nanoscribe
A BICO COMPANY

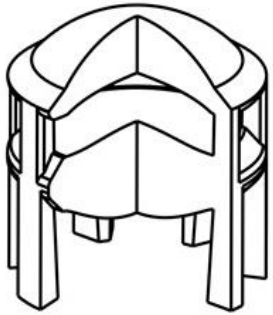
3D-Druck von Master-Templates für die Mikrooptik und Mikrofluidik

Dr. Jochen Zimmer, Sales Manager
Nanoscribe GmbH & Co. KG

Coffee Lectures 2022/2023: Polymers for the Future
25. Januar 2023: Smarte Prozesse: Aktivierung und Mikroproduktion

We build 3D microfabrication systems

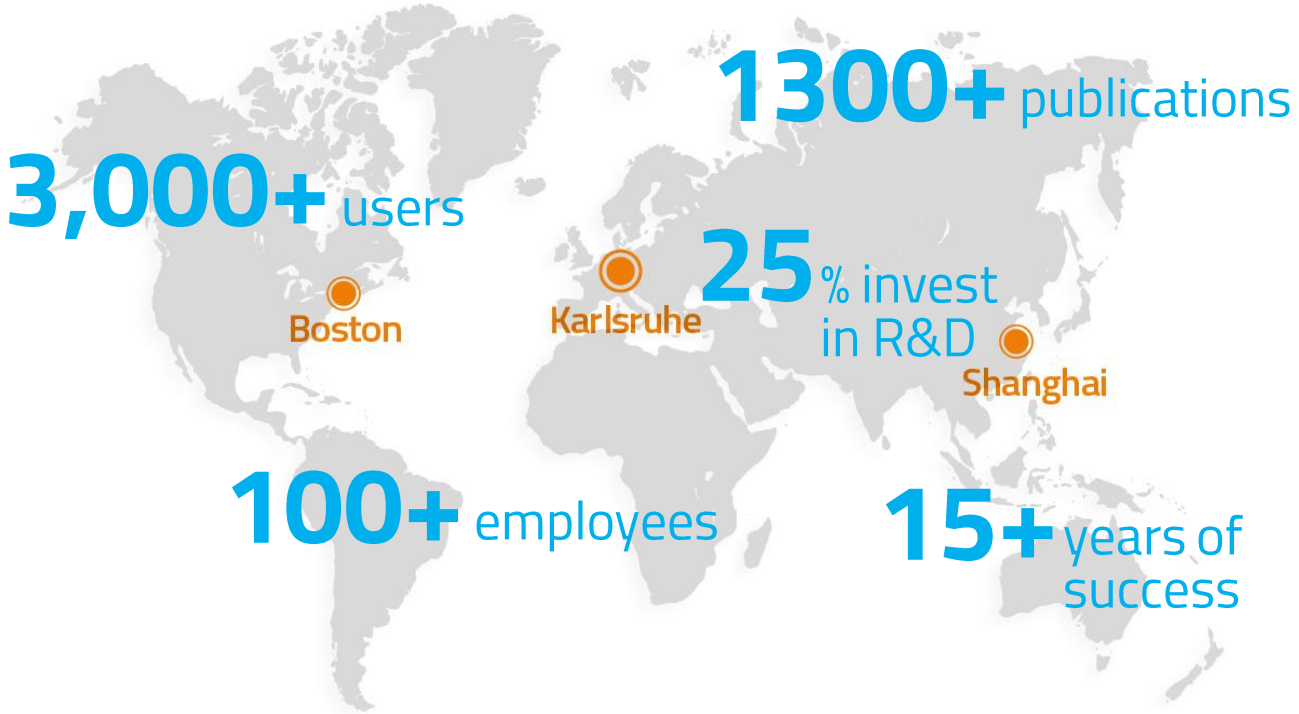
Design file



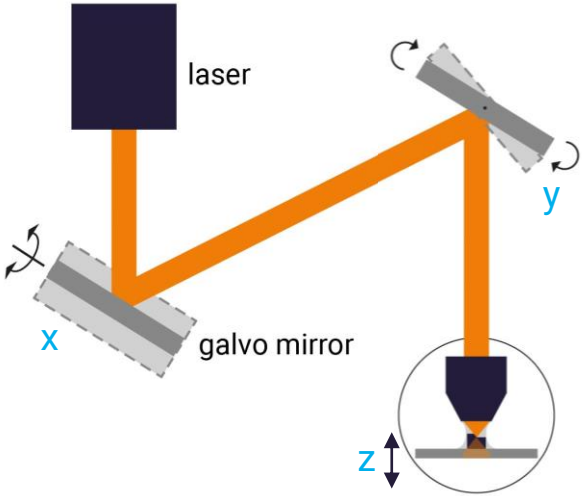
Microstructure


100 µm

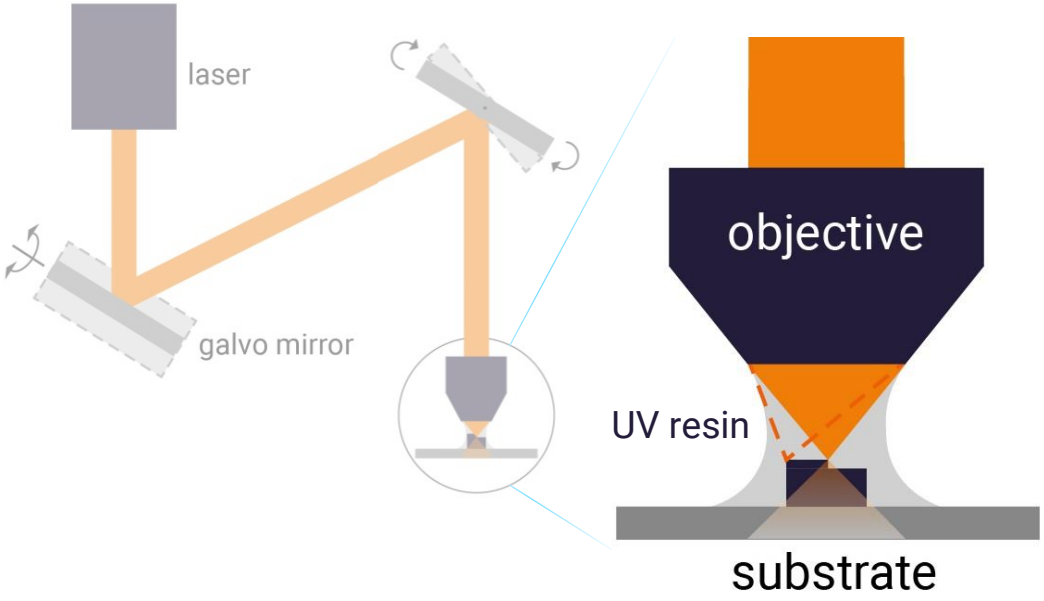
Nanoscribe worldwide in figures



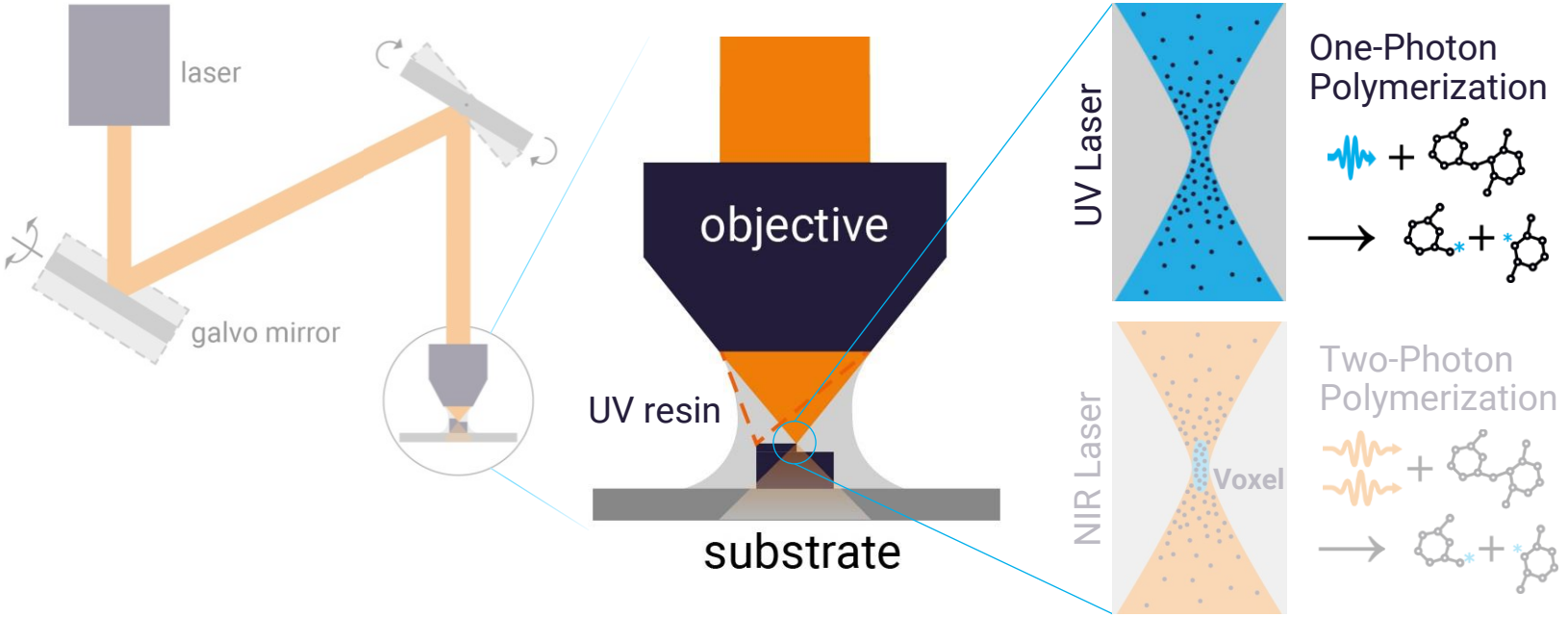
Technology basics
Galvo scanners for highest print speed



