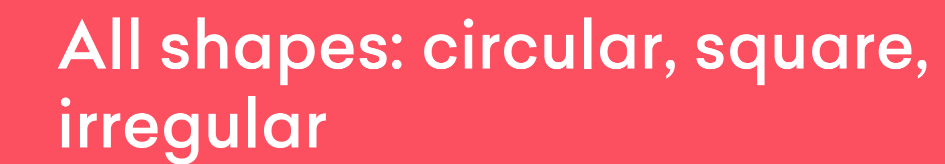


wophotonics.com

Sapphire, thickness 700 µm

Glass cutting

Features



WOP

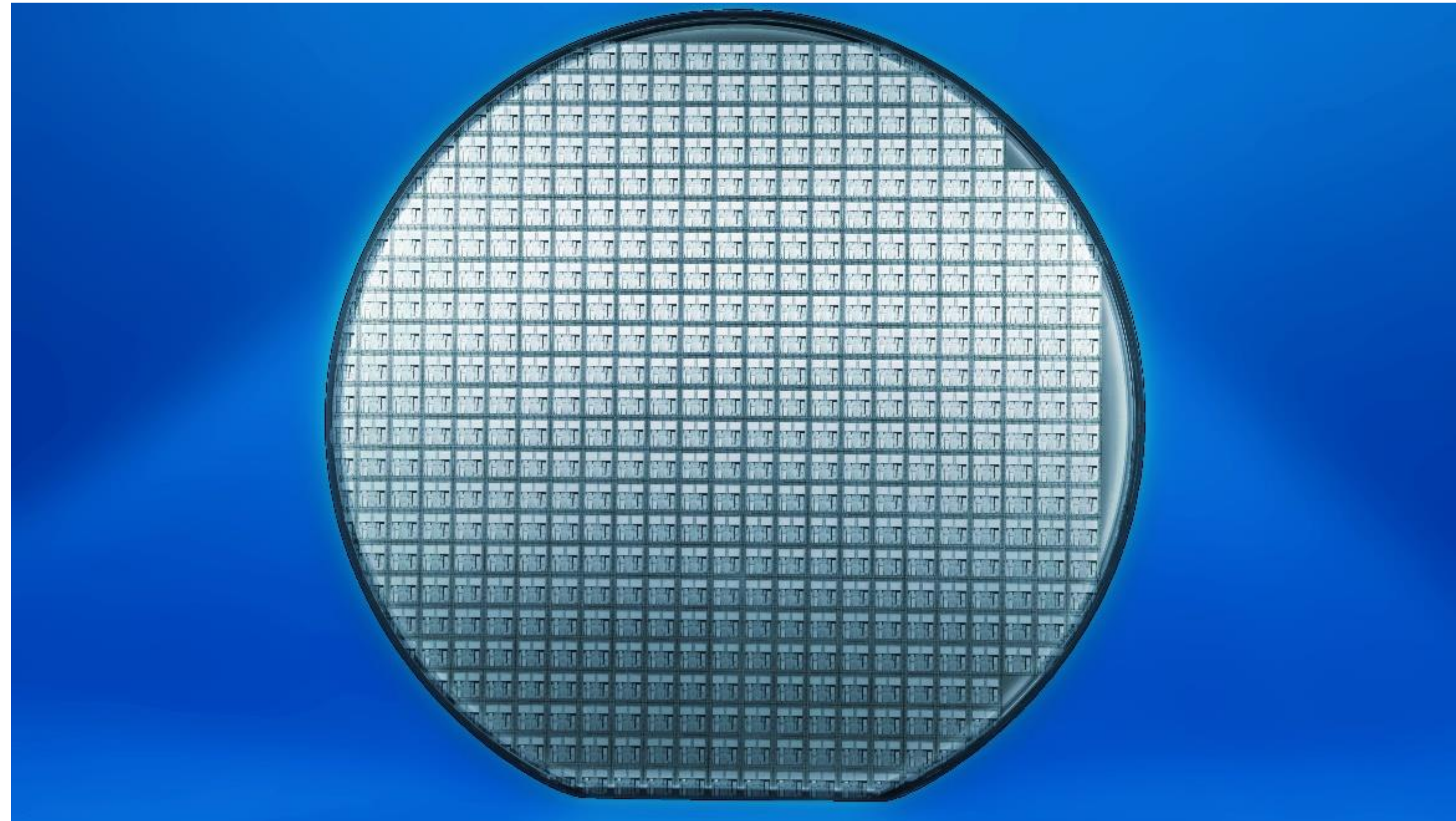
FemtoGLASS outperforms

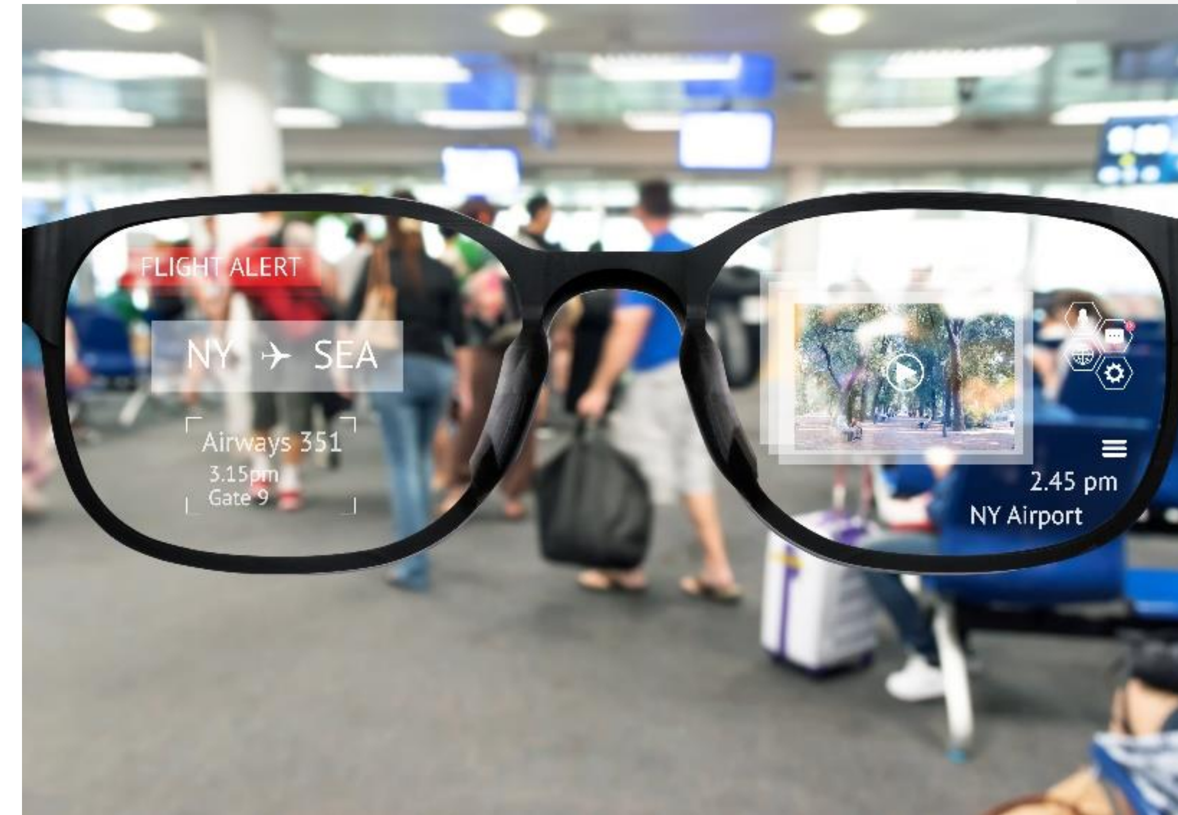
other glass dicing methods

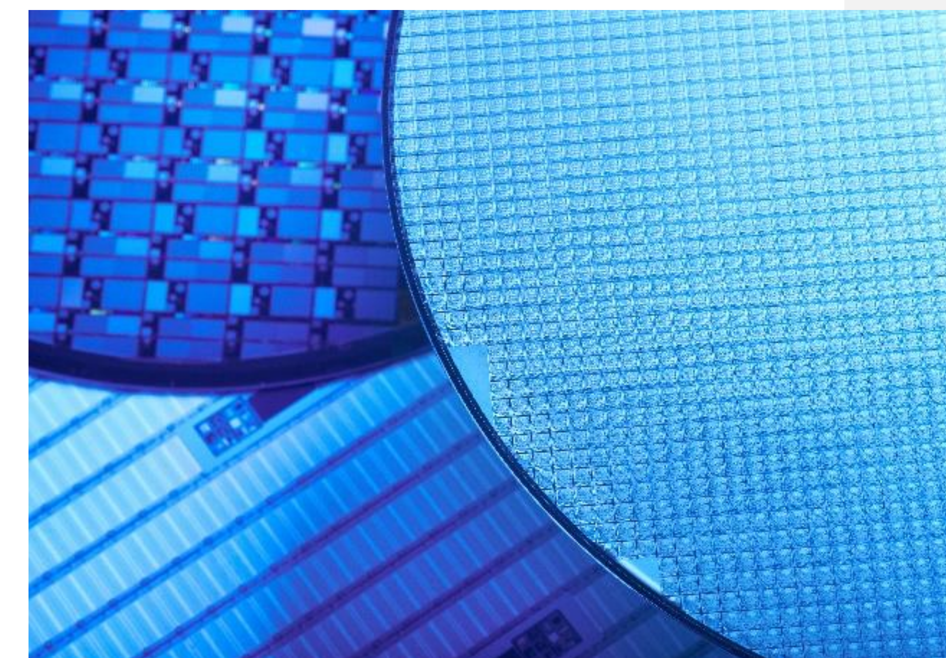
	Blade	Stealth laser	Laser ablation	WOP FemtoGLASS
Glass thickness	2 – 19 mm	200 µm – 10 mm	30 µm – 2 mm	**30 µm – 2 mm in a single pass**
Glass type	All types	Non-tempered Sapphire	All types	**Tempered Non-tempered Sapphire**
Cutting speed	up to 100 mm/s	Up to 300 mm/s	Up to 10 mm/s	**Up to 800 mm/s**
Possible shapes	Straight cuts only	T-shapes and circular shapes are possible	Any shape	**Any shape possible**
Surface chipping	< 200 µm	< 50 µm	< 50 µm	**< 10 µm**
Street requirement	> 50 µm	< 15 µm	> 50 µm	**< 1 µm**
Water (cooling/cleaning)	yes	no	yes	**no**
Debris	yes	no	yes	**no**
Thermal effect on the device	yes	no	yes	**no**

Where to apply?

W O P







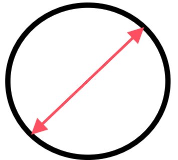
- Wafer level glass product dicing
- Augmented reality, smart glasses screens
- Mobile phone screens, camera lenses
- Micro optics elements
- Thin glass
- Electronic components
- Display technologies

W O P

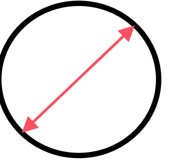
All kind of holes in glass

25 µm

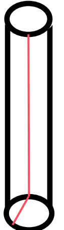
Glass drilling



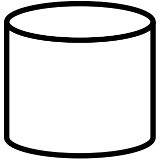
Hole diameter
from 20 μm



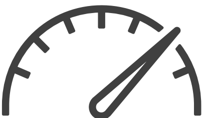
Hole size tolerance
± 1 μm



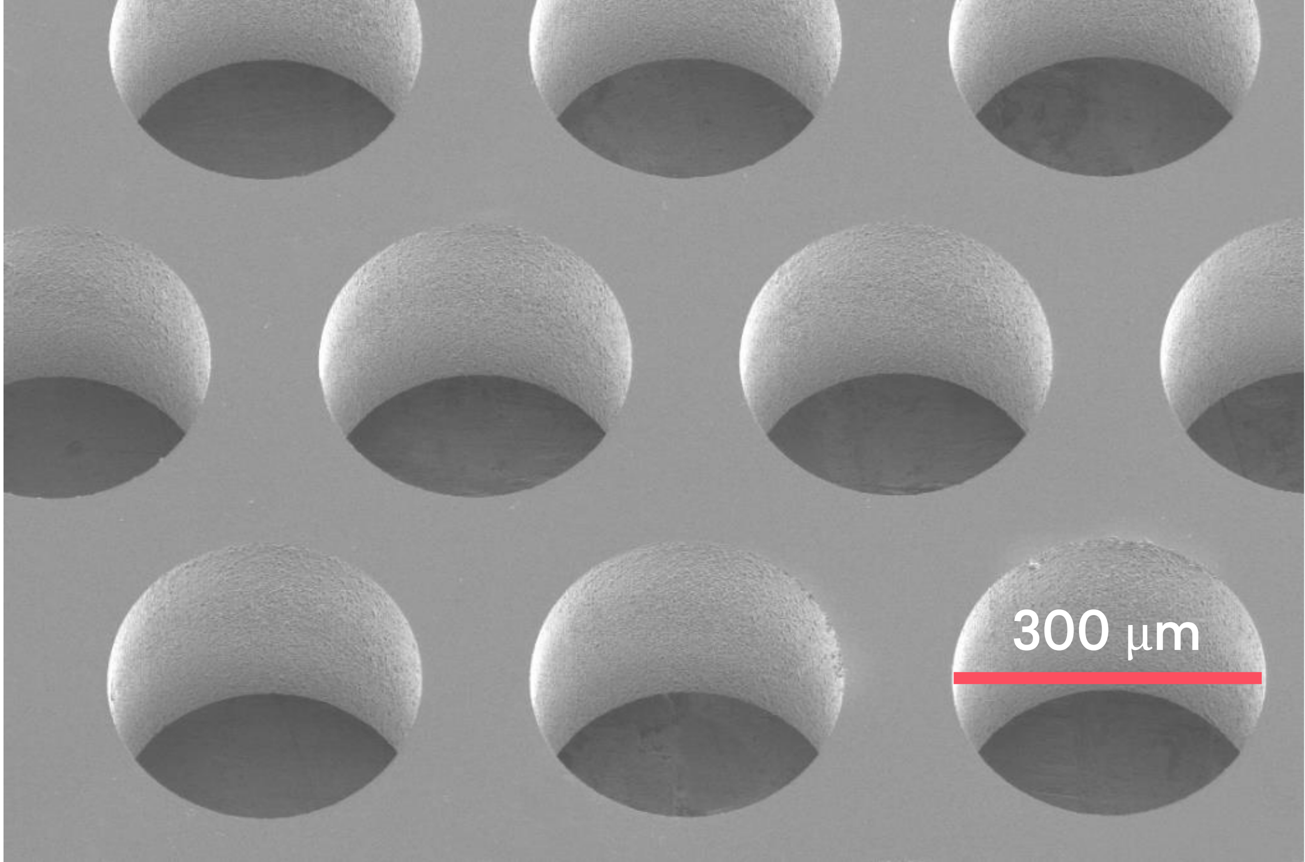
Aspect ratio
To 1:100



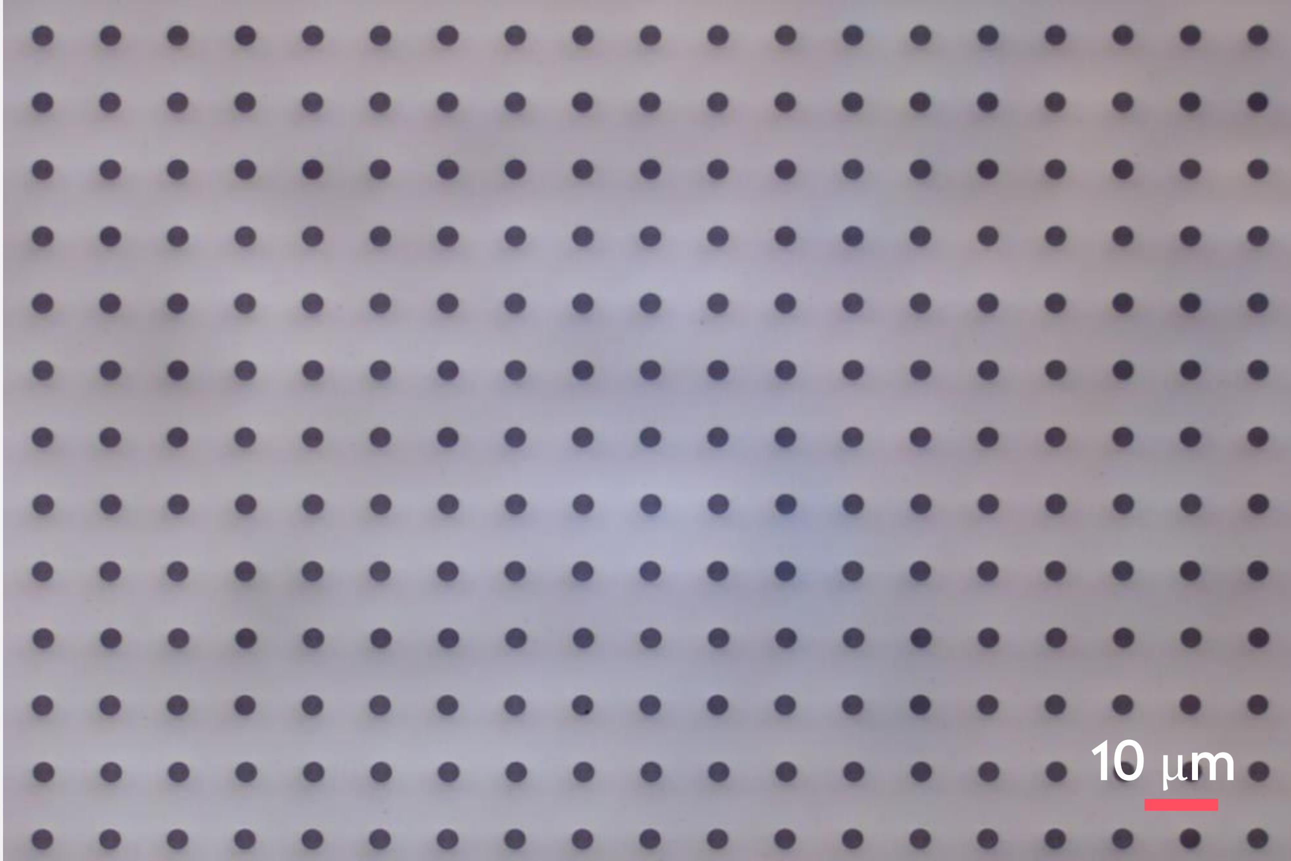
Smooth sidewalls
Ra < 1 μm



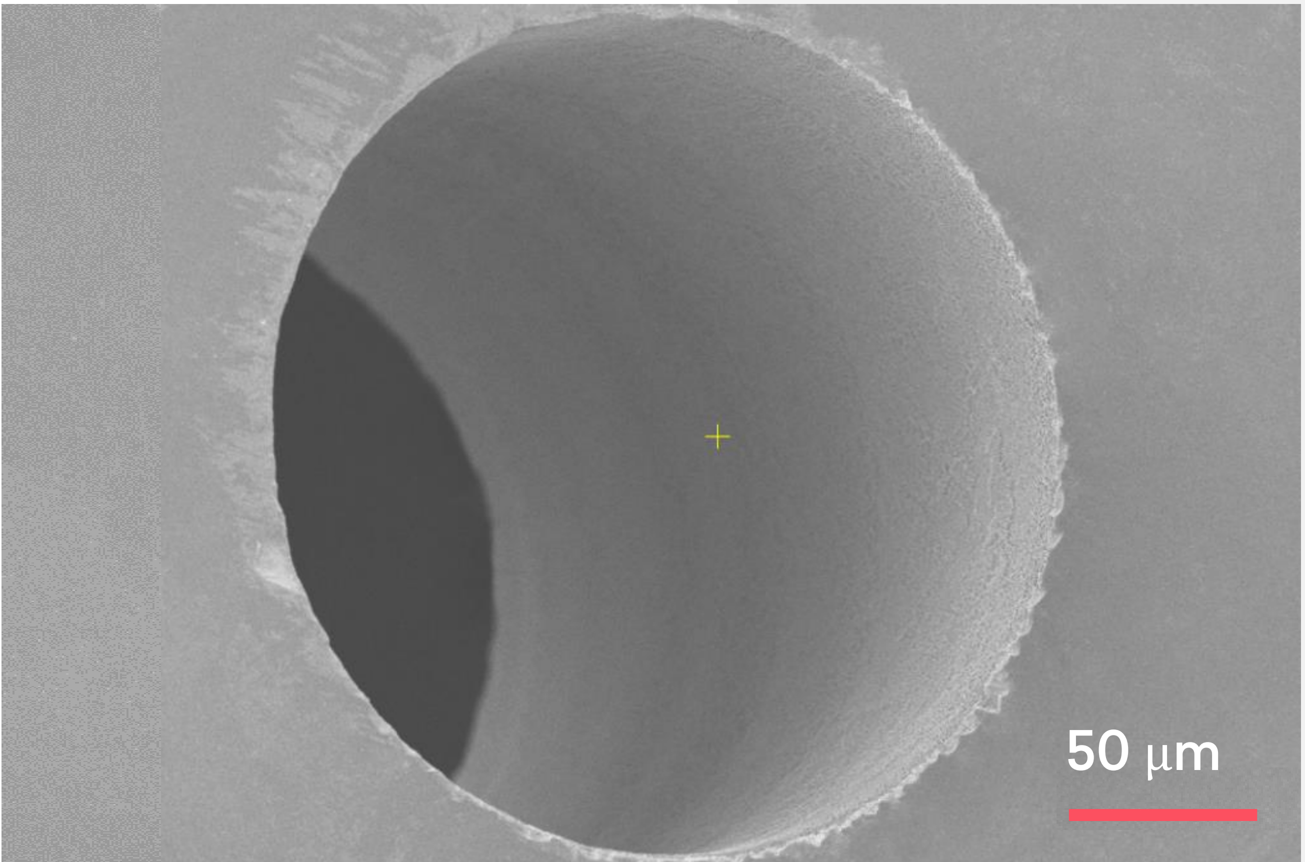
Holes drilled per 1 minute
65 000 +