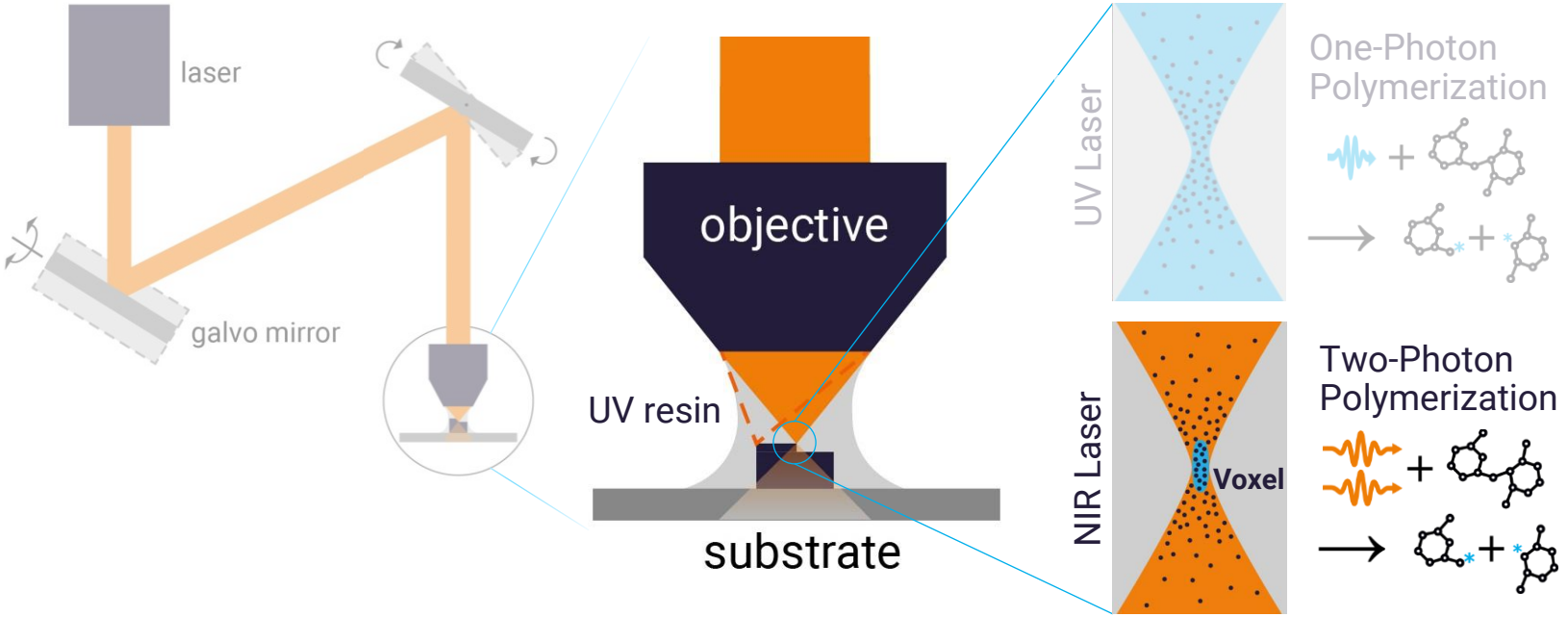
Technology basics
Dip-in Laser Lithography (DiLL)



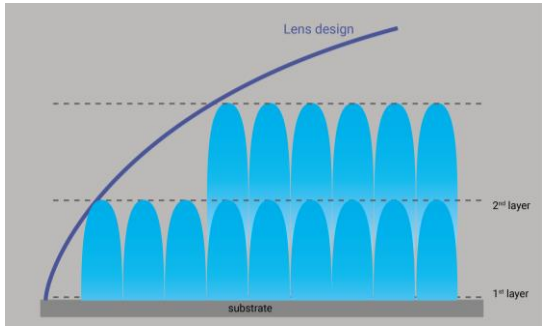
Technology basics
Two-Photon Polymerization (2PP)

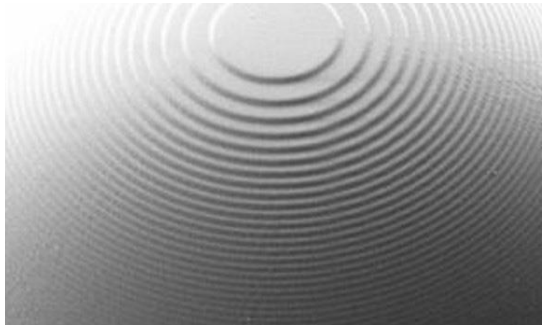


Technology basics
Two-Photon Polymerization (2PP)



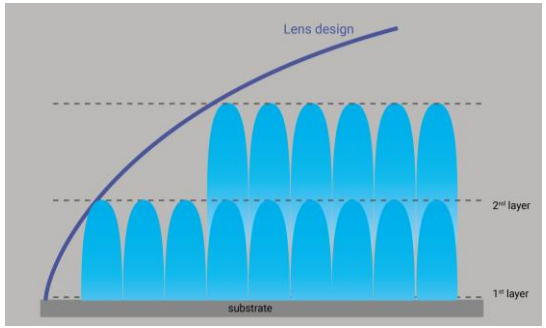
Challenge in high-precision 3D printing
Staircasing vs. printing speed

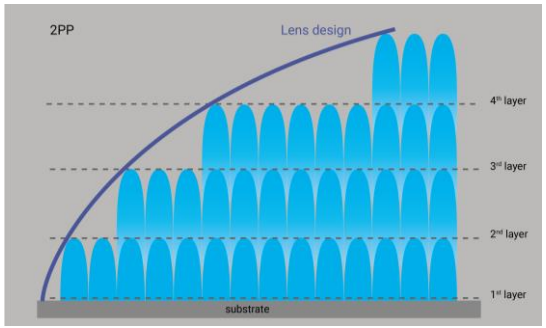


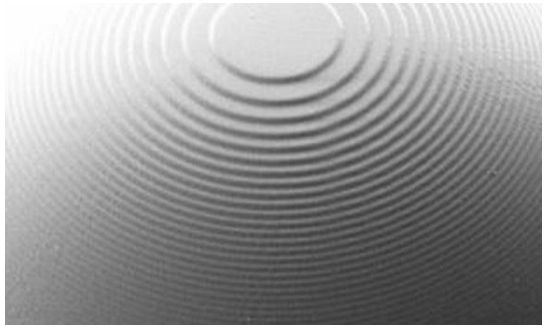


Slicing distance 2 µm

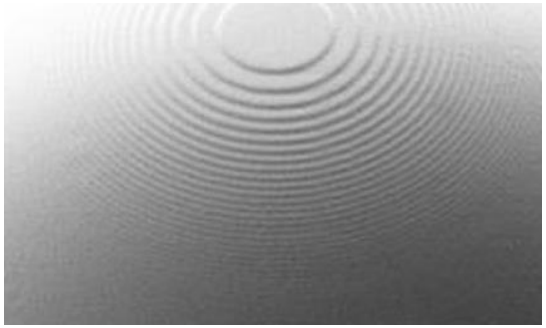
Challenge in high-precision 3D printing
Staircasing vs. printing speed