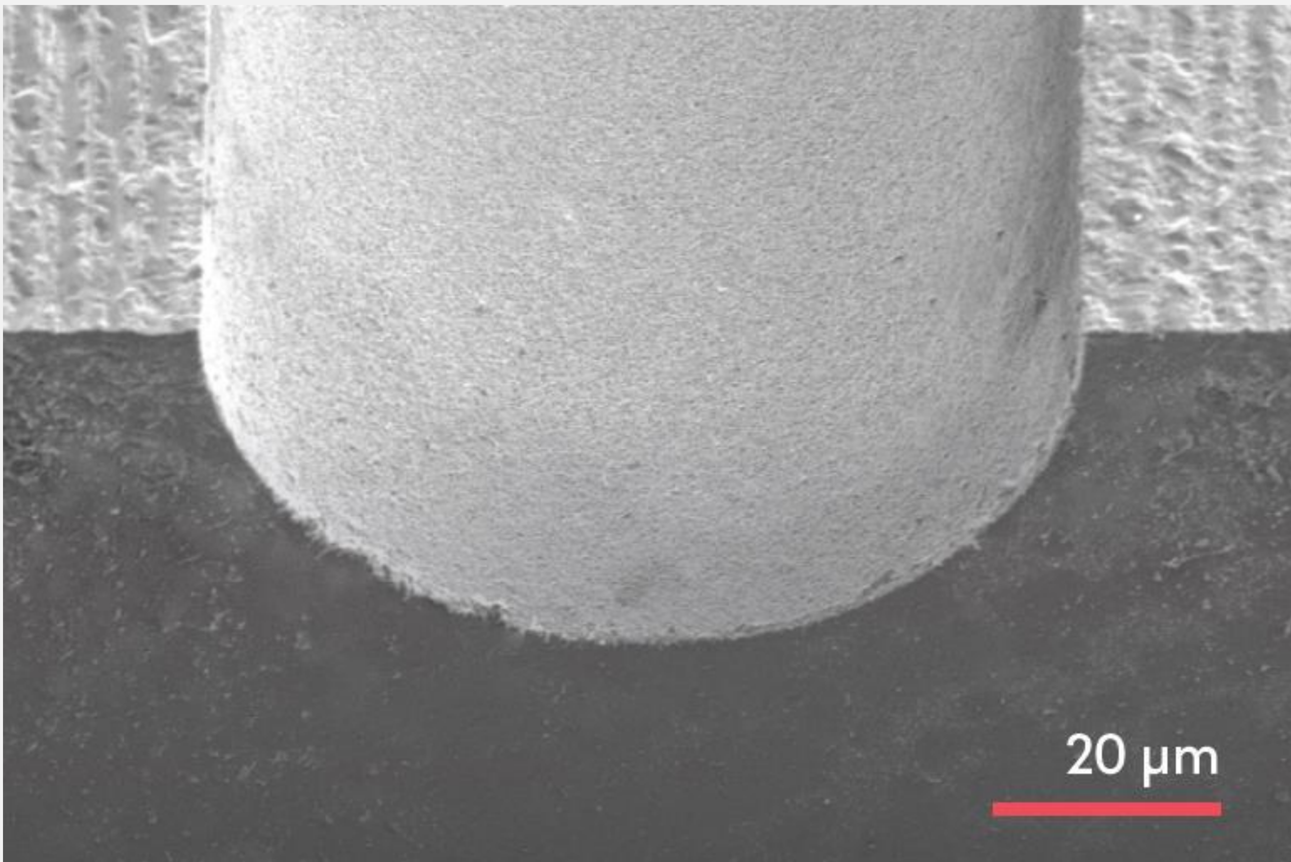
SEM images of vertical wall hole array



3 million holes in 8" diameter, 500 μm thickness fused silica wafer



Obsidian (SiO_2) micro drilling without taper

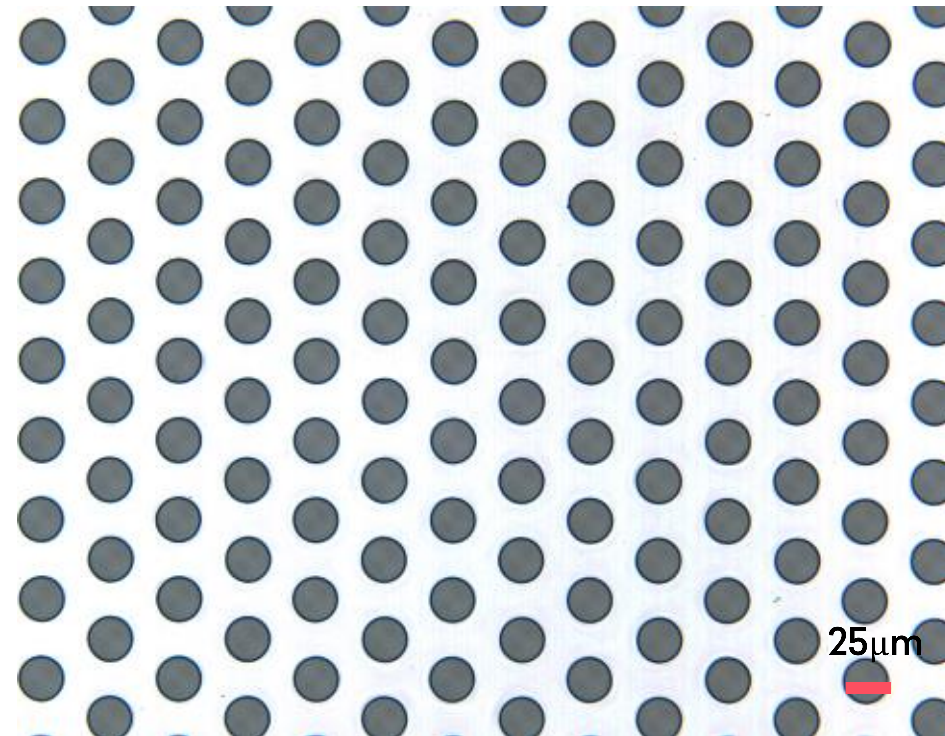


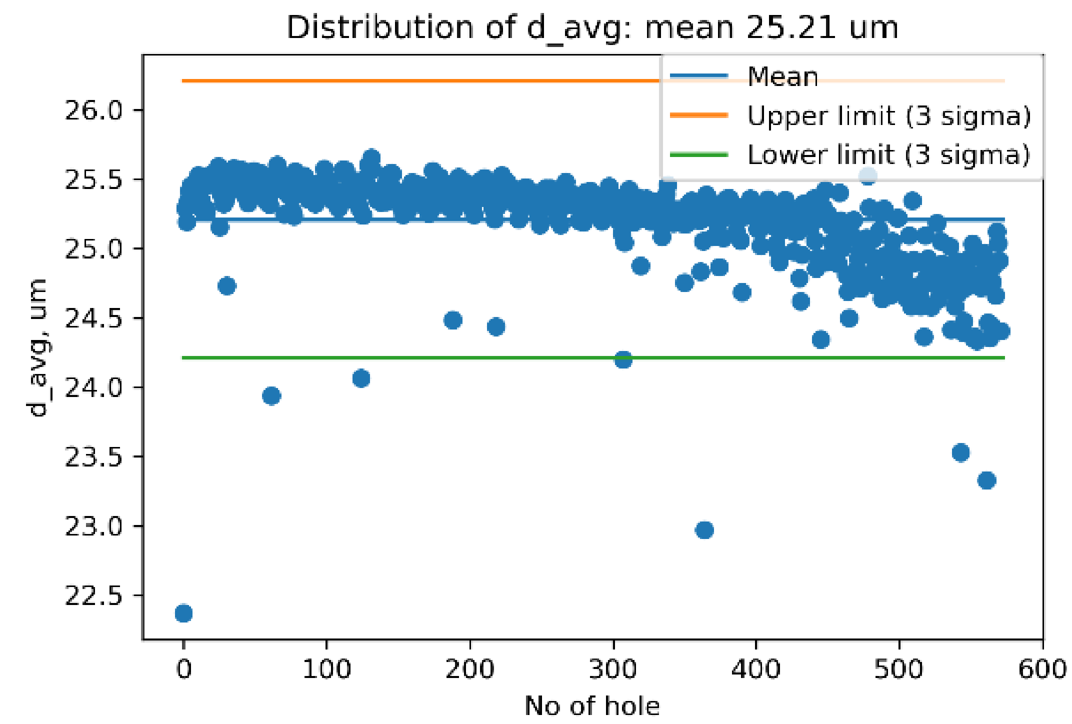
Sapphire drilling top view

More drilling

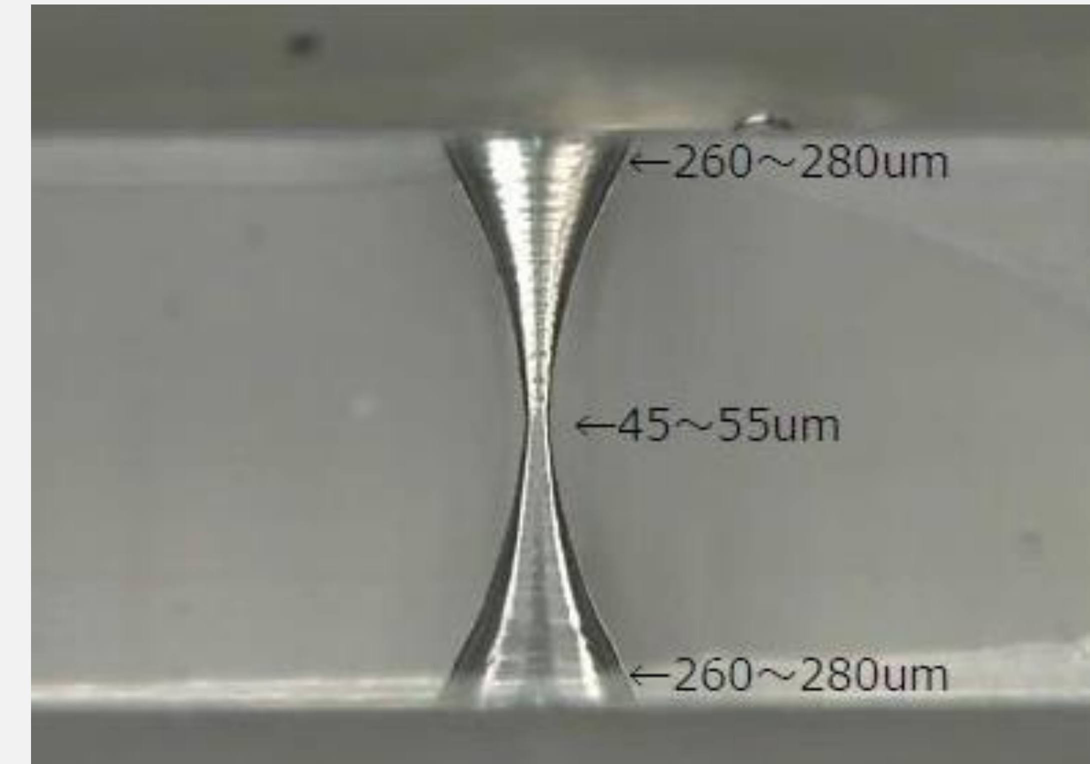
W O P

99% identical diameter holes

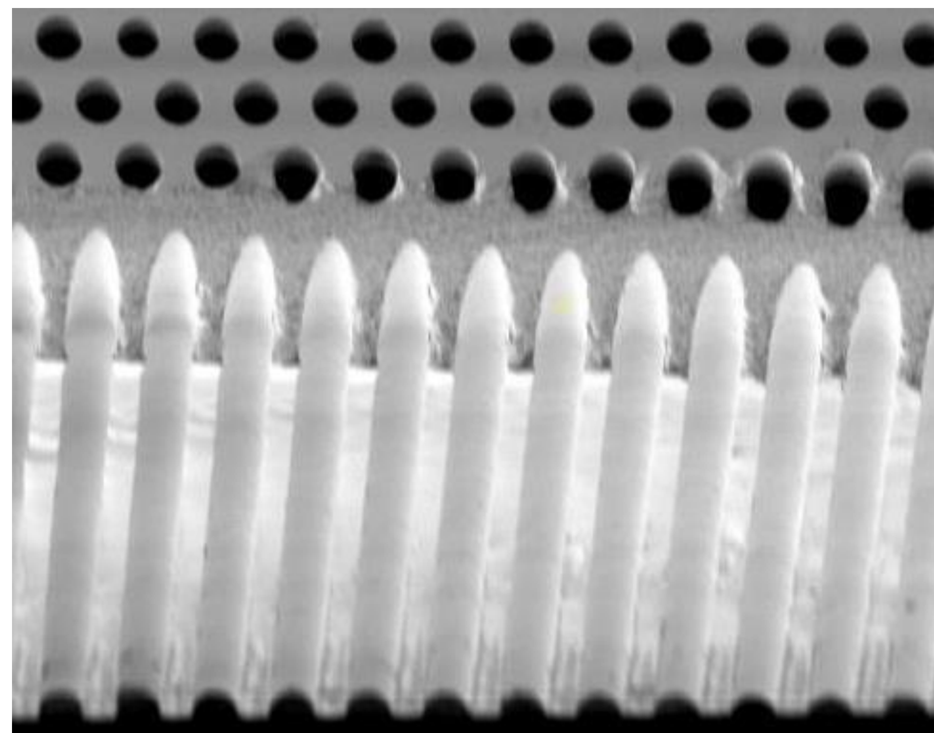


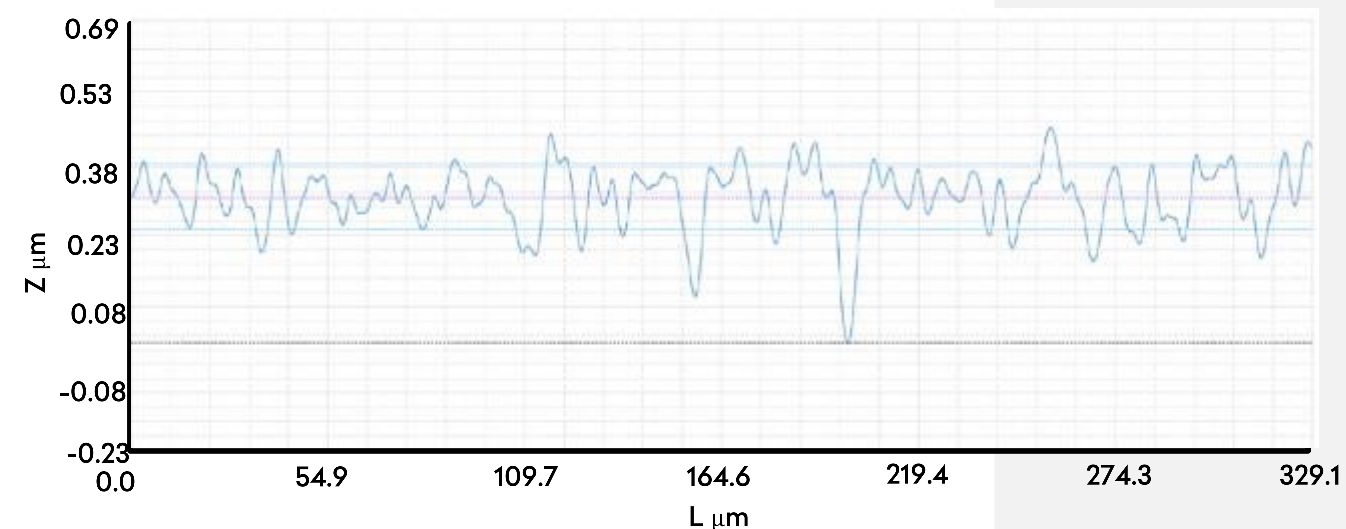


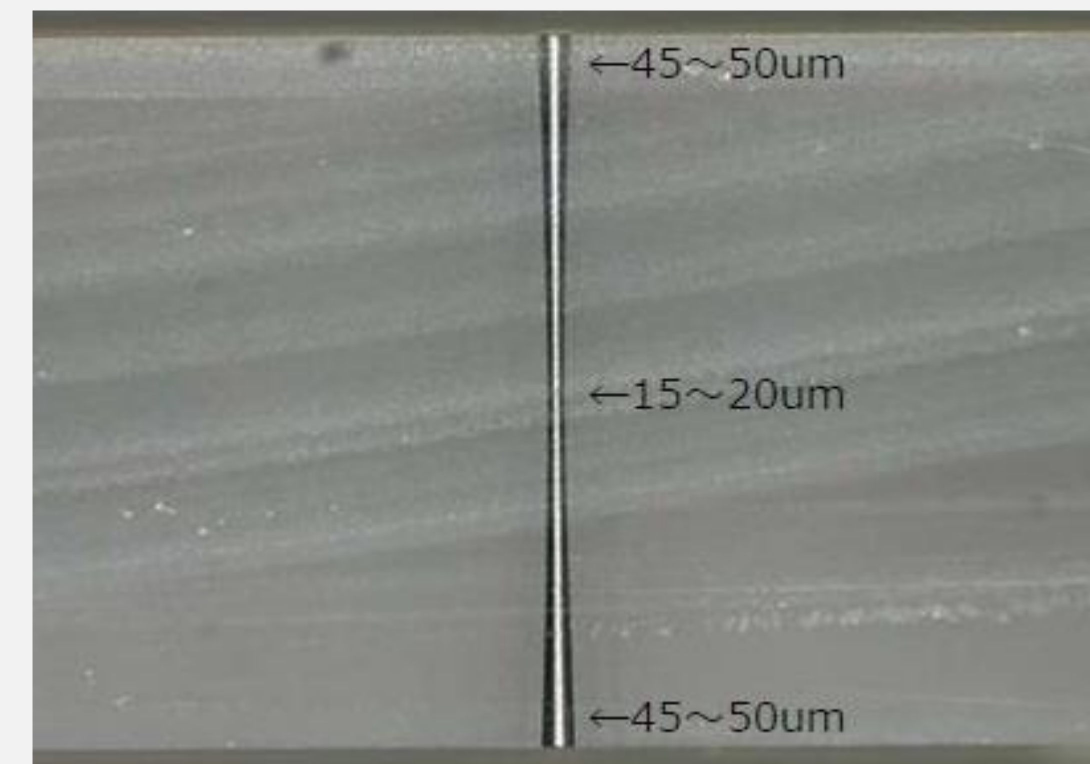
Hole shape: hourglass



Ra <0.08 µm: super smooth sidewalls

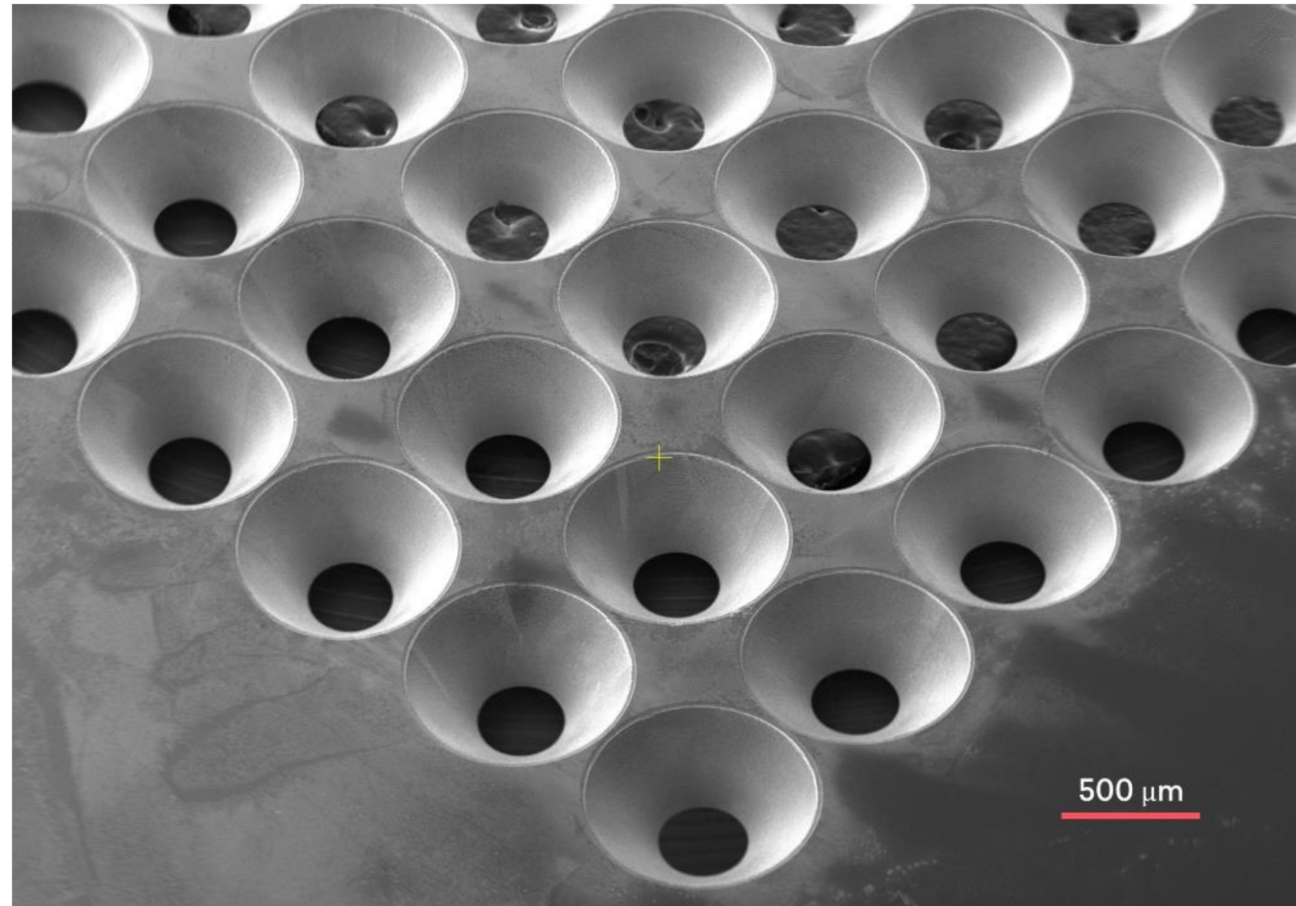




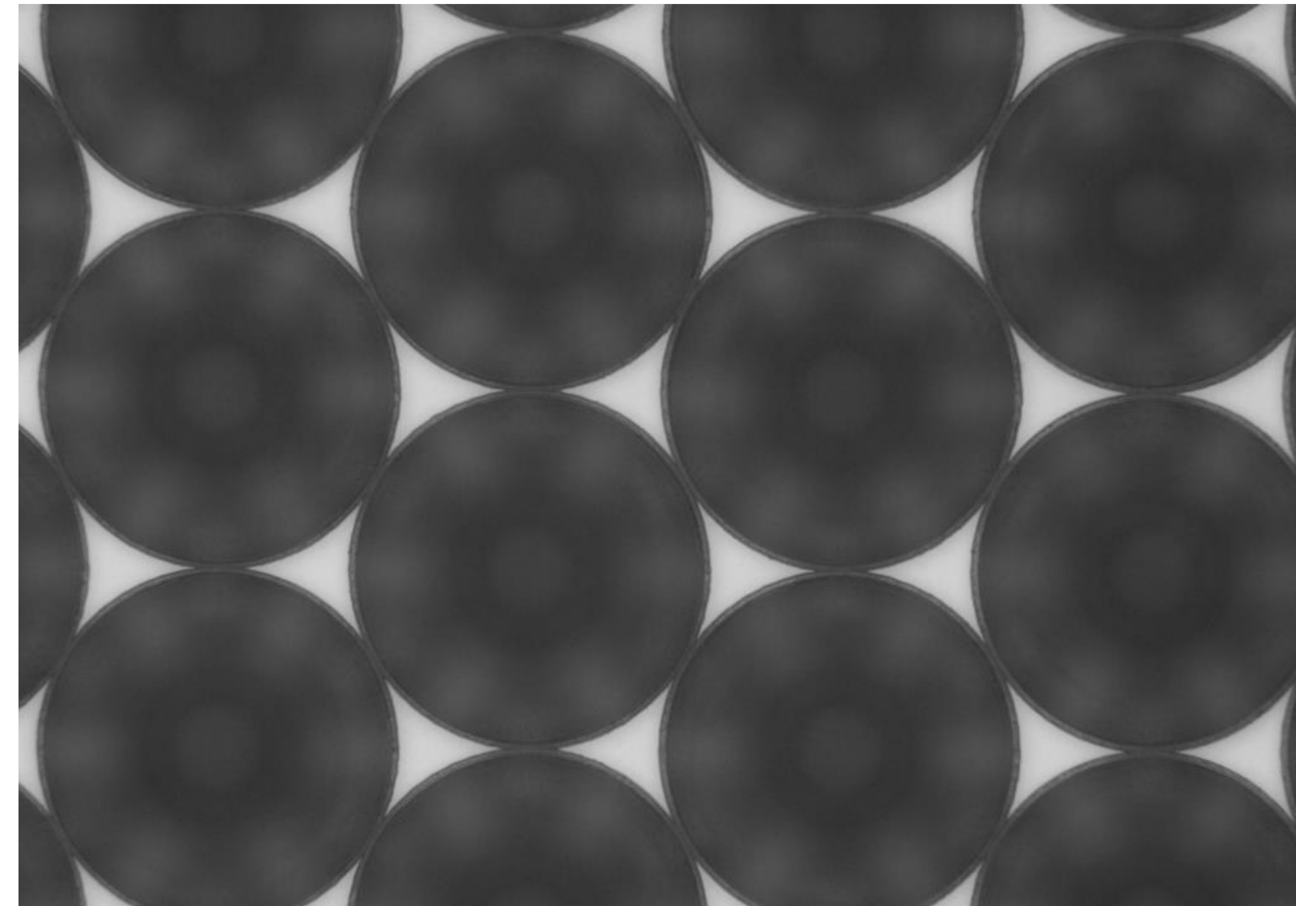


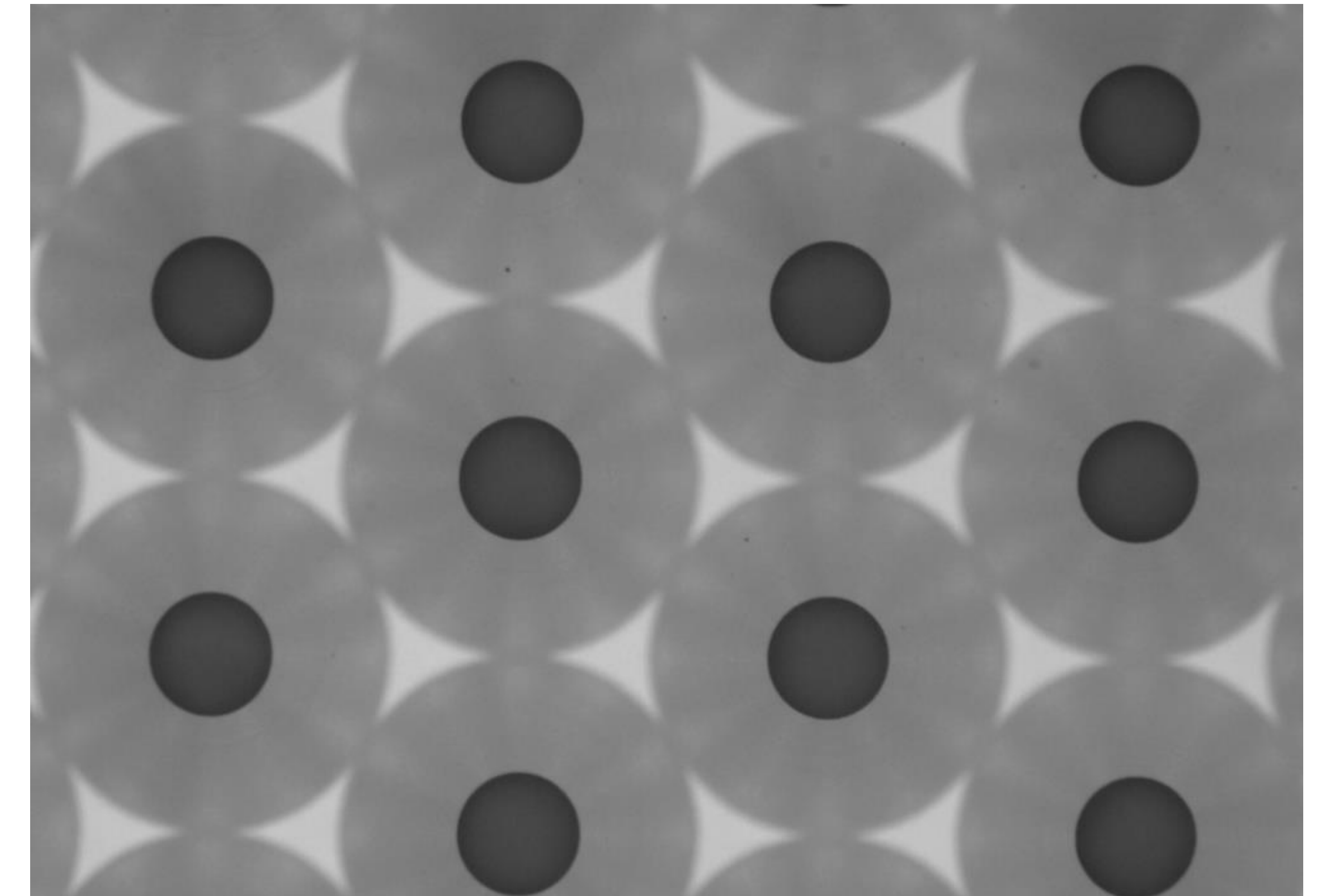
Tapered holes

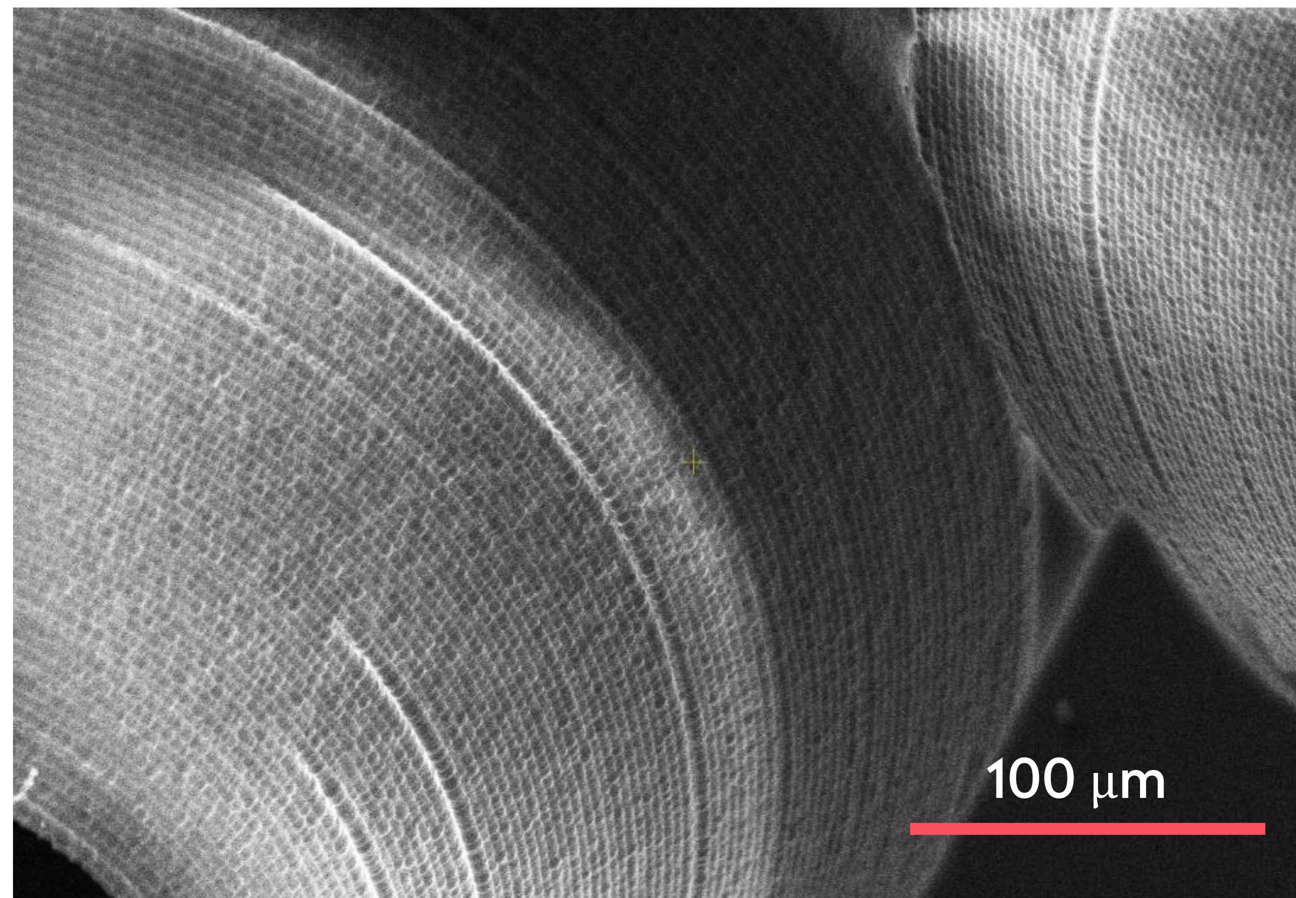
WOP

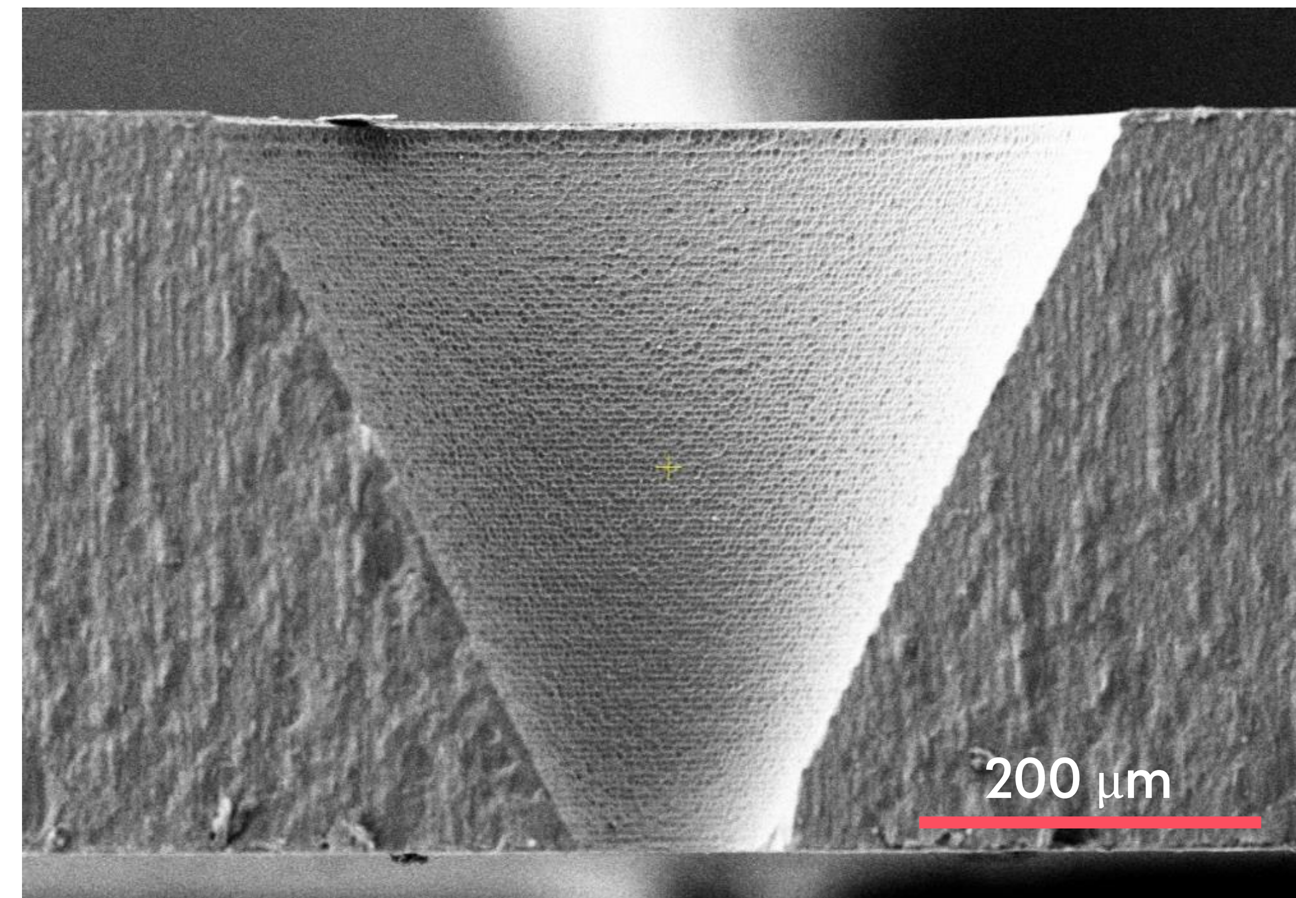


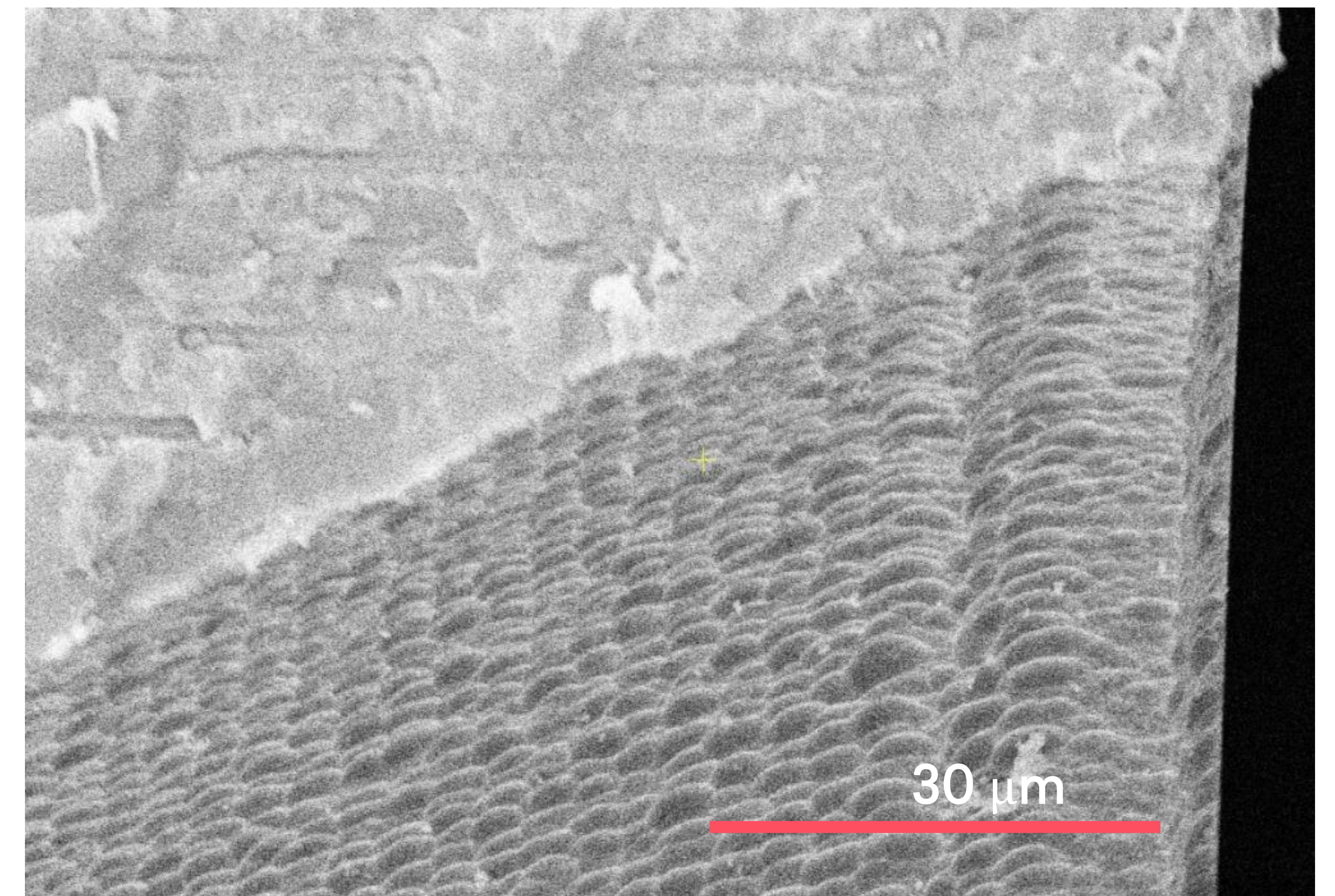
SEM images of tapered holes


Entry 5x


Exit 5x

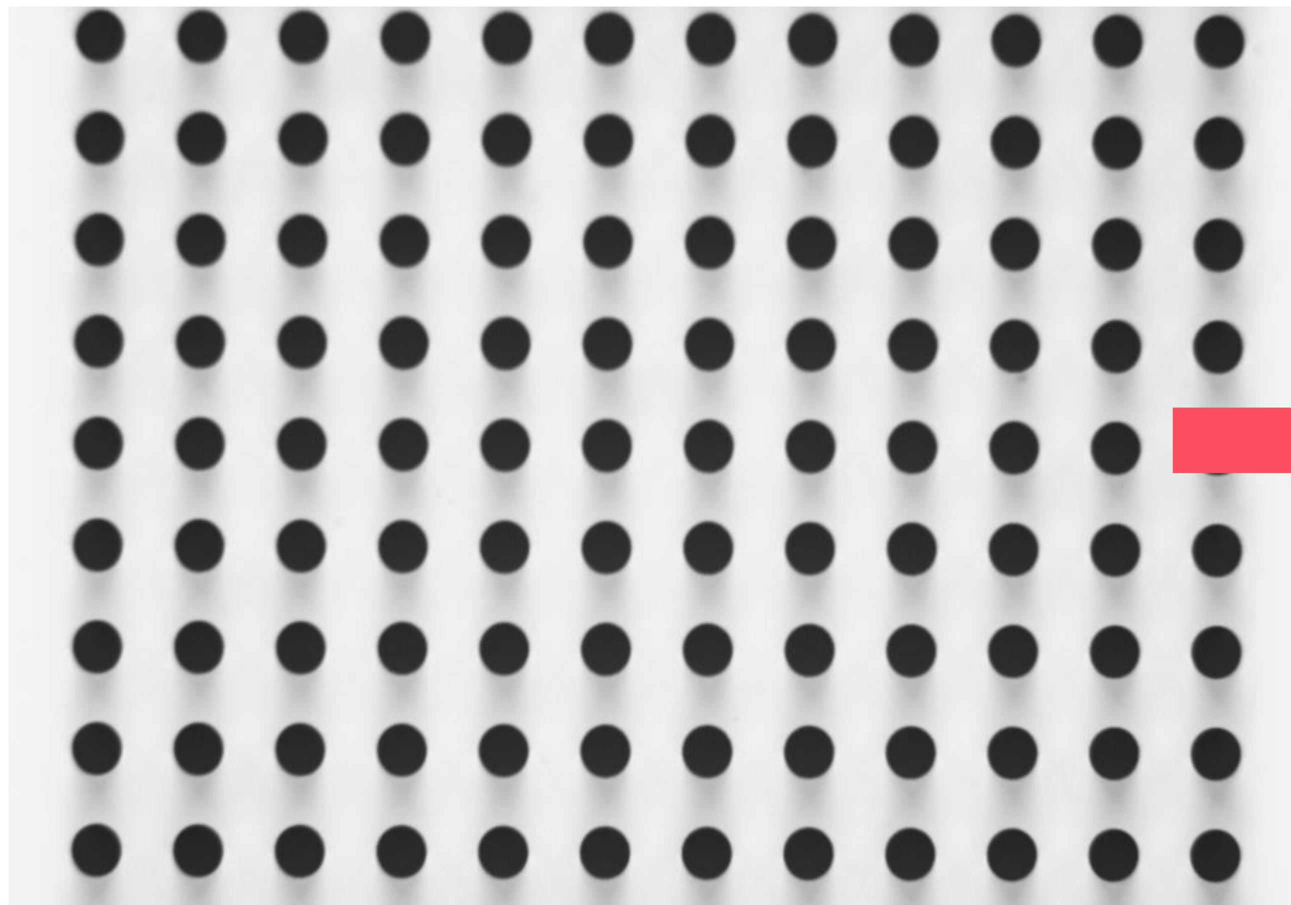




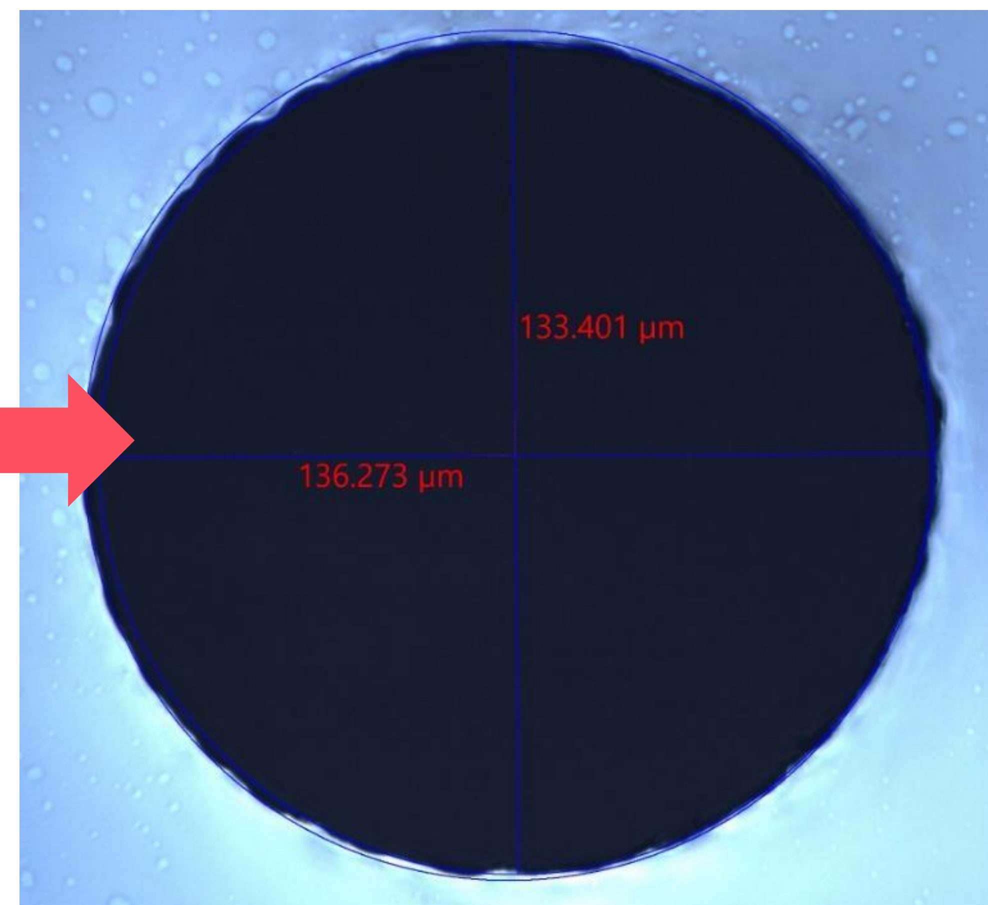


SEM images of tapered holes