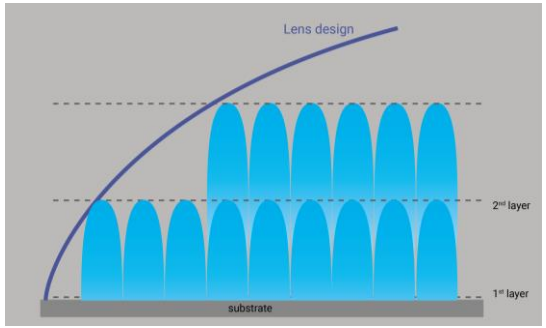


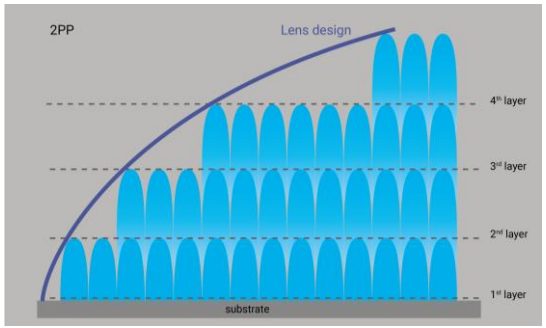
Slicing distance 2 µm

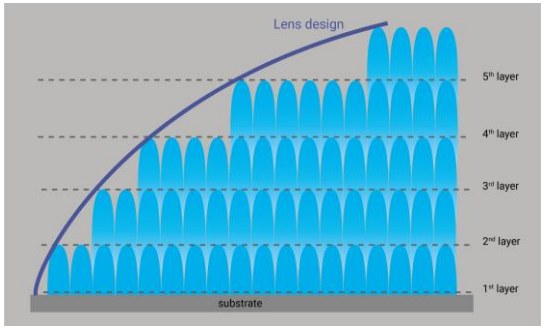


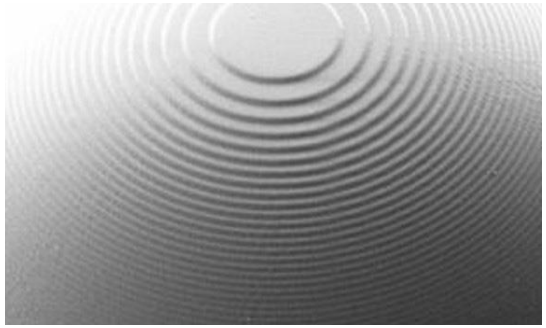
Slicing distance 1 µm

Challenge in high-precision 3D printing
Staircasing vs. printing speed

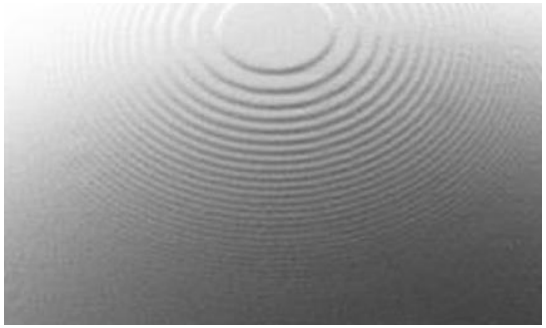




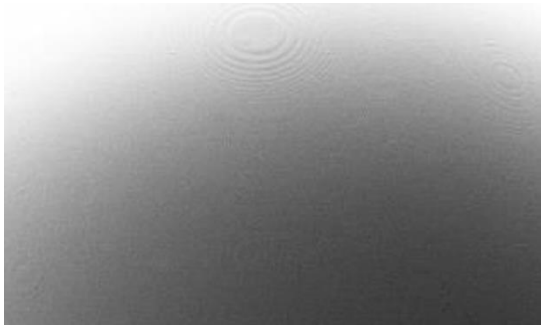




Slicing distance 2 µm

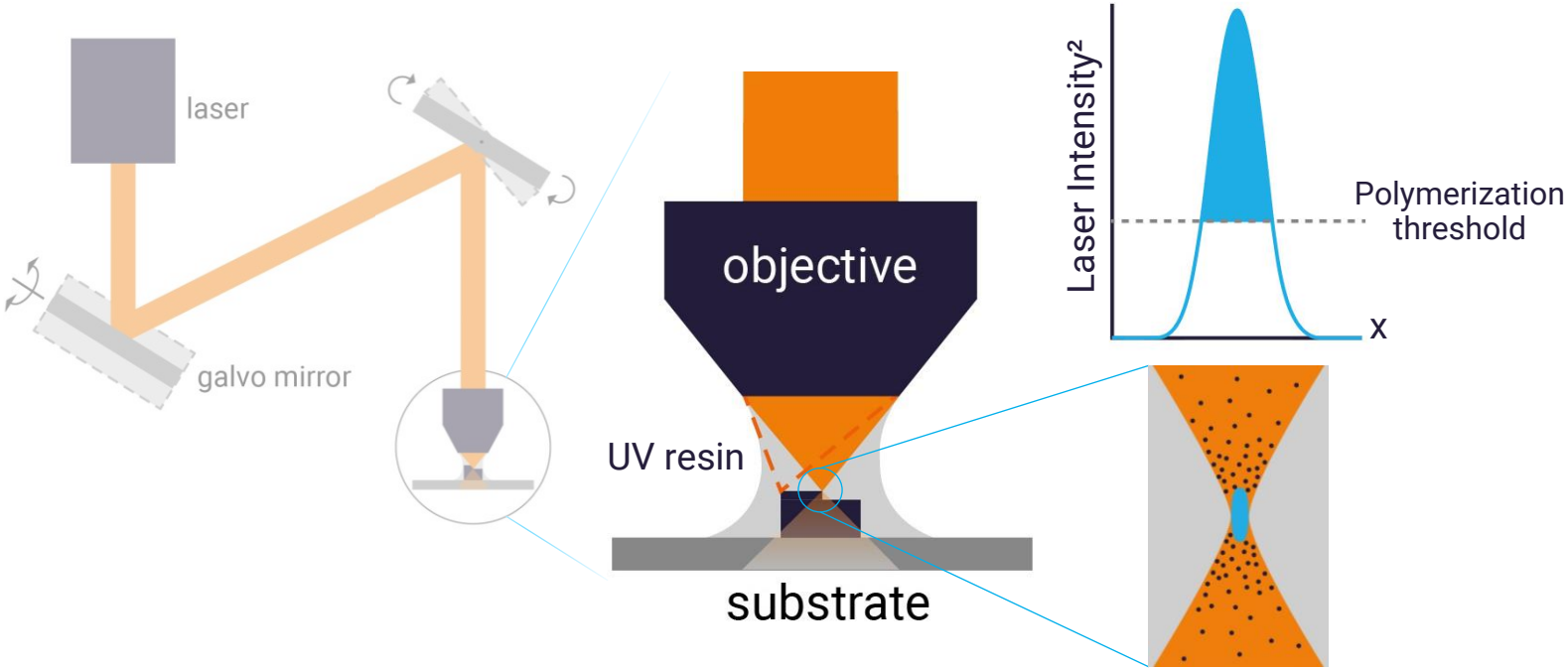


Slicing distance 1 µm

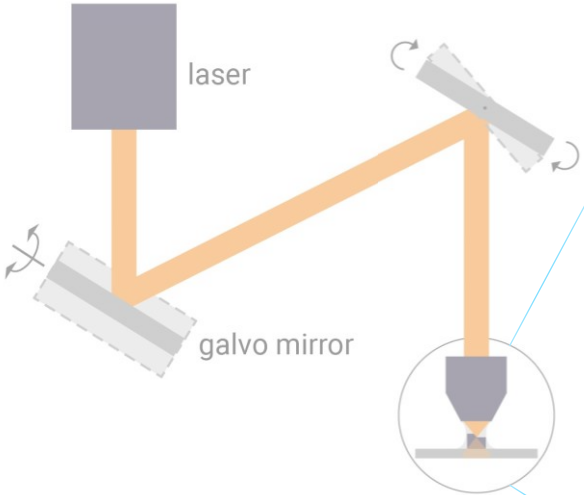


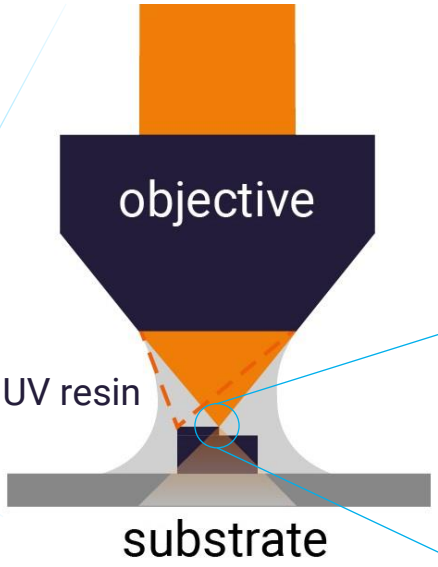
Slicing distance 0.6 µm

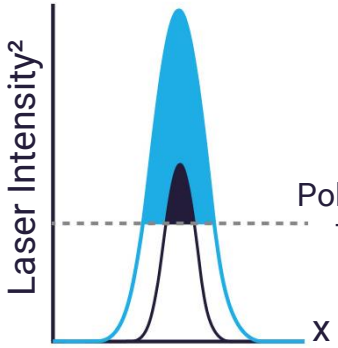
Technology basics
Two-Photon Grayscale Lithography (2GL®)

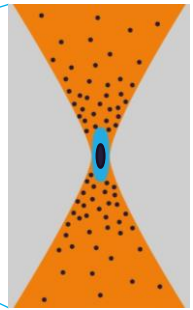


Technology basics
Two-Photon Grayscale Lithography (2GL®)