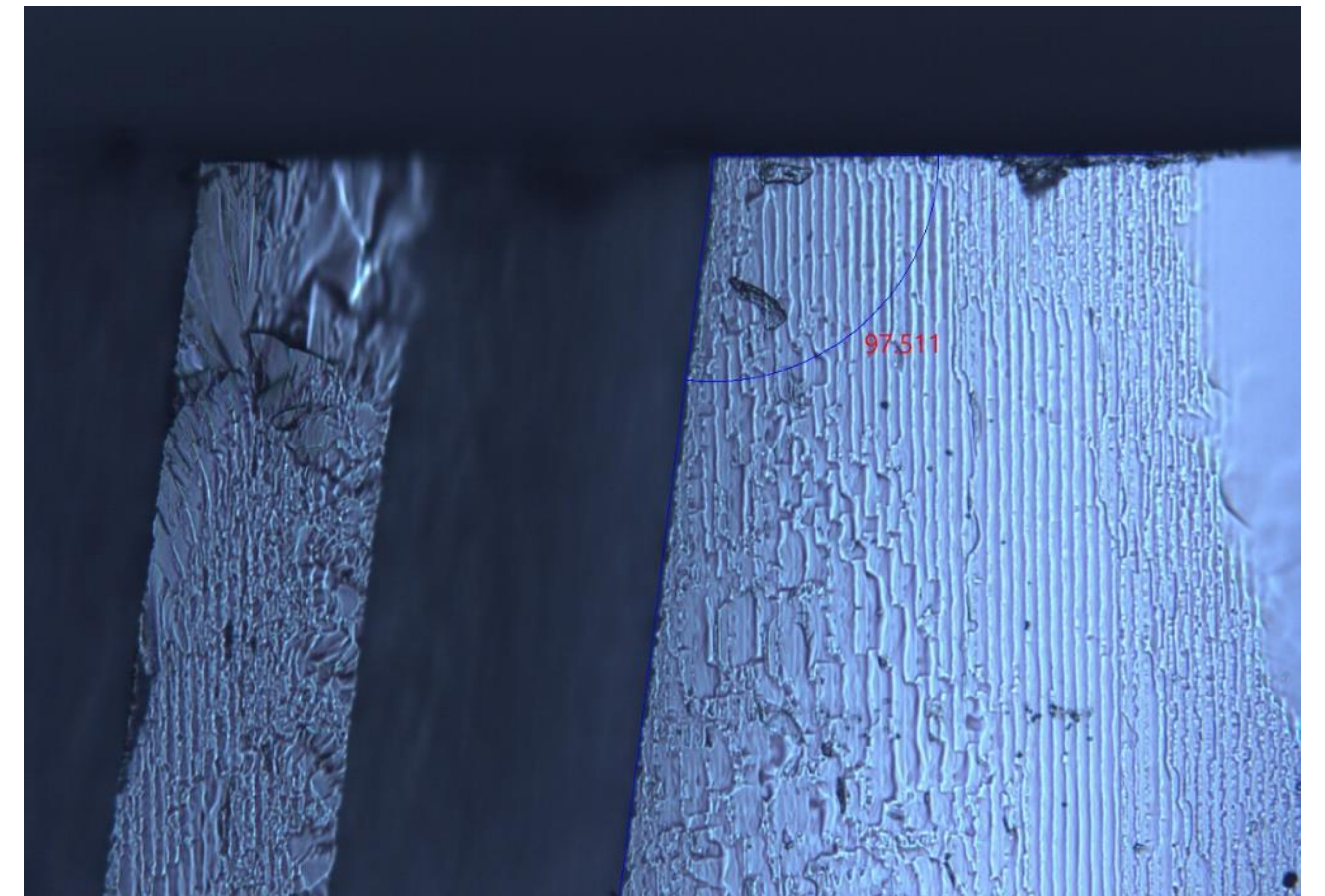
Angled hole arrays



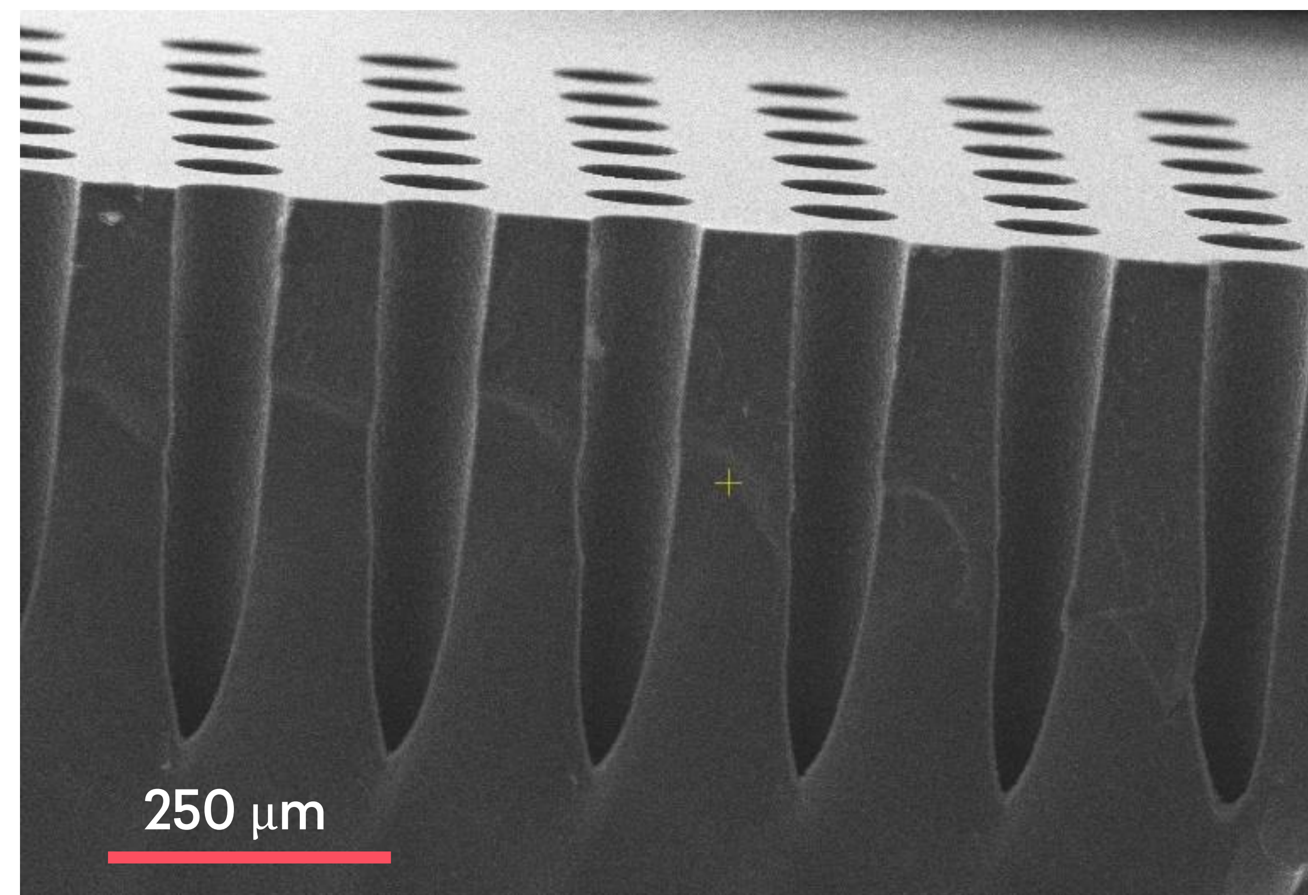
Entry 5x

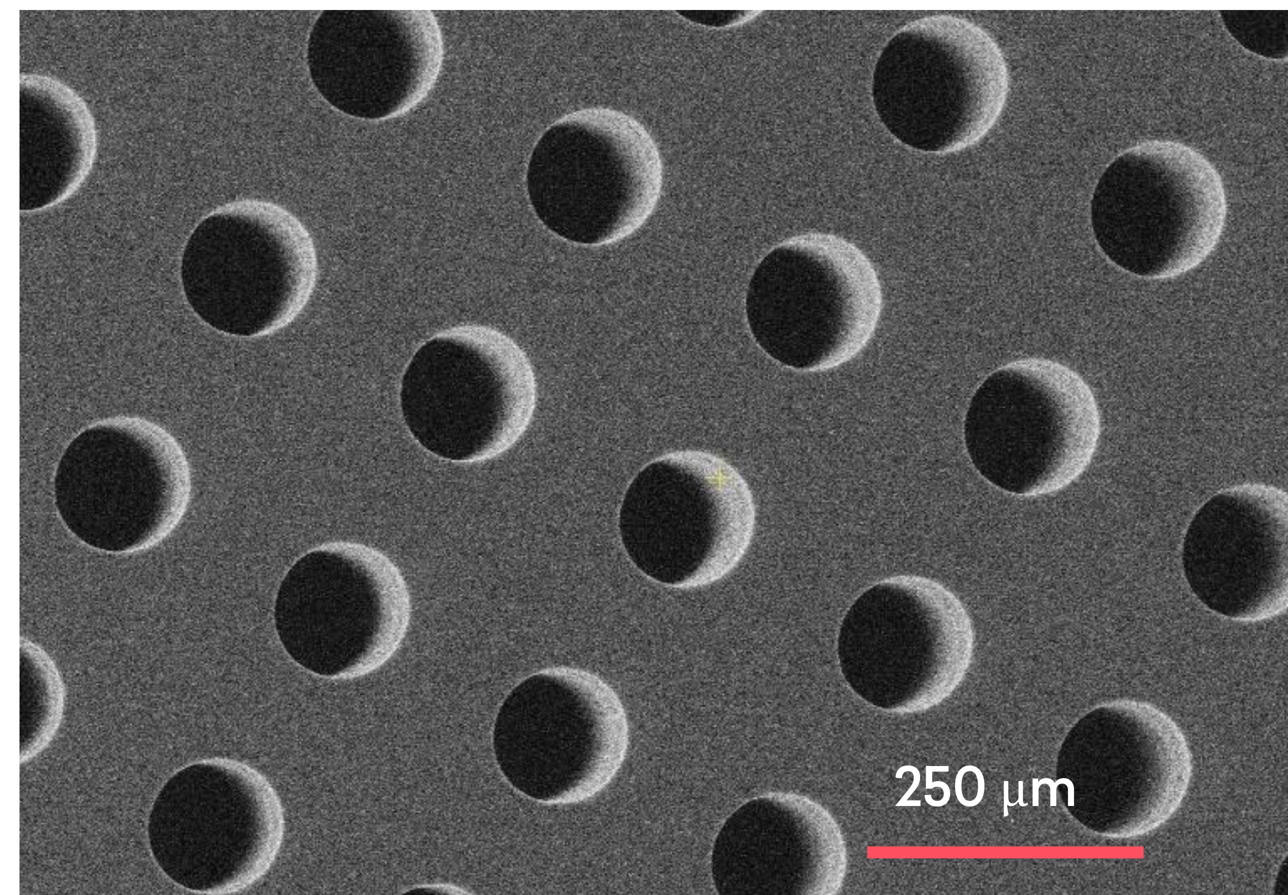


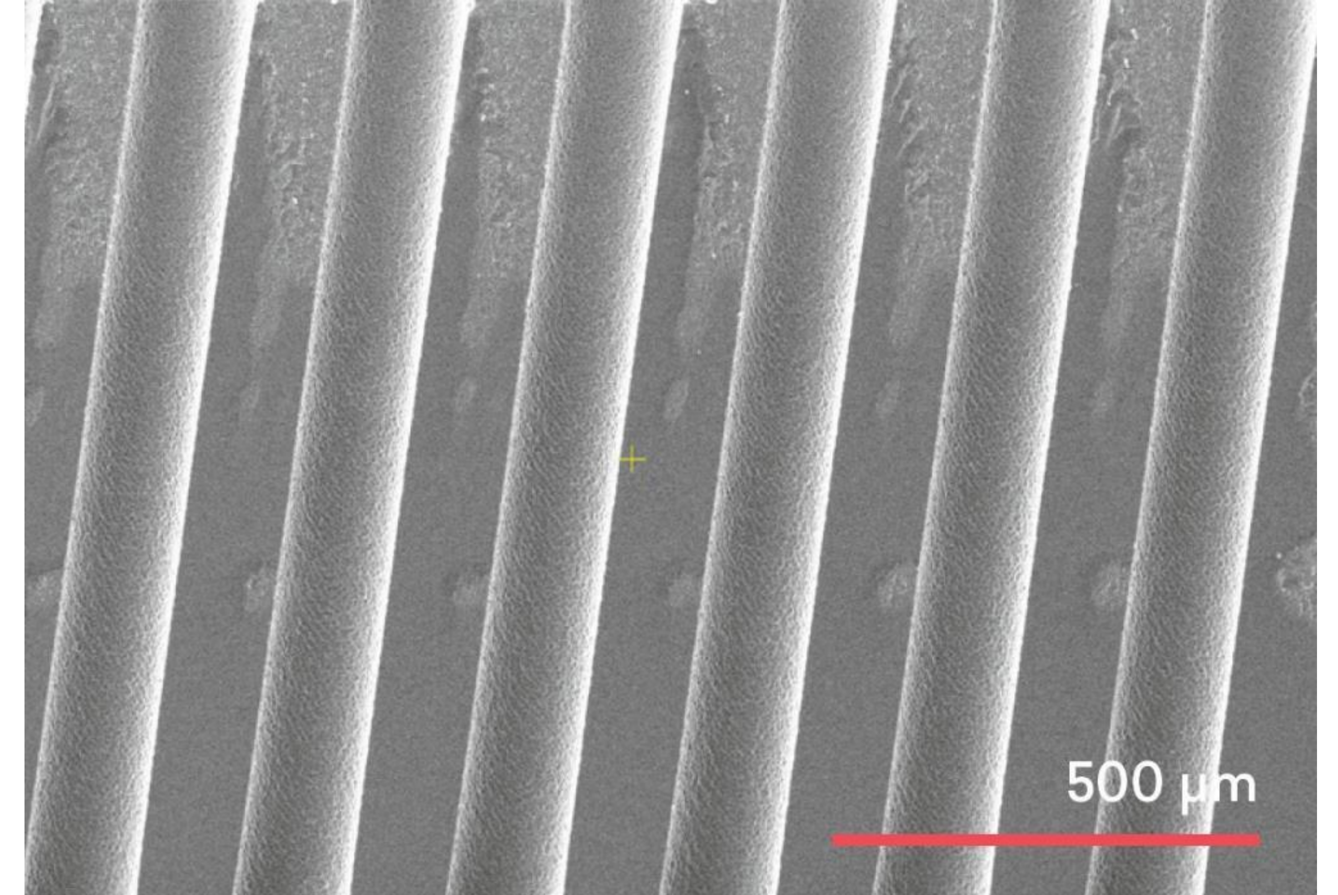
Entry, 50x



Side view, 20x







Side view, 10x

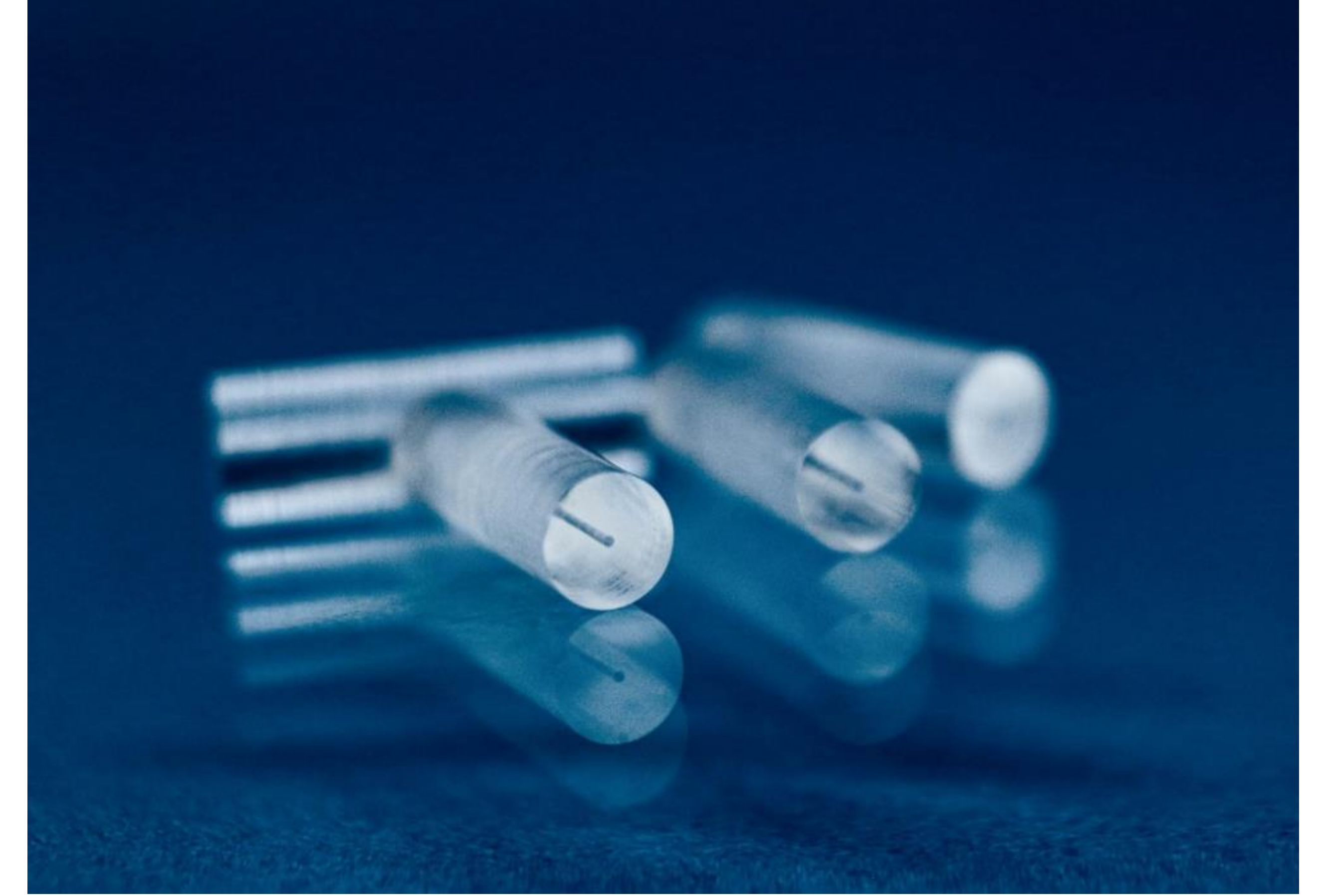
SLE | Selective laser etching

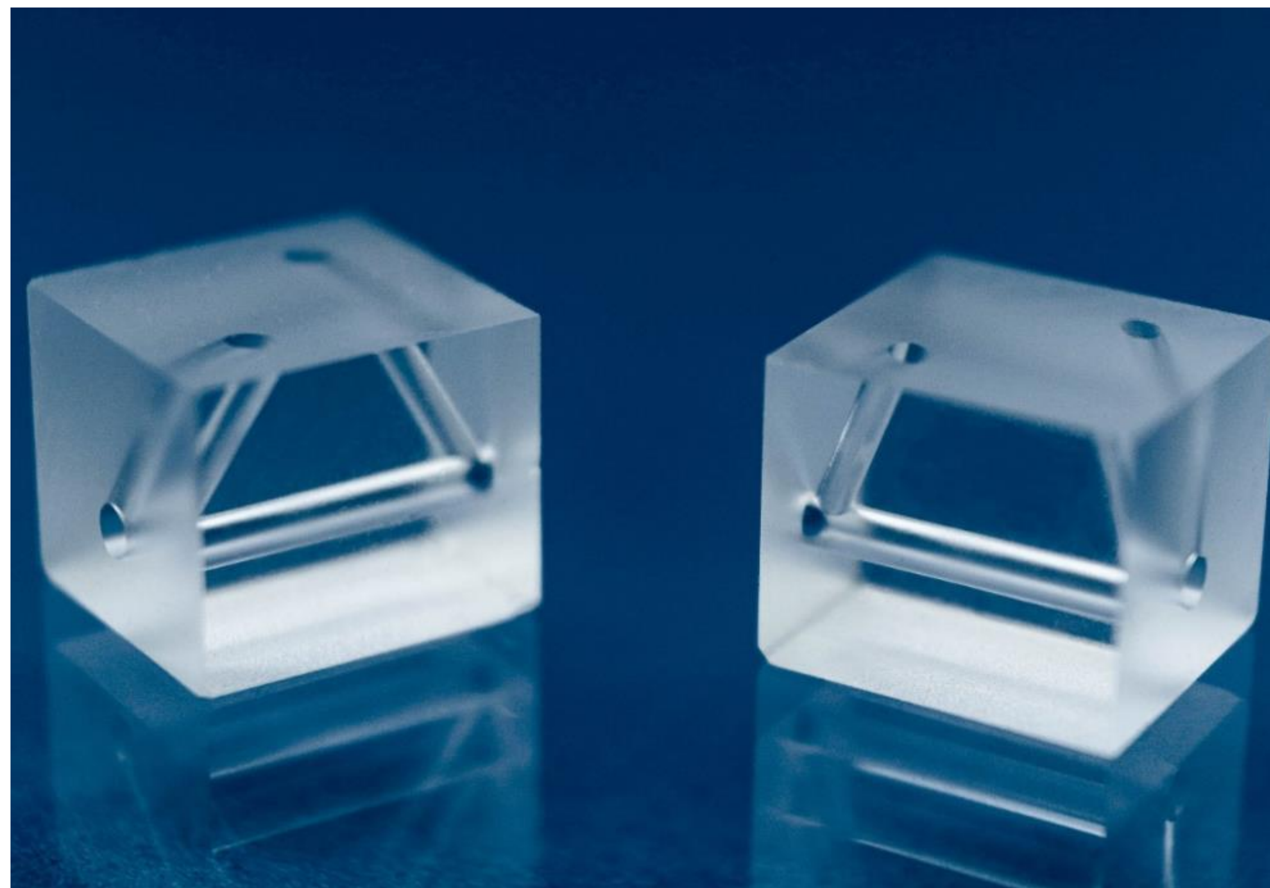
SLE technology ensures zero micro-cracks or chipping

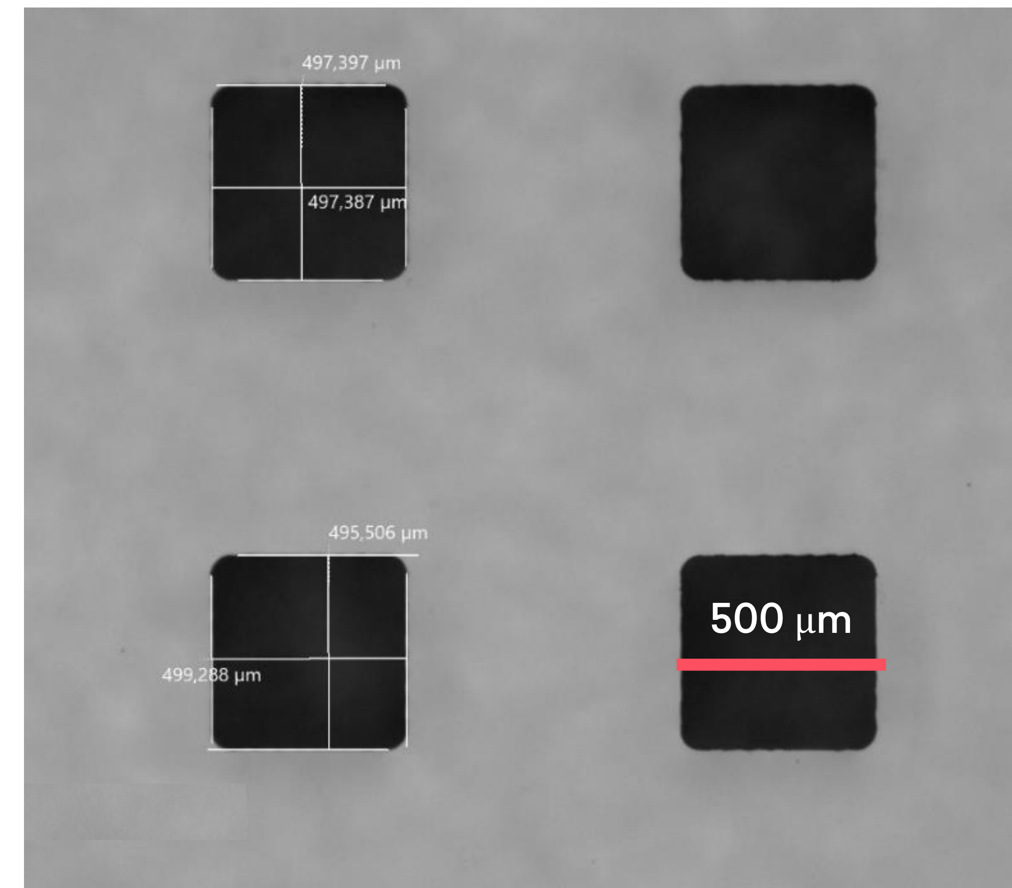
Various shapes:
circular, square, irregular

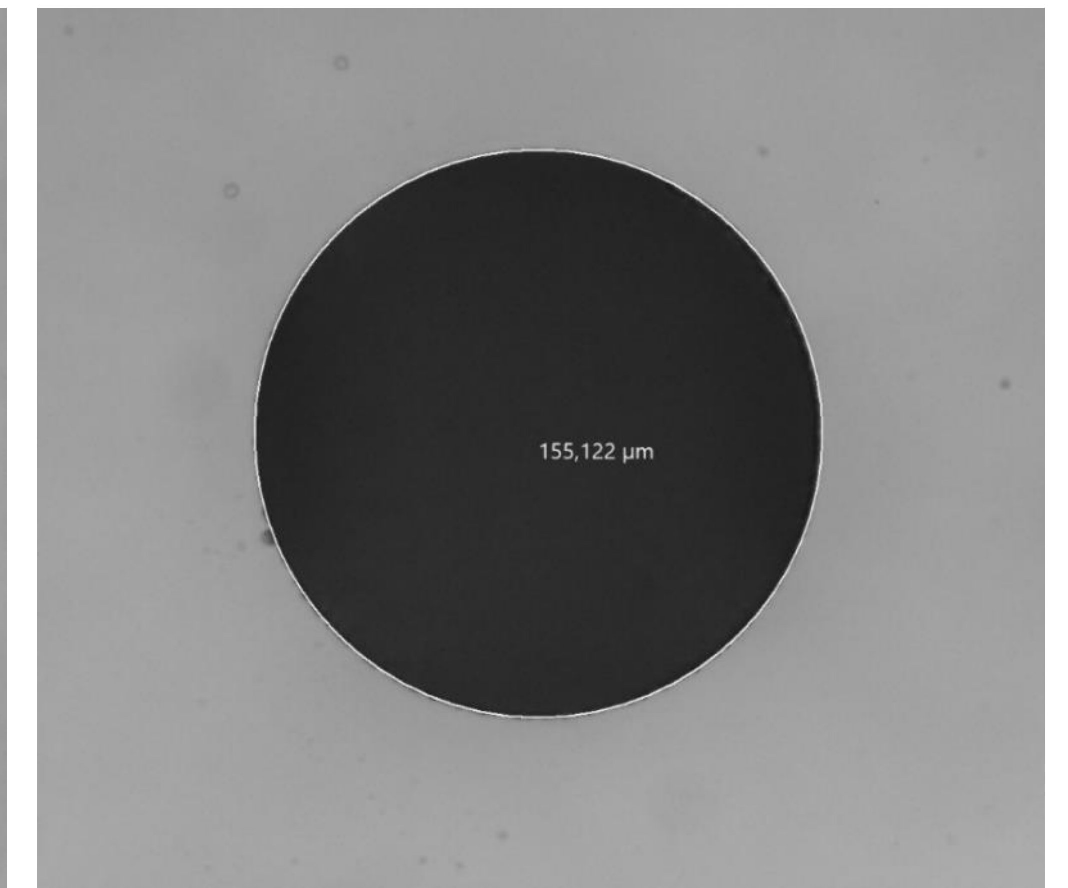
Thin glass: from 30 µm to 3 mm

Fiber alignment arrays, with SLE


Glass rod for fiber optic collimators, ferrules, alignment fixture





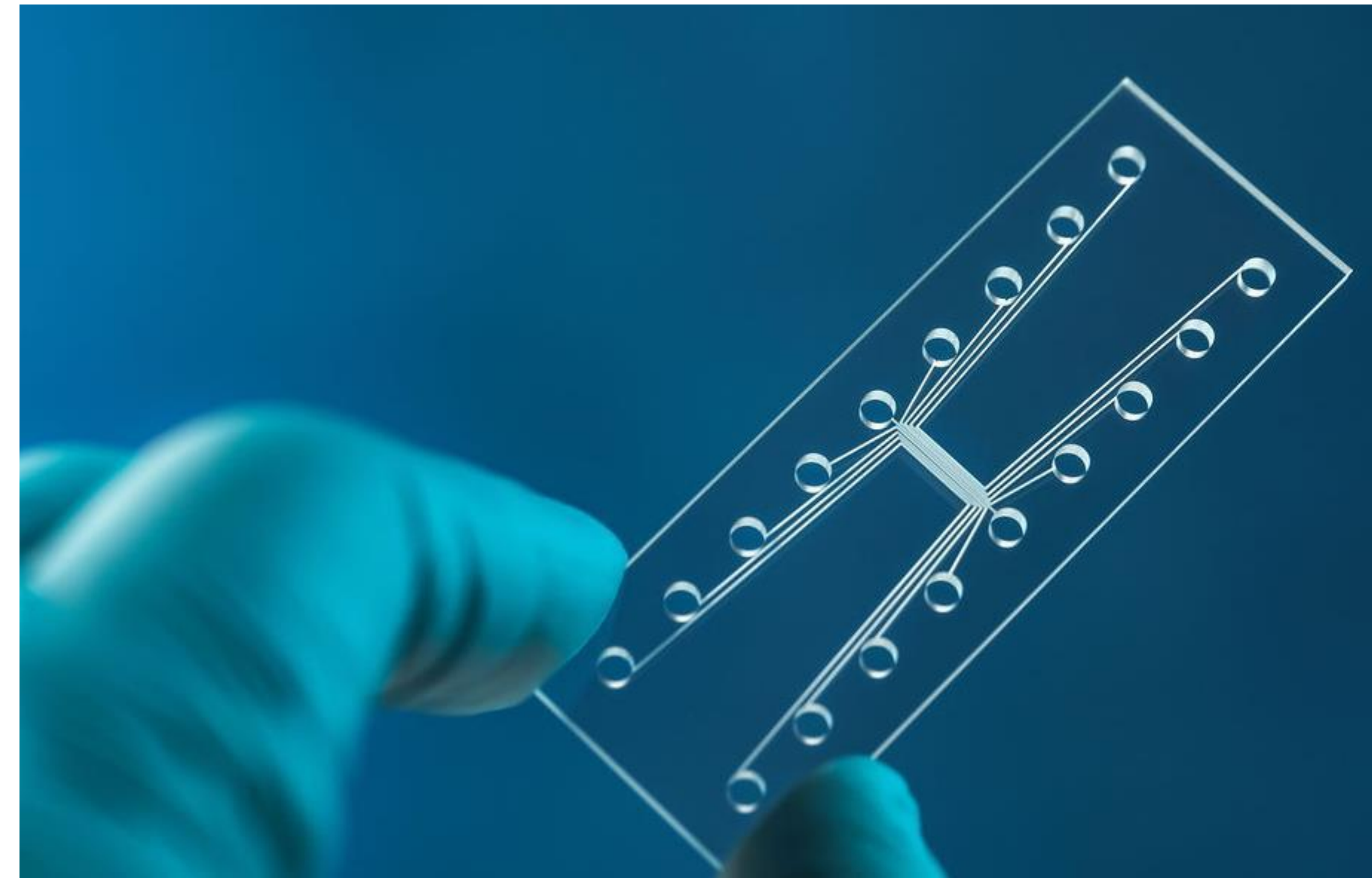


Selective laser etching for 3D glass structures

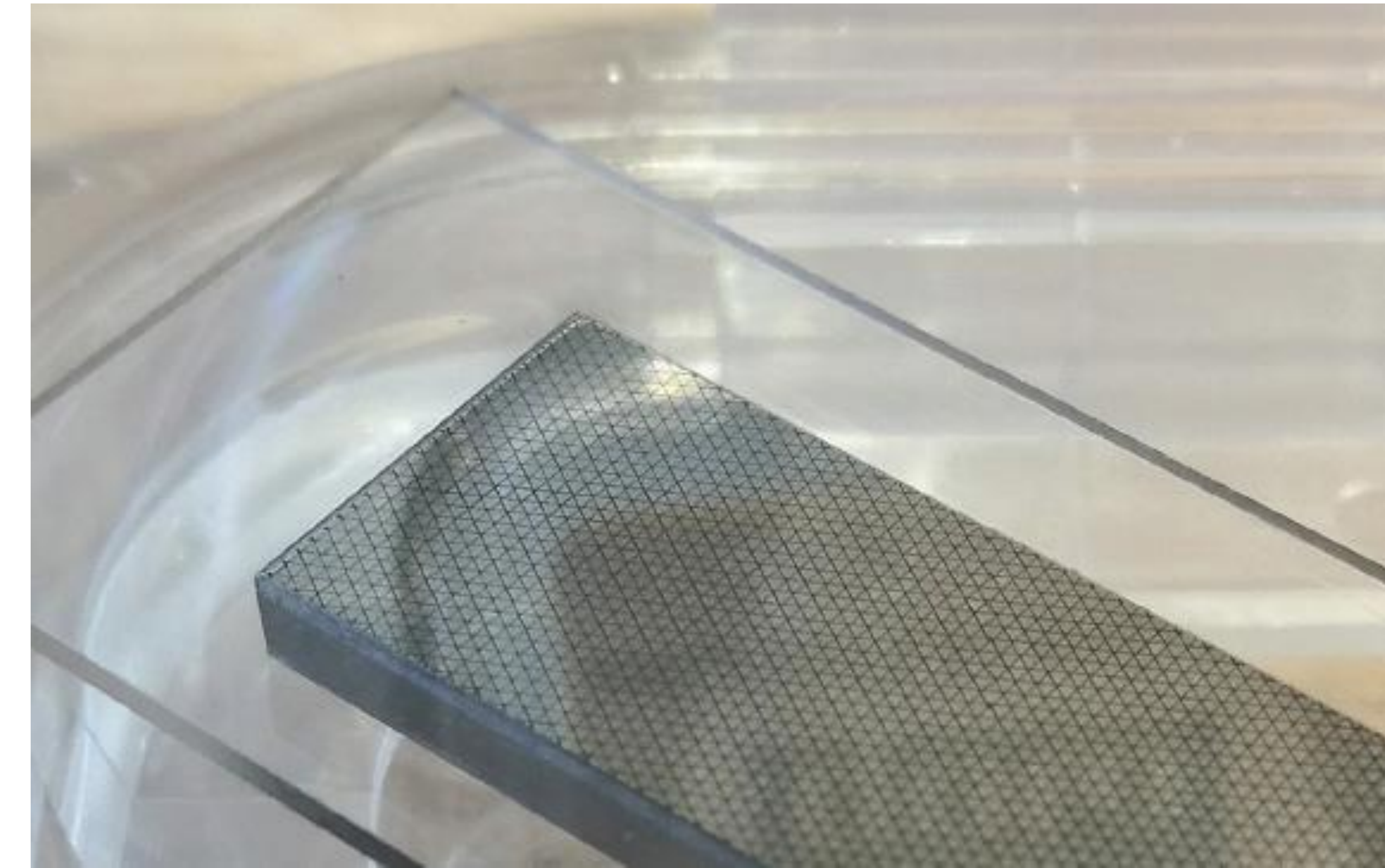
Laser welding

WOP

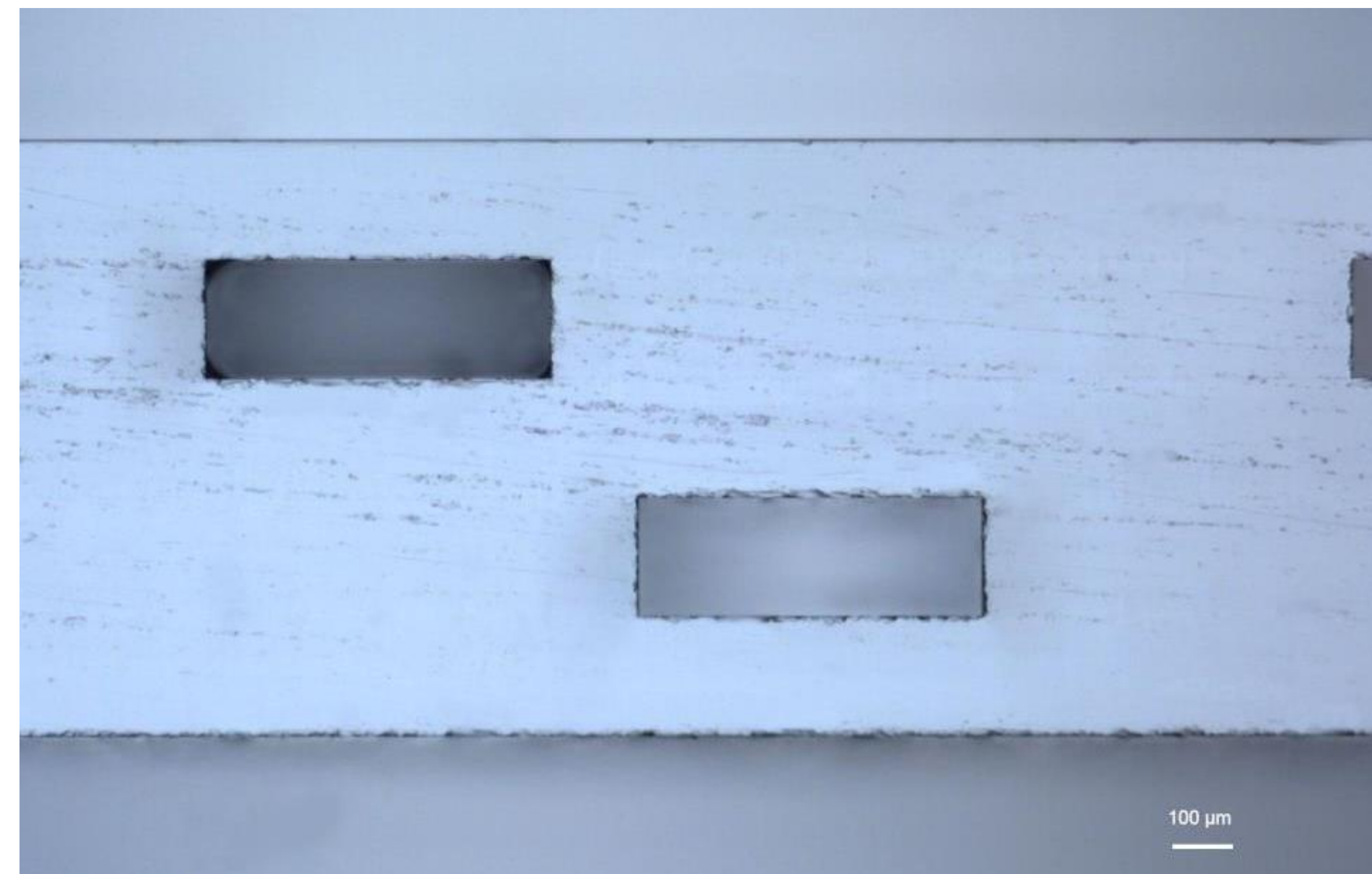
- High precision
- Good mechanical strength
- No extra bonding material is needed
- Hermetic sealing
- Minimum heat-affected zones



Microfluidic channels sealing



Glass to metal micro welding

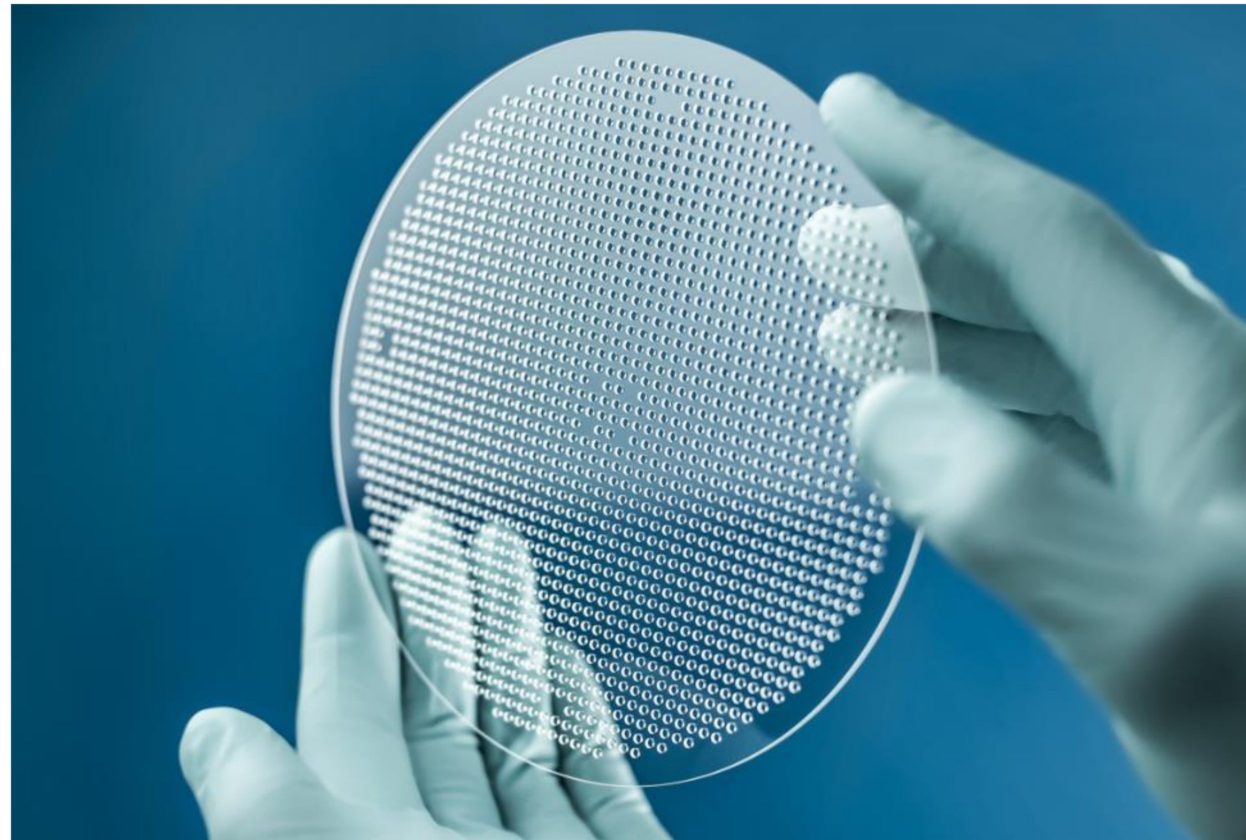


Microfluidic chip, 5 hermetic layers bonded without adhesive, side view

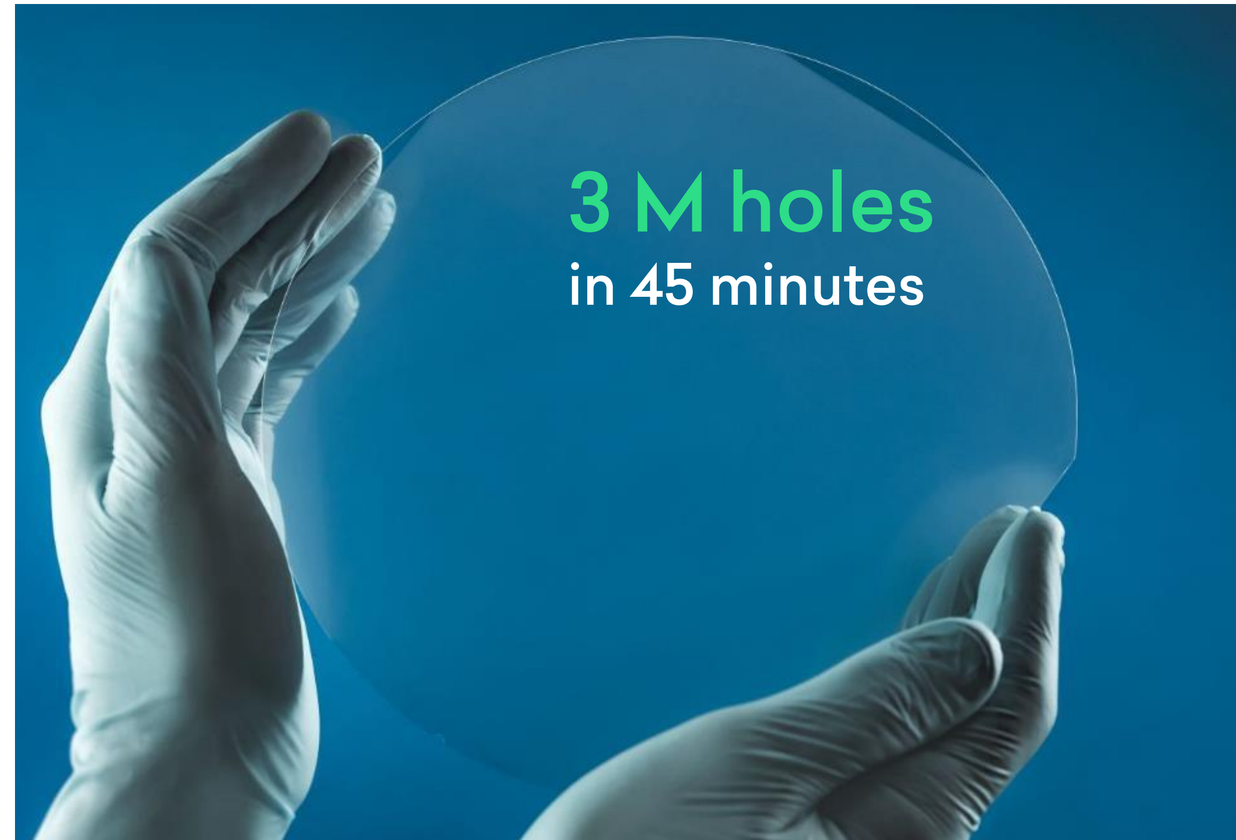
Glass to metal micro welding

Where to apply?