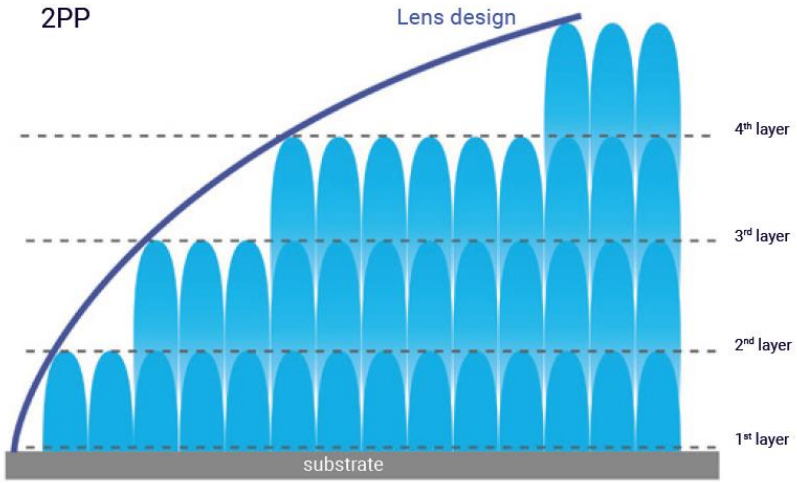


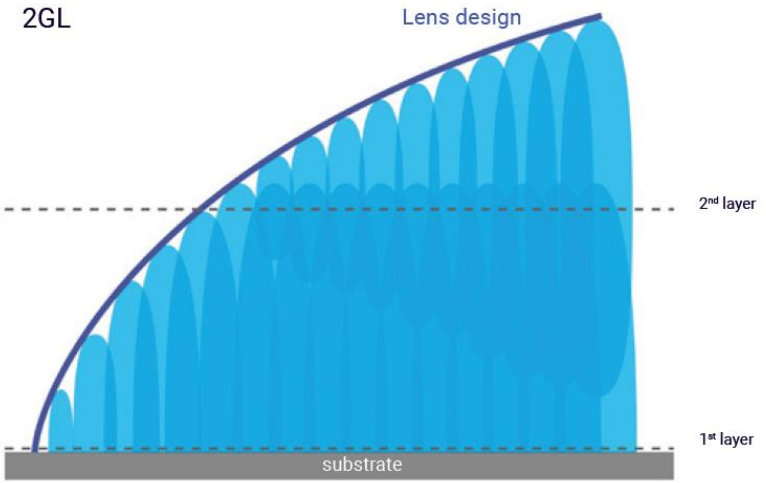


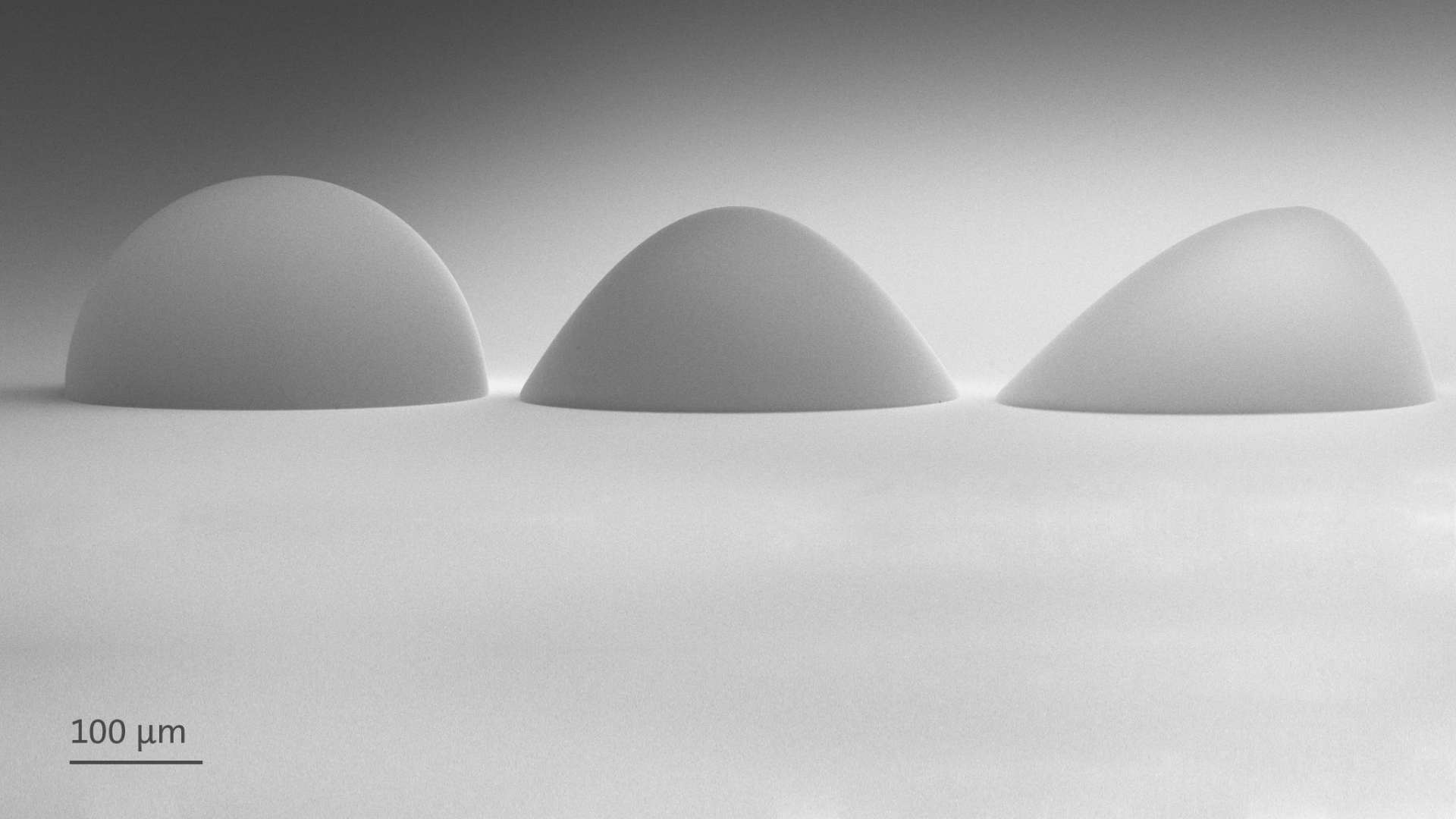


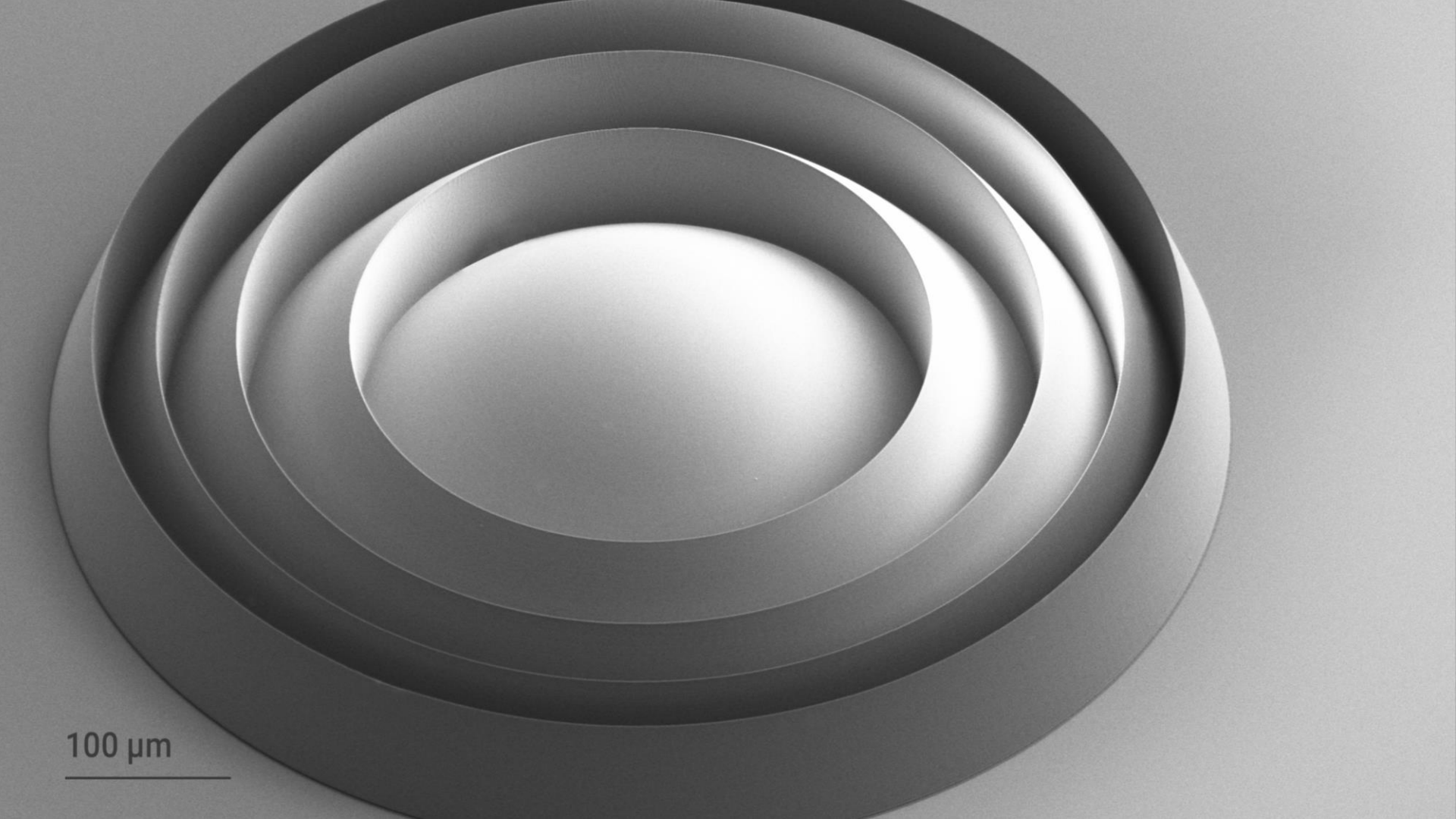
Dynamic voxel size control

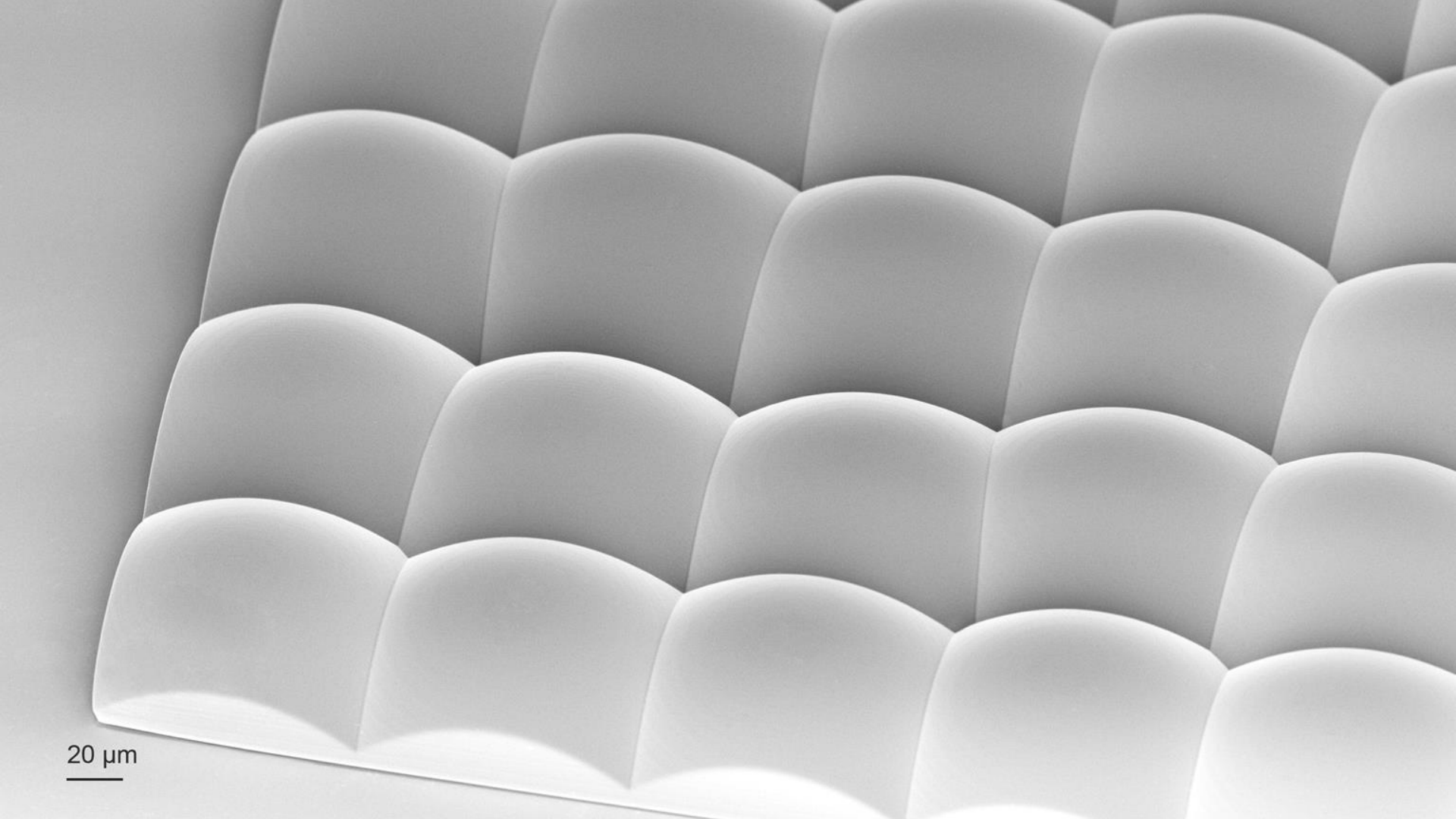
Challenge in 3D printing
Staircasing vs. printing speed