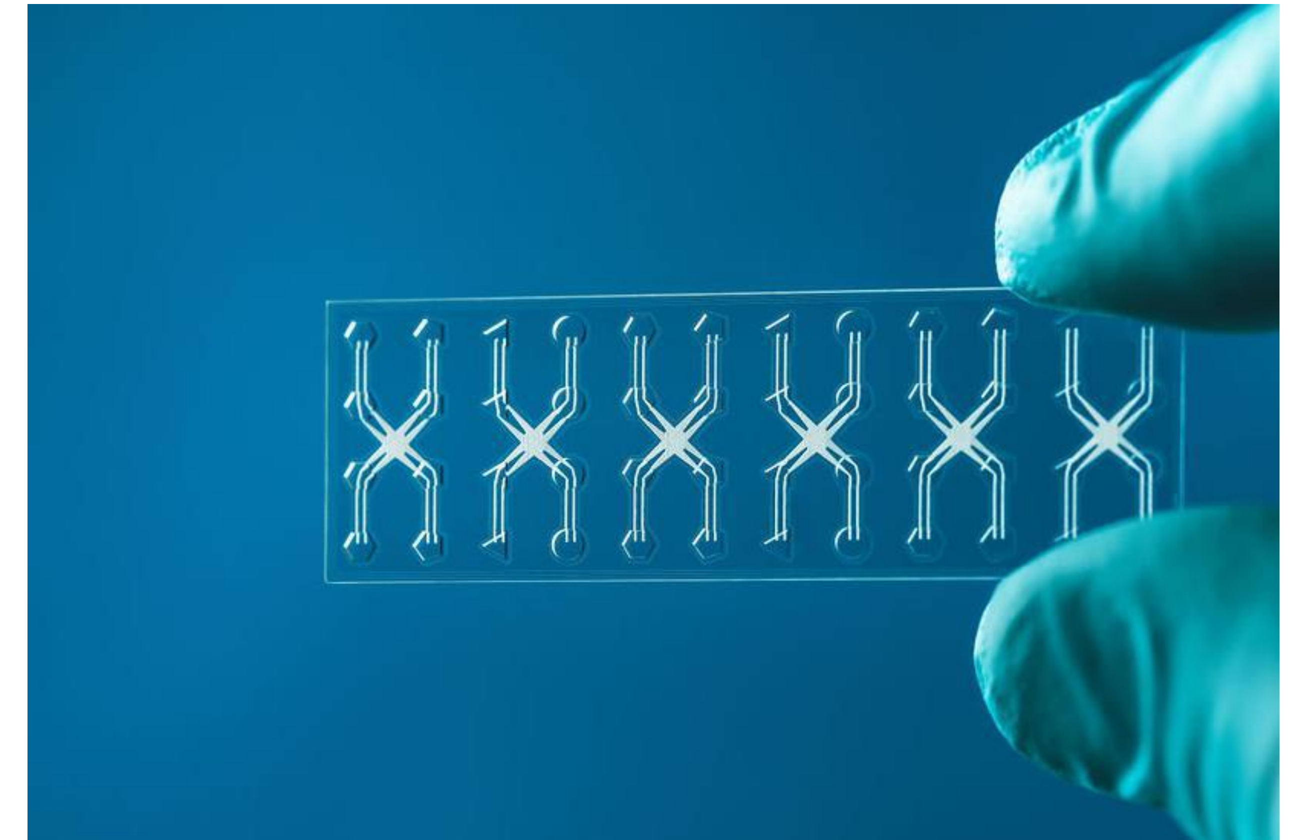
W O P



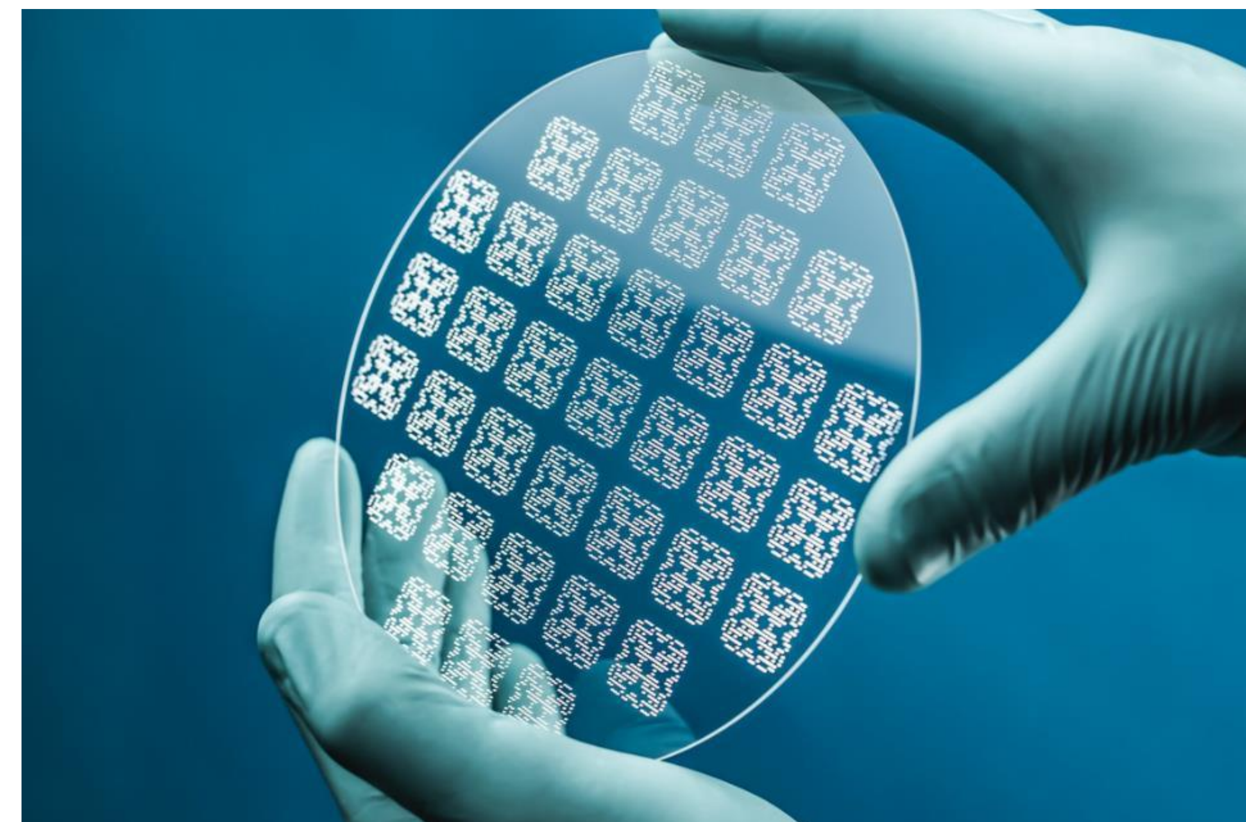
Glass spacers | Interposers



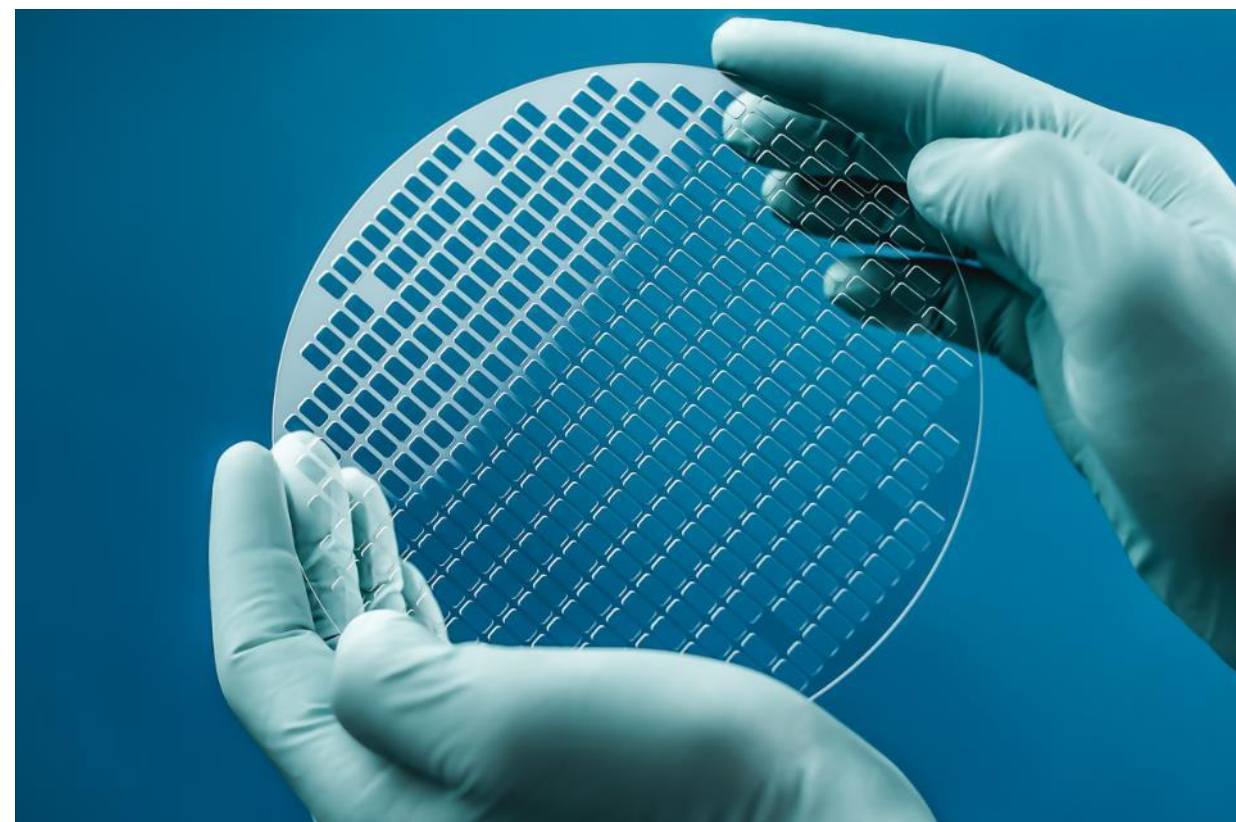
Glass carrier wafers > 8" diameter, 500 µm thickness fused silica wafer



Microfluidic chips & devices



Through glass via (TGV) wafers

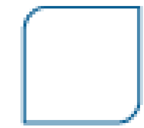


Packaging glass products

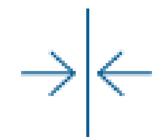
Switch ceramics to glass for probe cards to reach 80% less defects and 20x faster processing

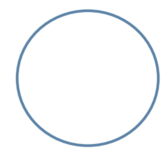
Precision in microfluidics

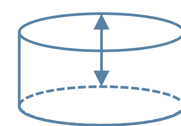
WOP


Straight or irregular cuts

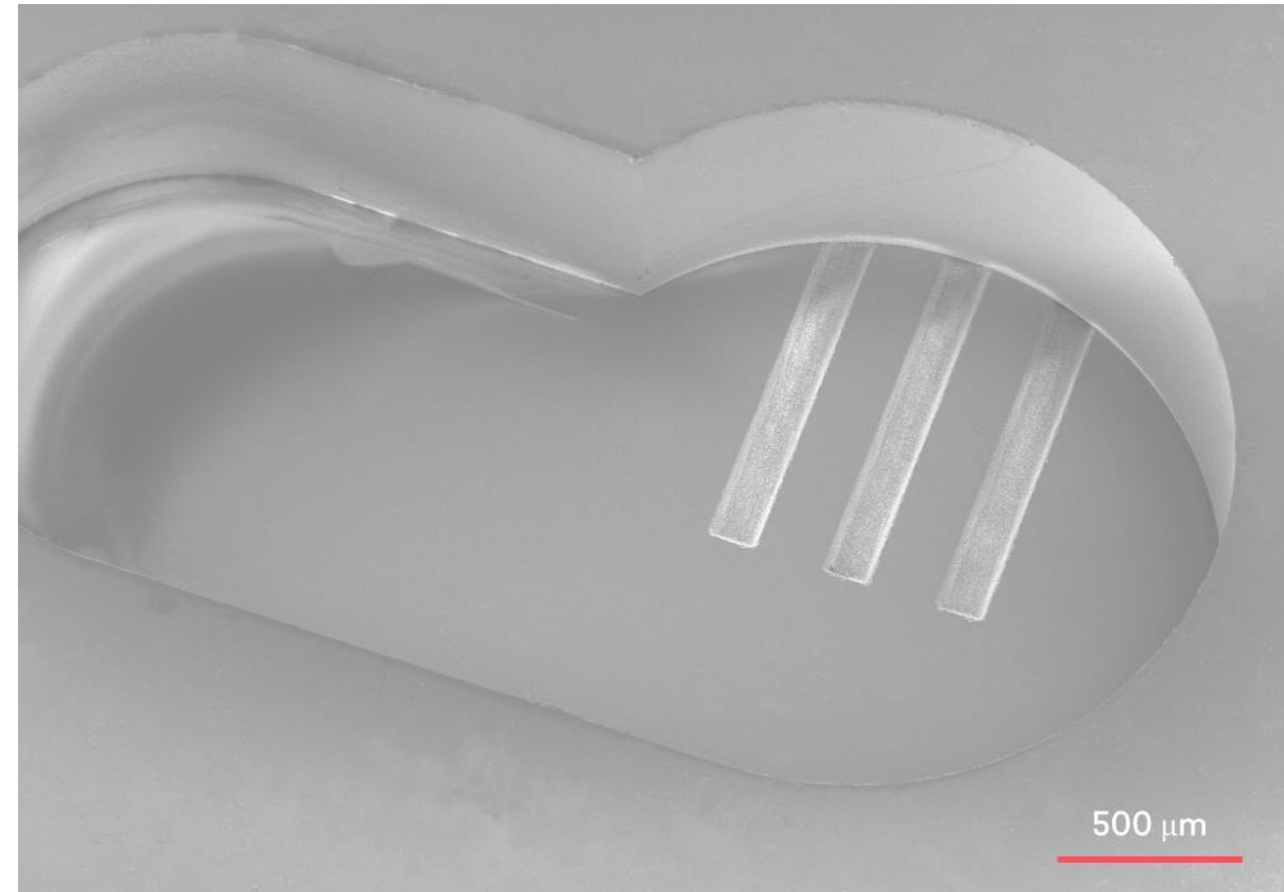
Feature sizes from 10 µm


Substrate thickness from 100 µm to 10 mm

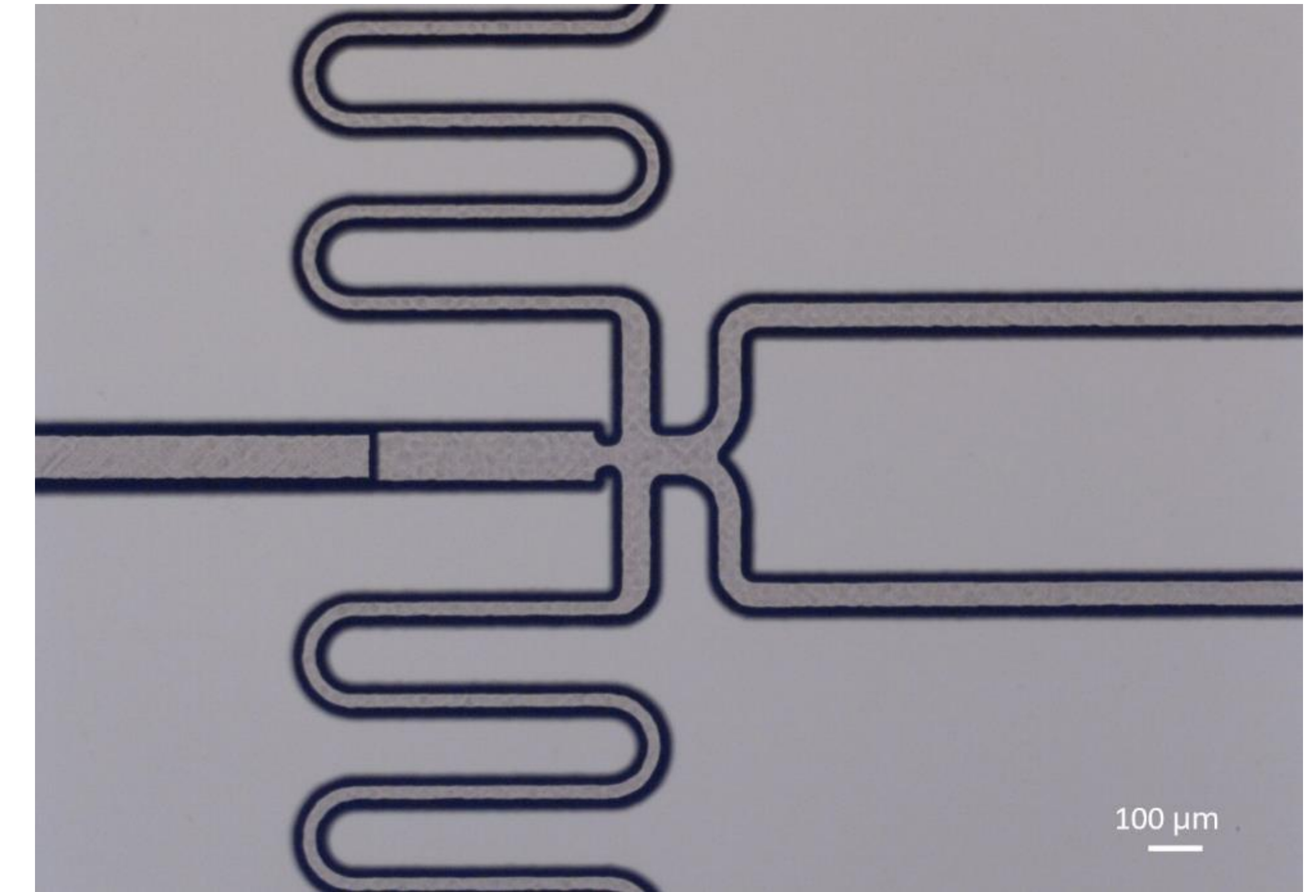

Low chipping <10 µm, typ. none


Surface roughness Ra <1 µm
or less after polishing

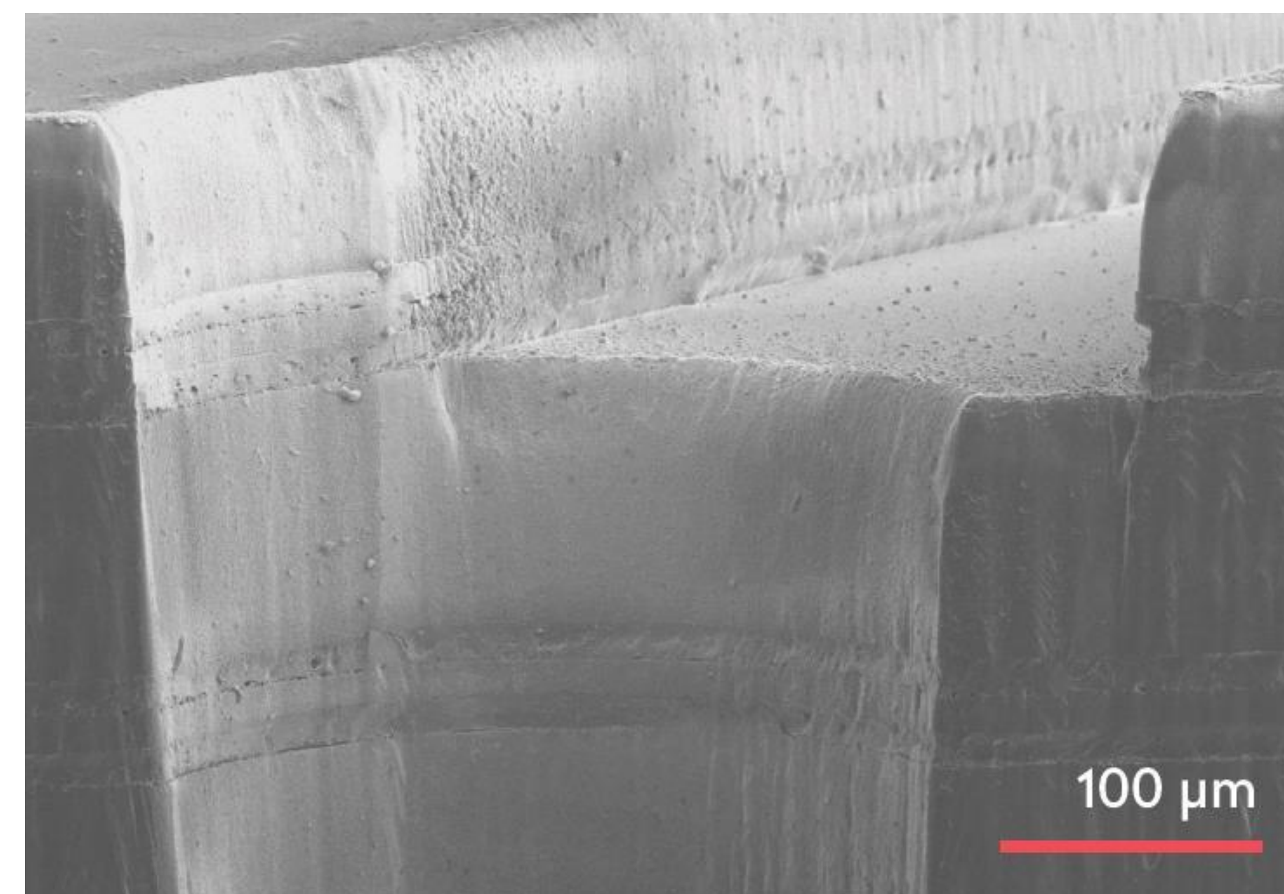
Wide range of channel width and depth
with aspect ratio up to 1:100



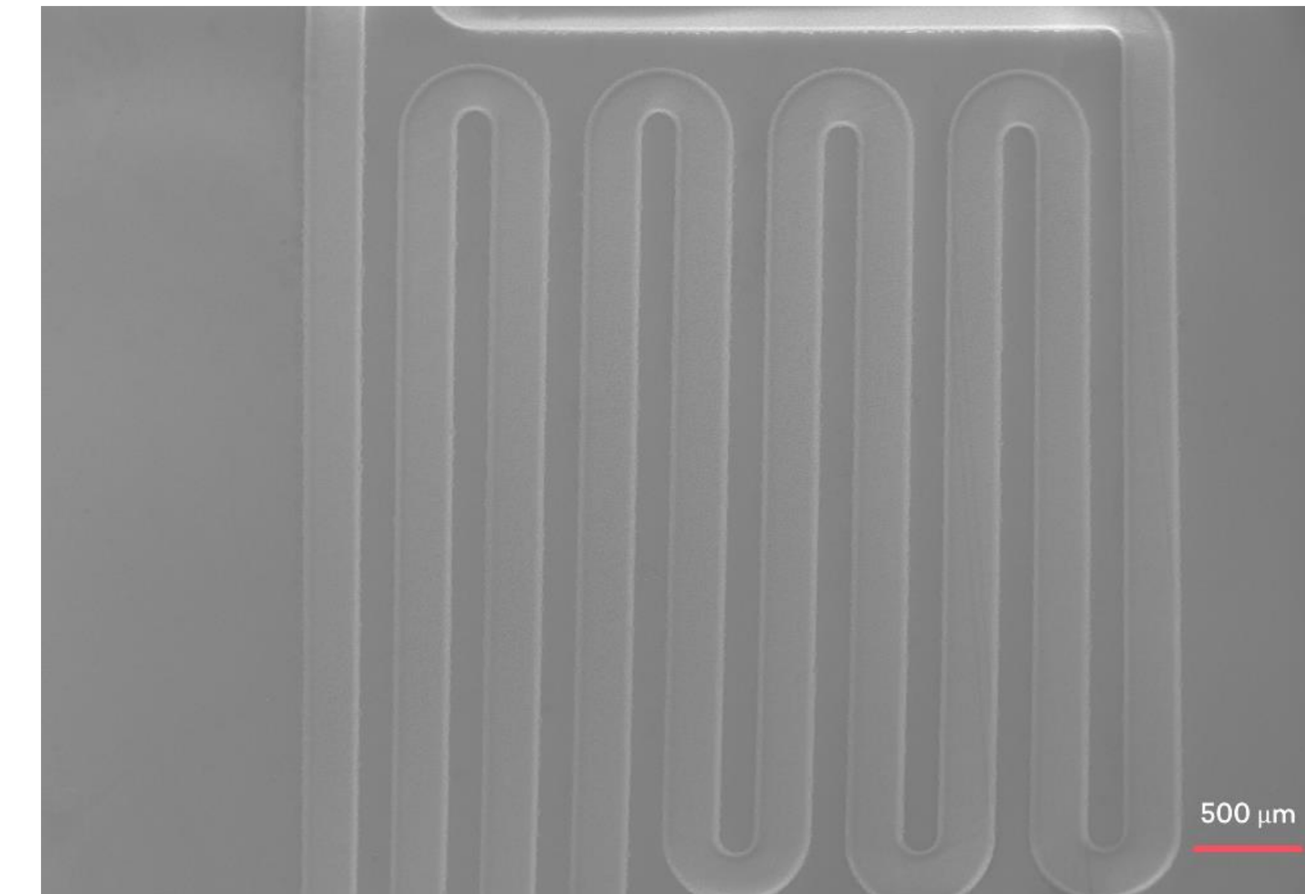
Microfluidics channels drilling with SLE



Microfluidics channels formation in glass



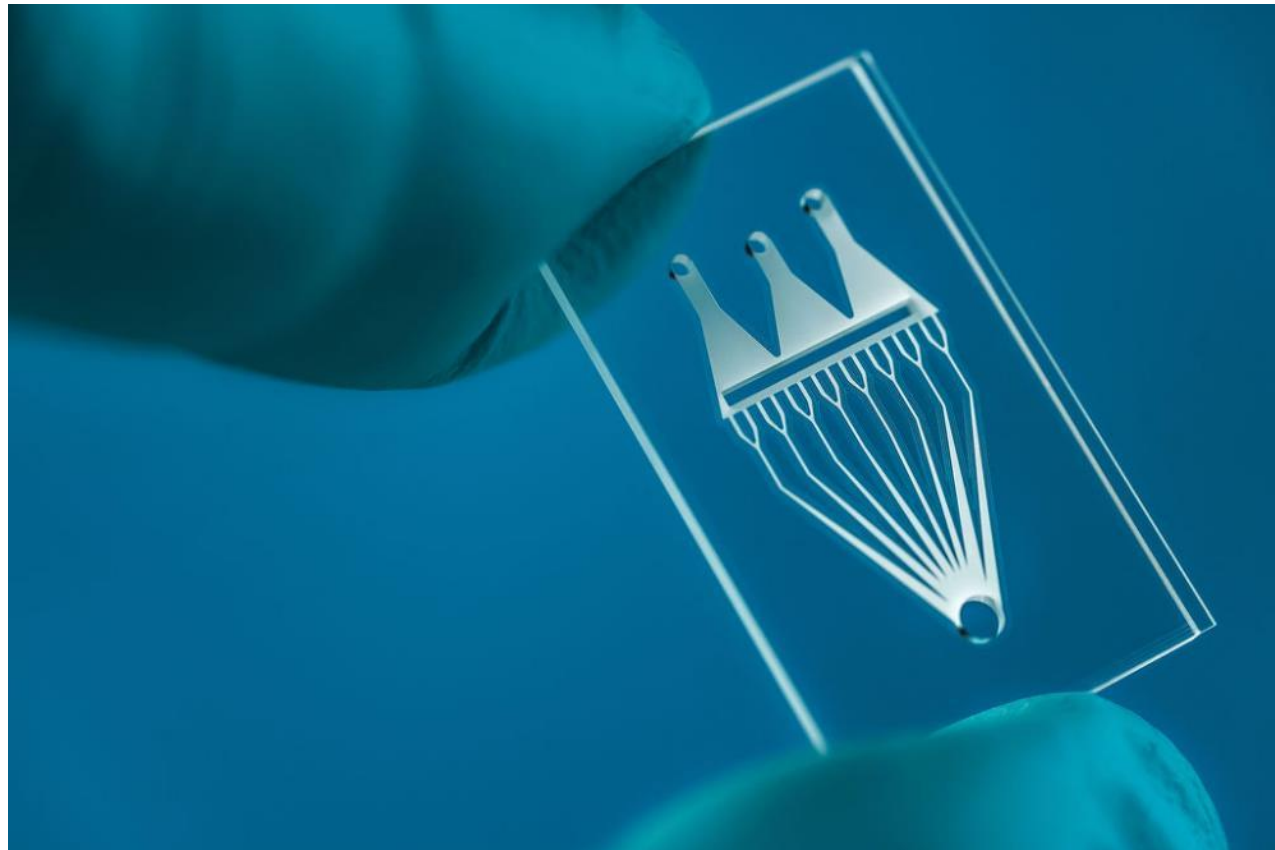
Microfluidics chips channel drilling

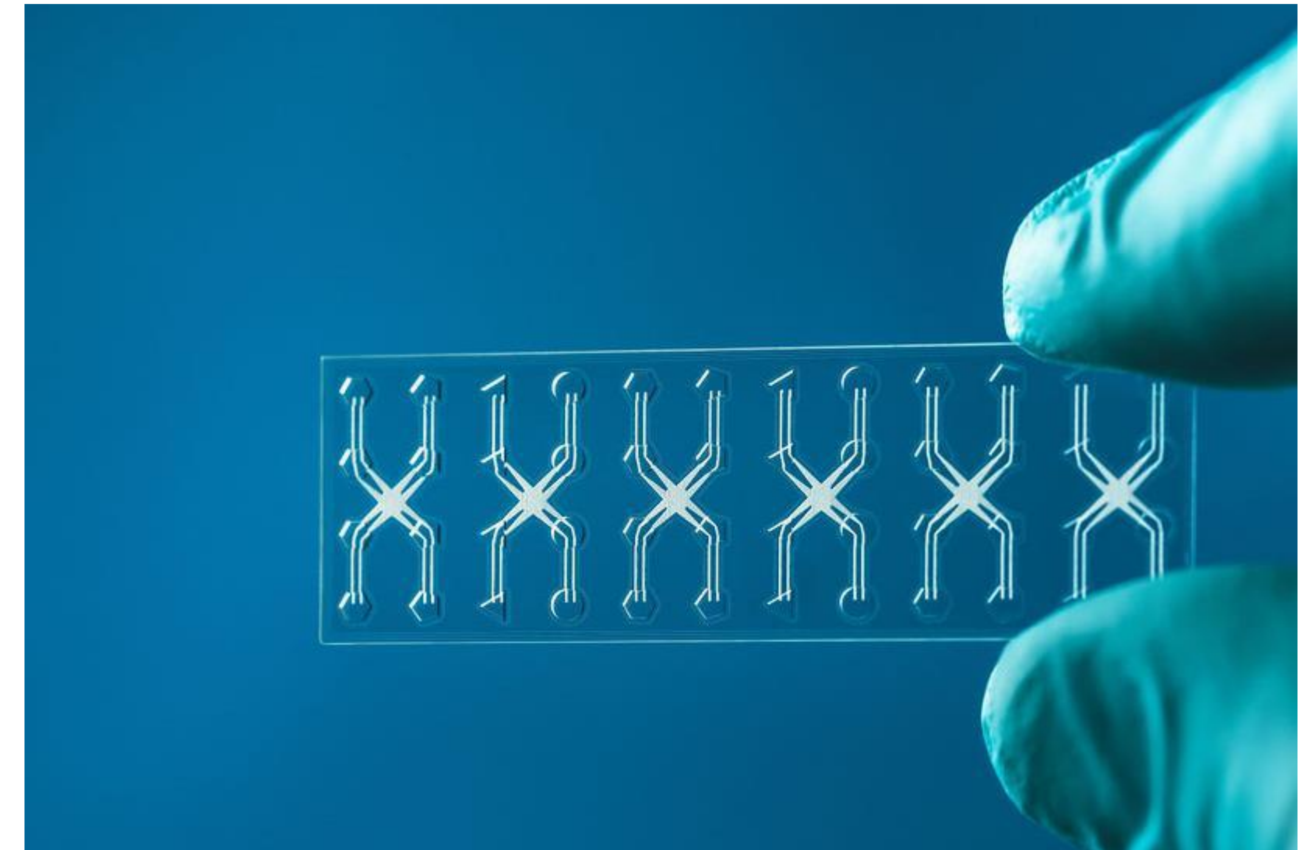


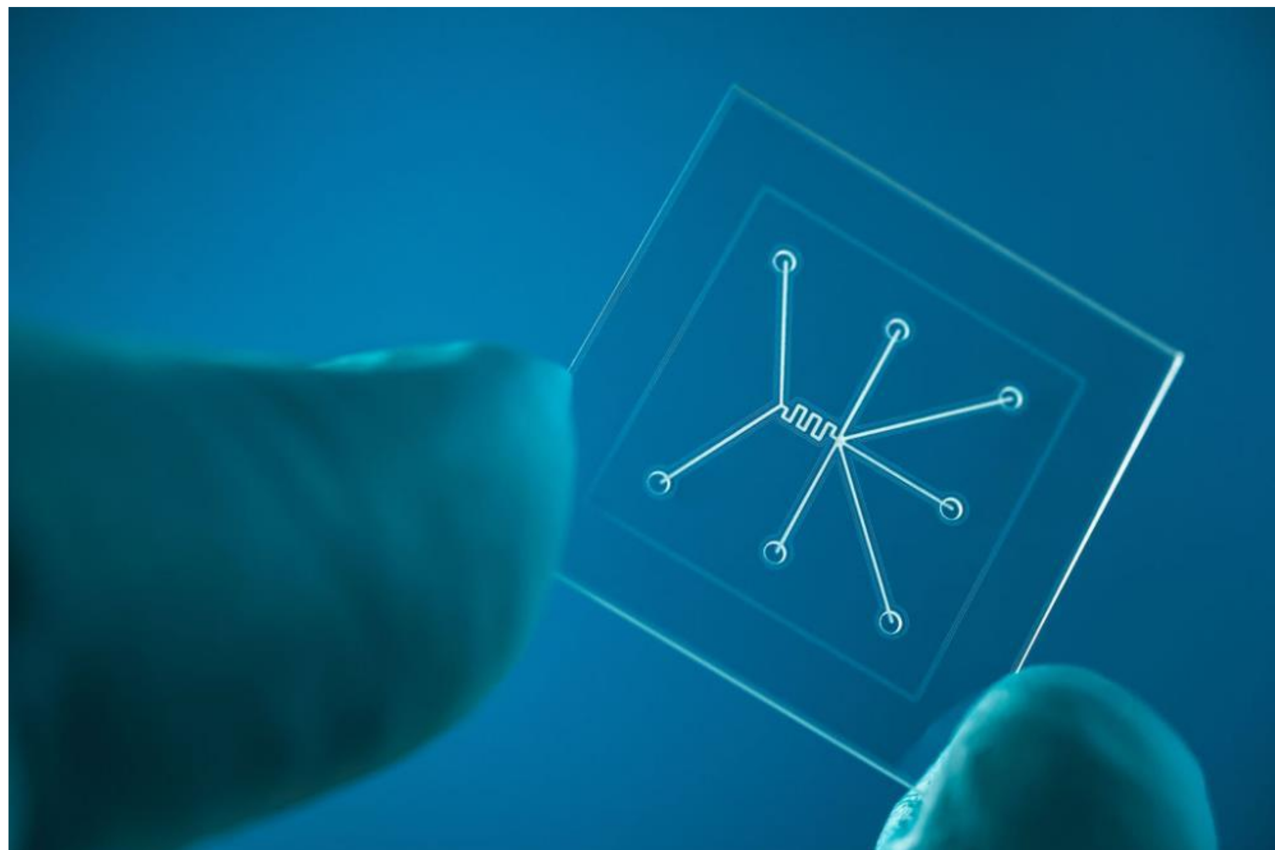
Microfluidics channels formation in glass

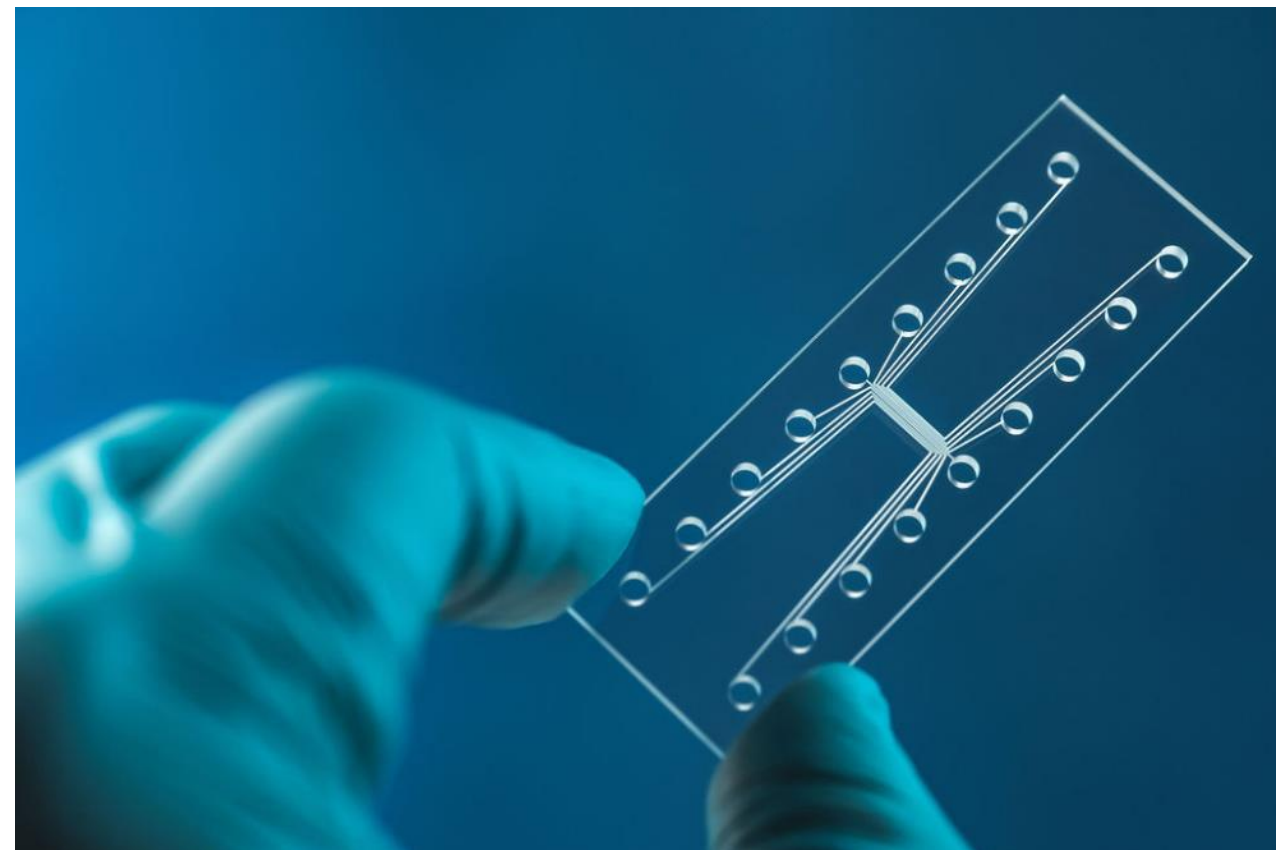
Microfluidics: Custom solutions

WOP



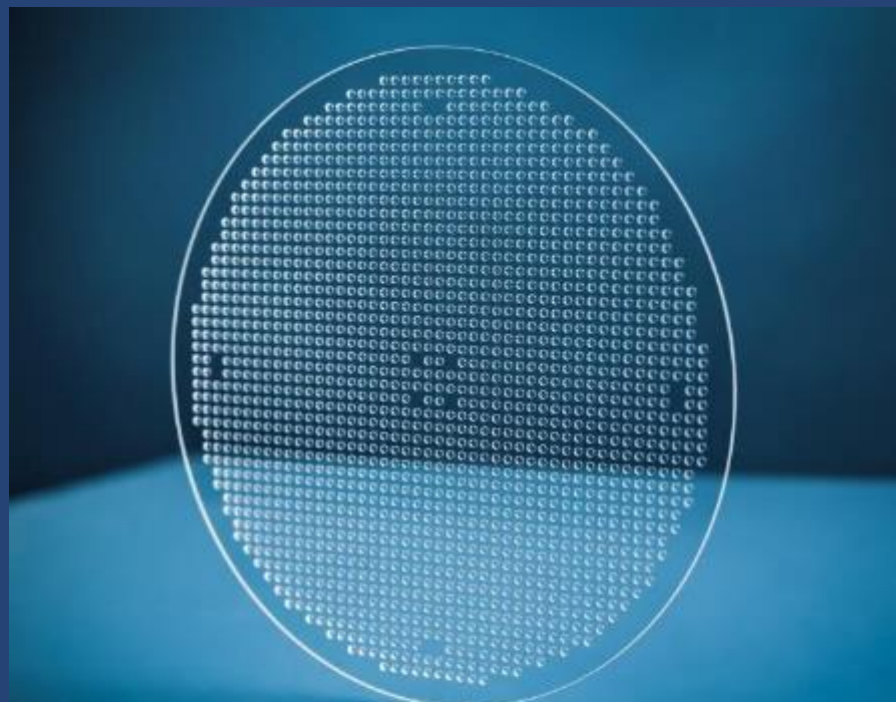


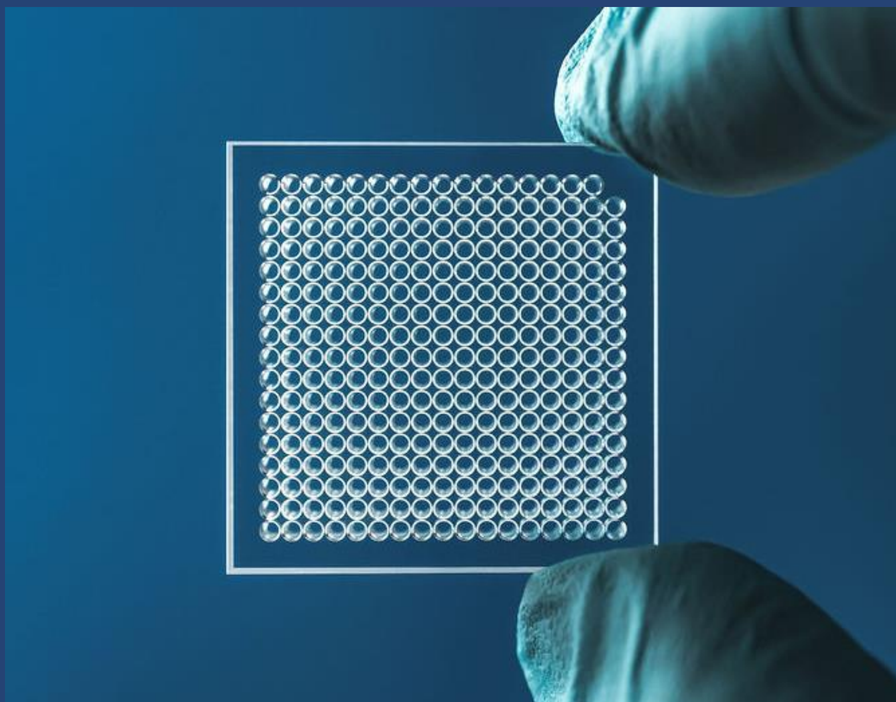




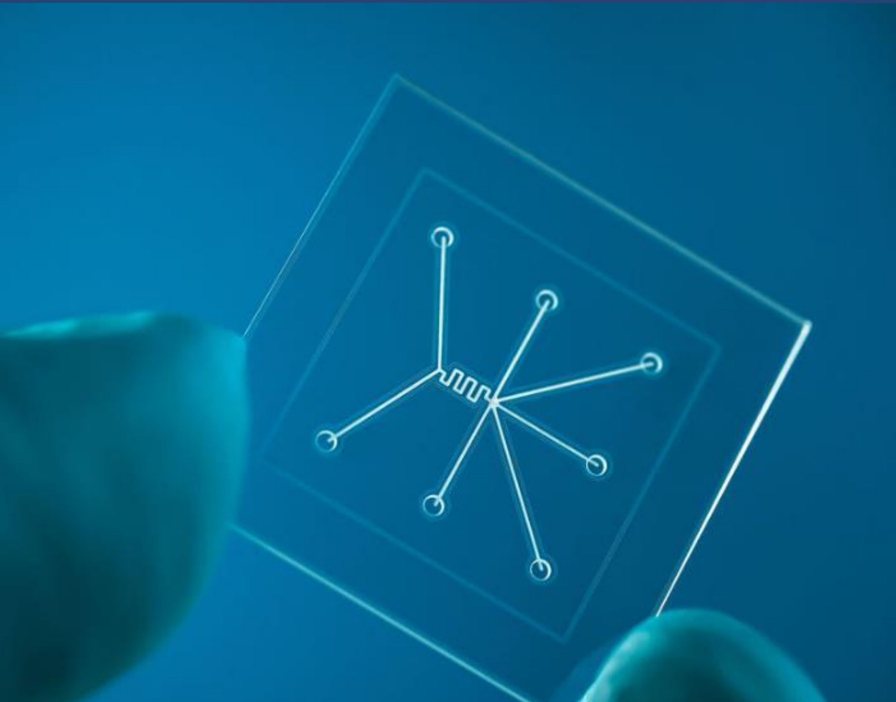
Overview

W O P


GLASS SPACERS


MICRO DRILLED GLASS

GLASS GUIDE PLATES
FOR PROBE CARDS


MICROFLUIDIC CHIPS

PACKAGING GLASS
PRODUCTS

GLASS CARRIER WAFERS

GLASS CUTTING

MICROWELL PLATES

We’ll deliver a solution for your µ task!

Thank you & let’s talk!

Ernestas Nacius
ernestas.nacius@wophotonics.com

Workshop of Photonics | Altechna R&D, UAB
Mokslininku St. 6A, Vilnius
LT-08412 Lithuania

www.wophotonics.com