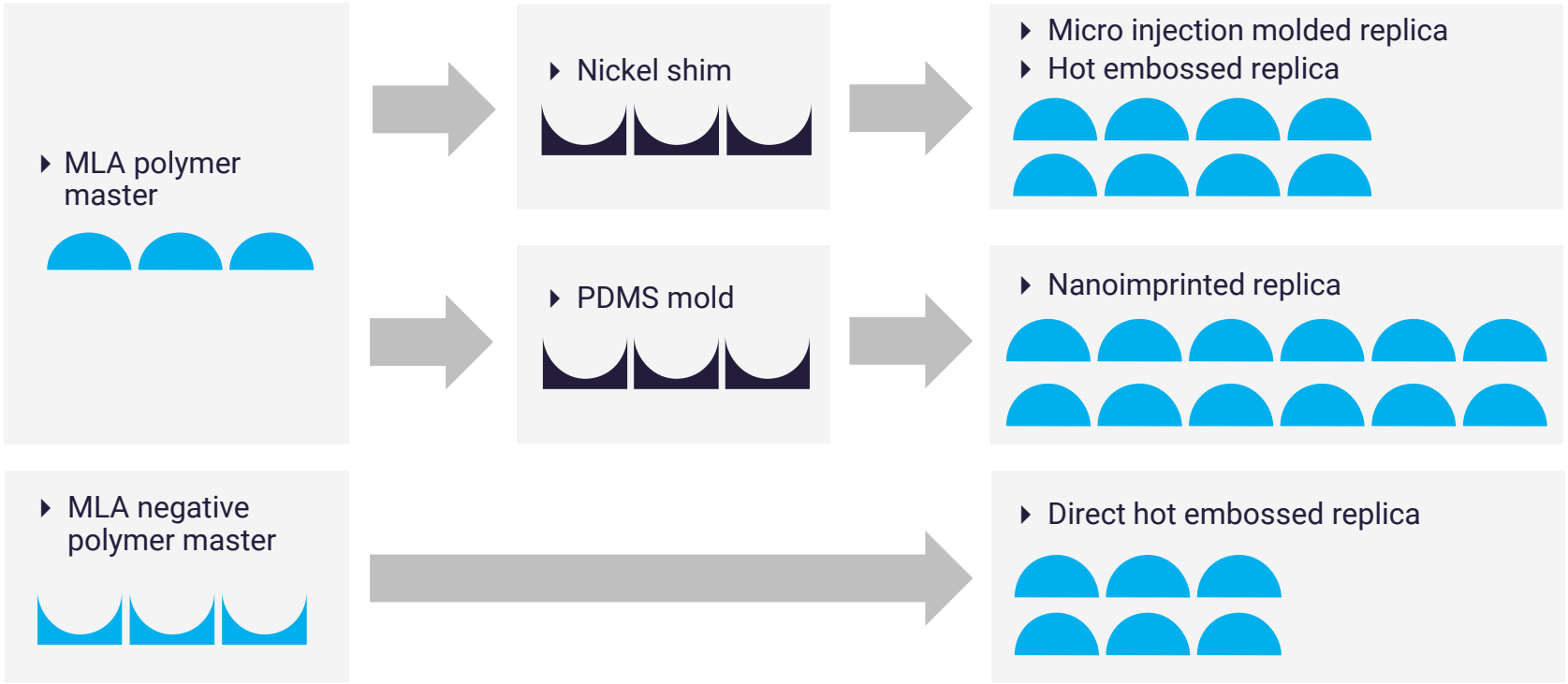



100 µm


100 µm

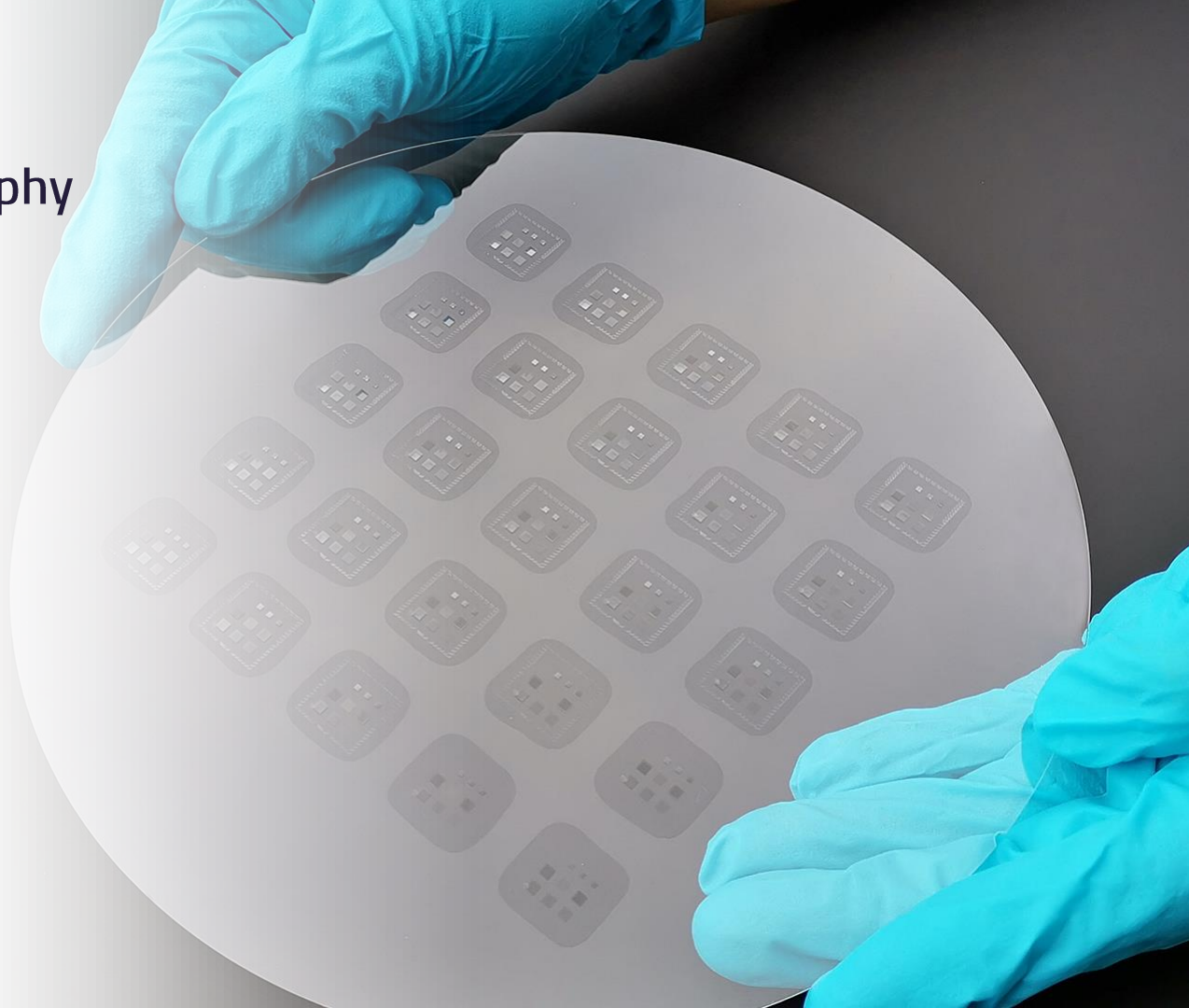

20 µm

Replication processes
From polymer master to small series production



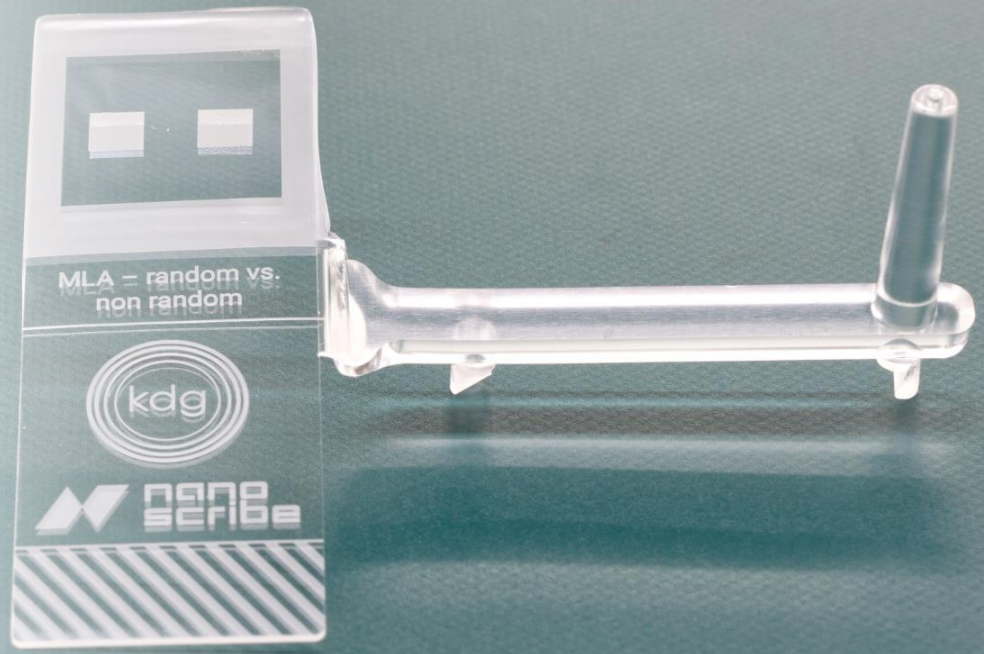
Replication processes
Nanoimprint Lithography

- 8” wafer
- Nanoimprint replica
- Produced by our partner EV Group

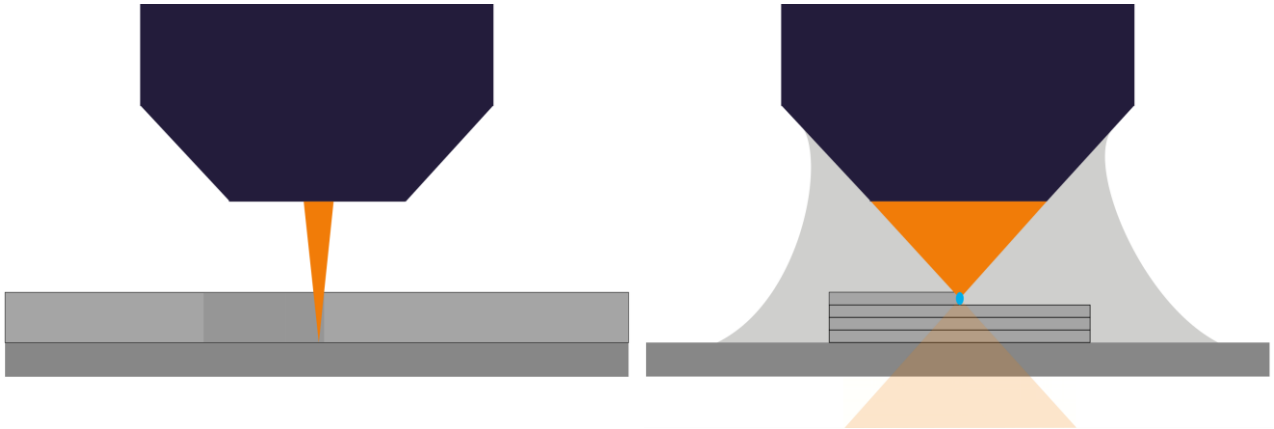


Replication processes
Injection Molding

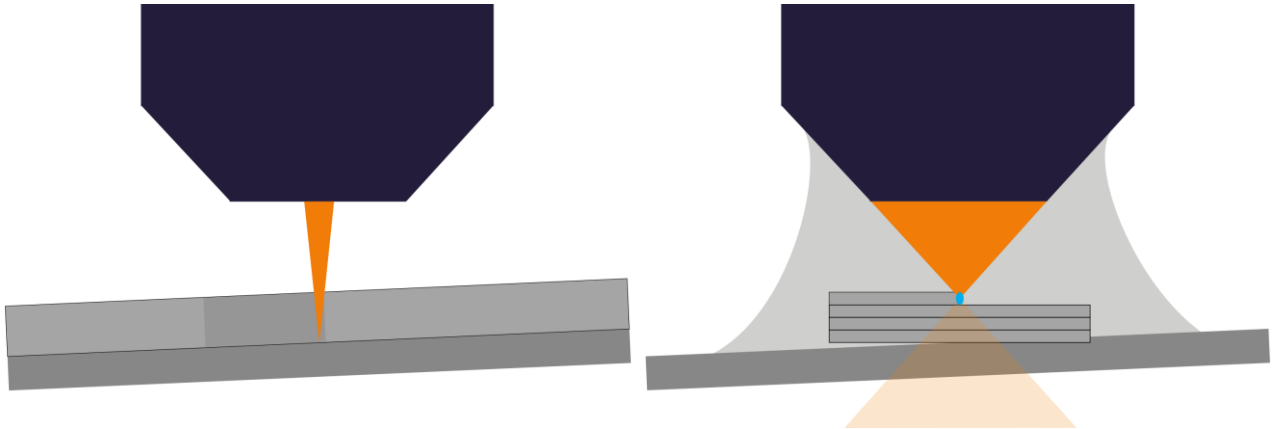
- Beam homogenizer
- Injection molded replica
- Sprue and runner still attached
- Produced by our partner kdg



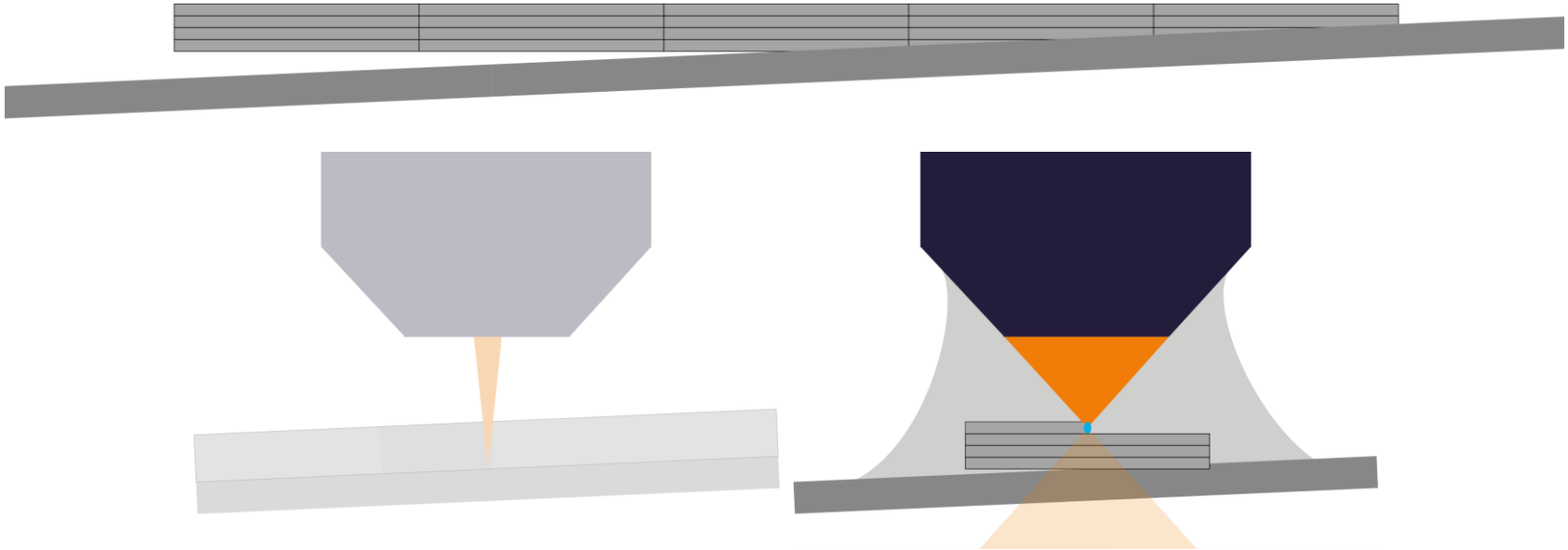
2D direct laser writing vs. 3D additive microfabrication



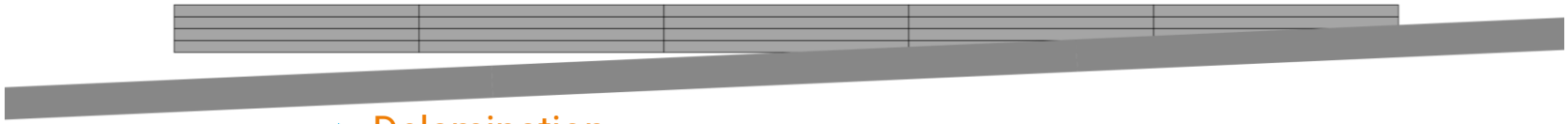
Sensitivity to minute substrate tilts



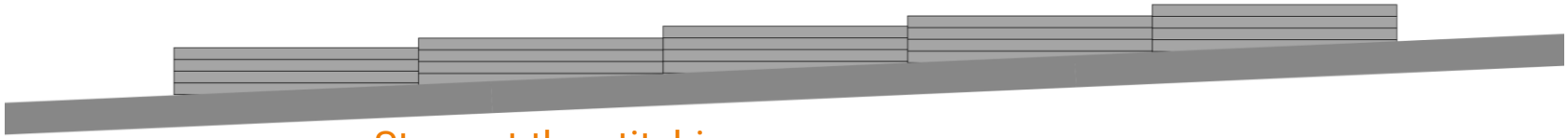
Large area fabrication on tilted substrates



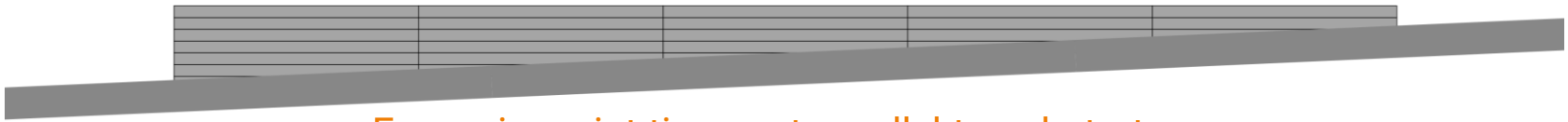
Large area fabrication on tilted substrates



- Delamination

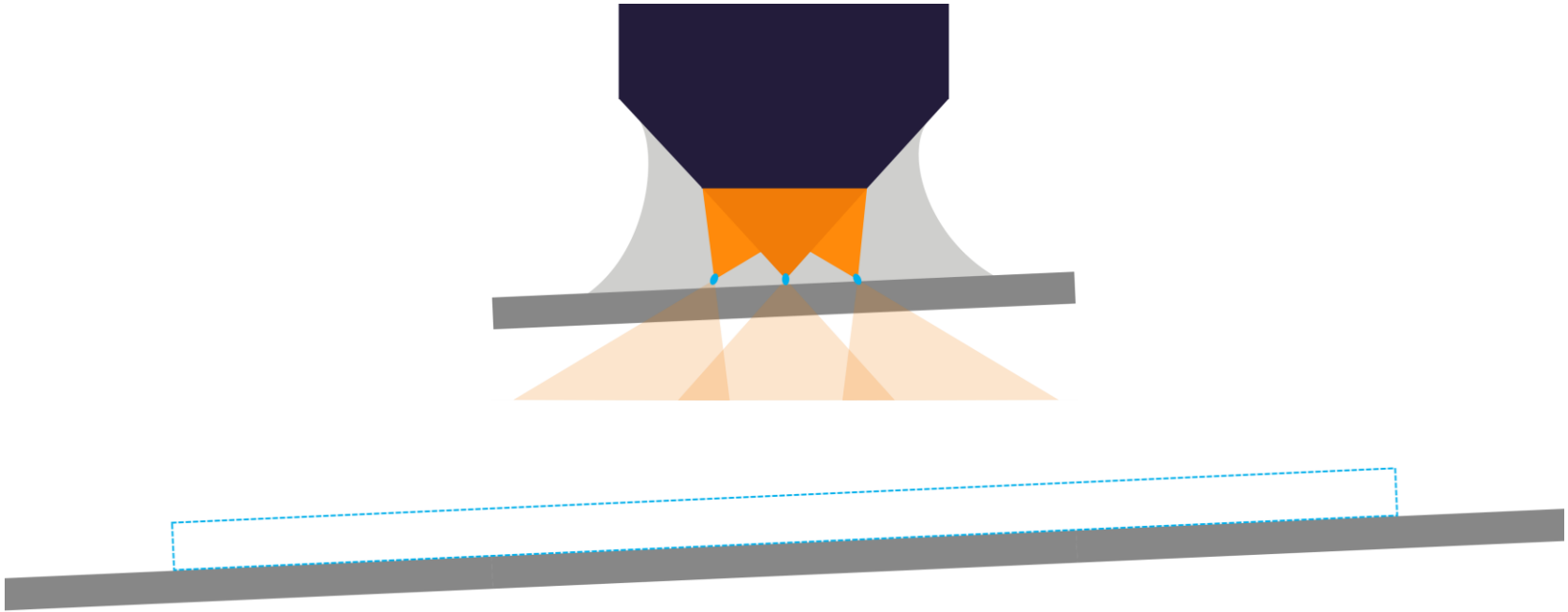


- Steps at the stitching seams

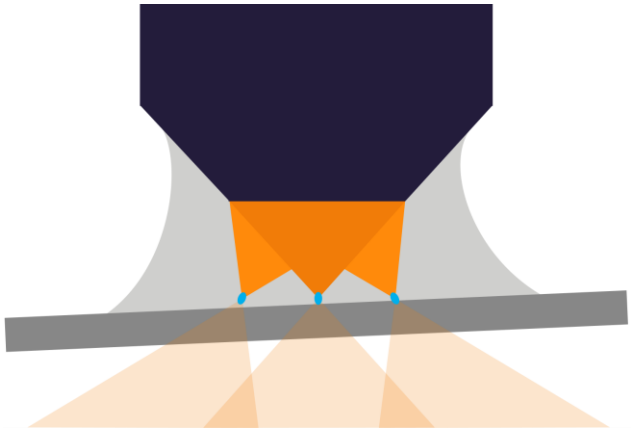


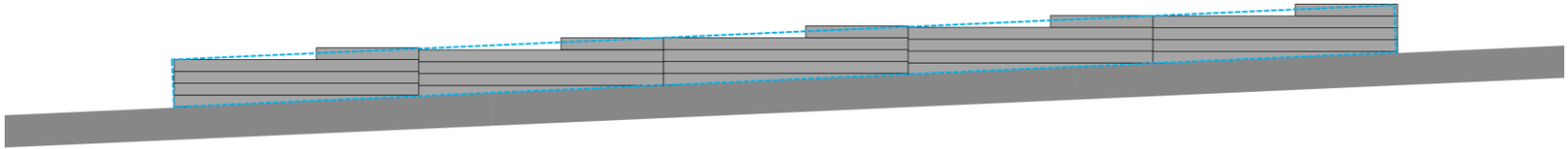
- Excessive print time, not parallel to substrate

Measure tilt and rotate design

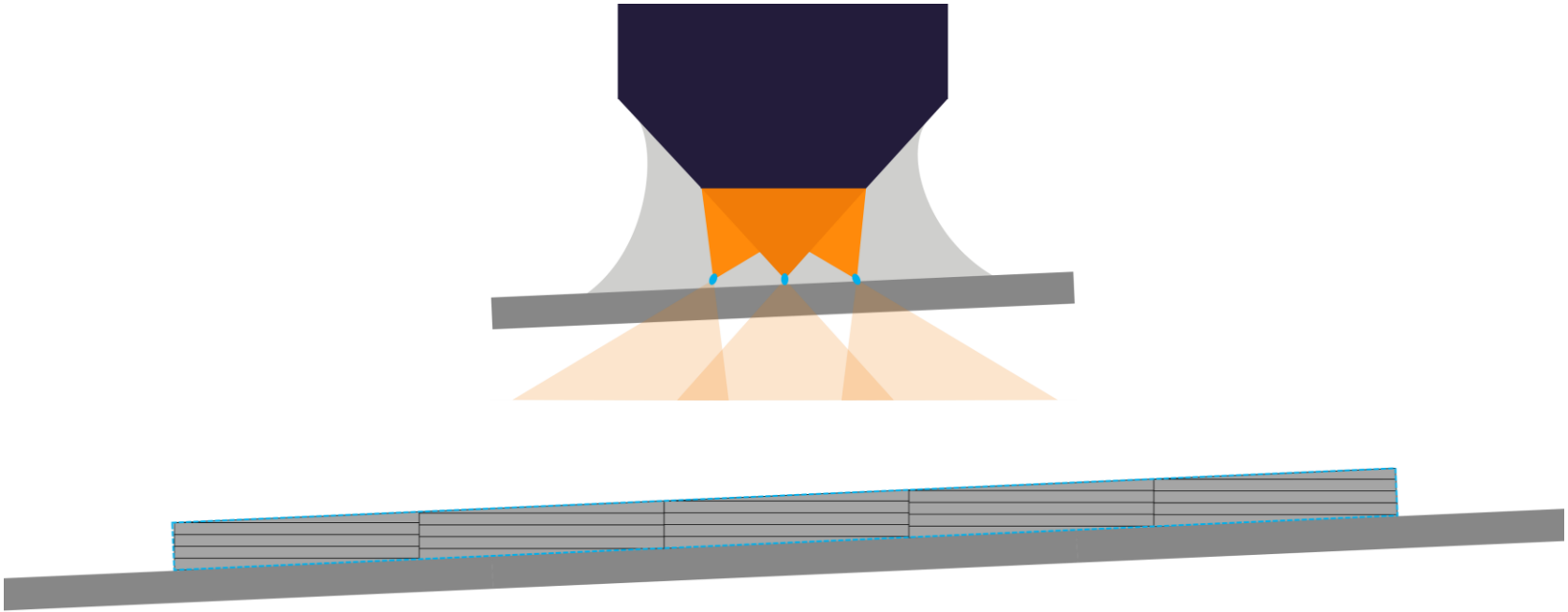


Measure tilt and rotate design with conventional slicing



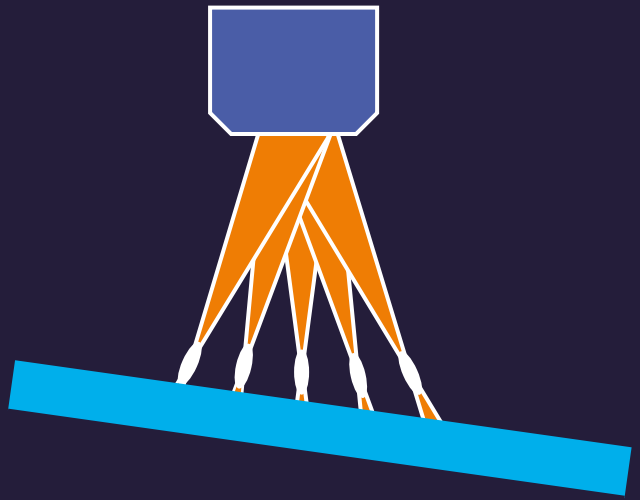


Measure tilt and rotate design with 2GL



Printing on wafer: Printing process

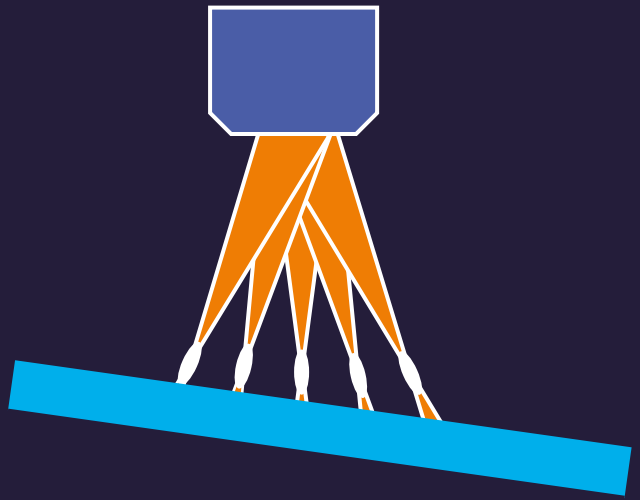
- Tilt measurement



PCT/EP2022/052687 patent pending

Printing on wafer: Printing process

- Tilt measurement



PCT/EP2022/052687 patent pending

Refractive beam diffuser based on random MLA

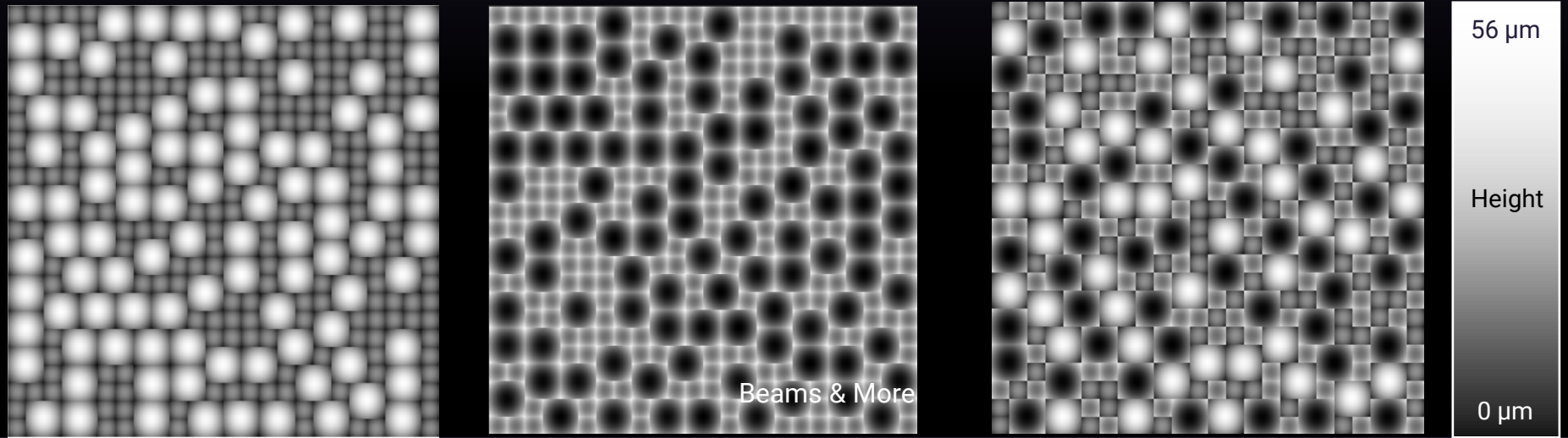
- Design files exported to grayscale 16-bit PNG images with a pixel size of 200nm
- Base unit 1.8 mm wide was repeated in a 3x3 array to create a 5.4 mm diffuser.

Convex (standard)

Concave

1.8 mm (base unit)

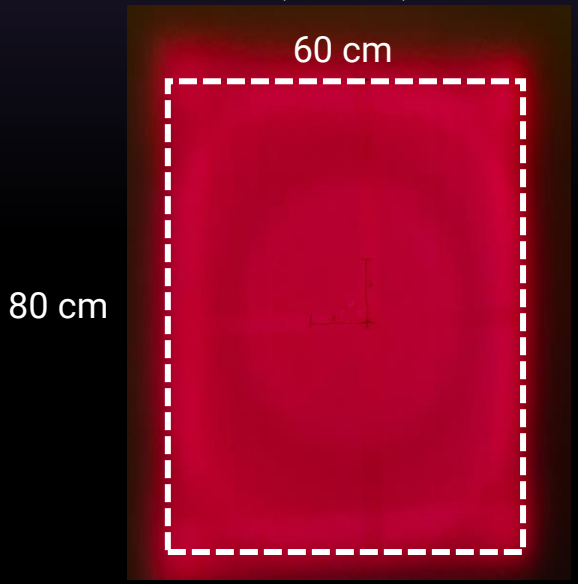
Mixed



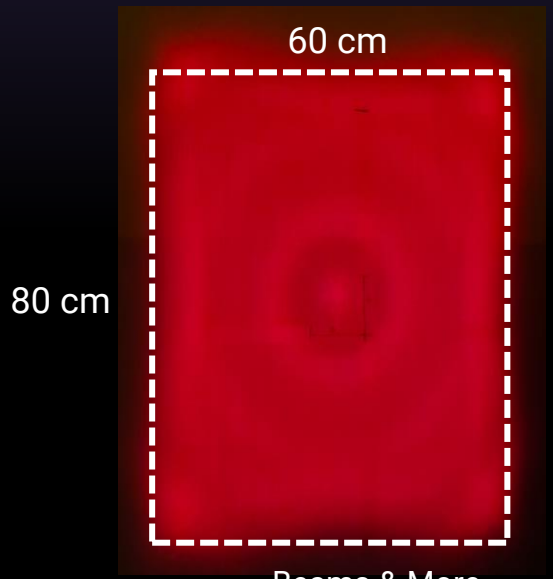
Refractive beam diffuser based on random MLA

- Experimental results

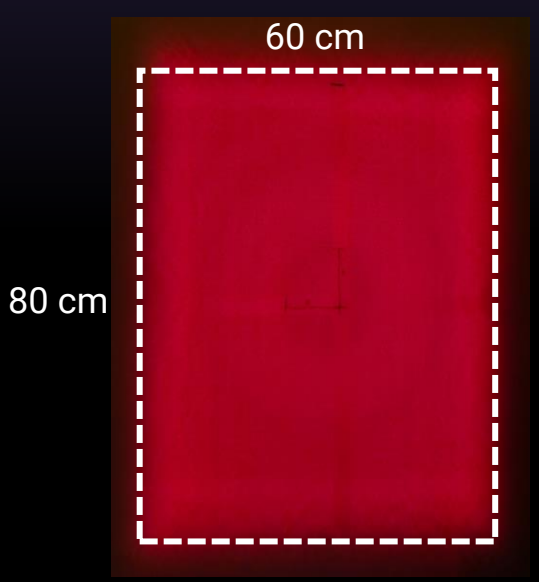
Convex (standard)

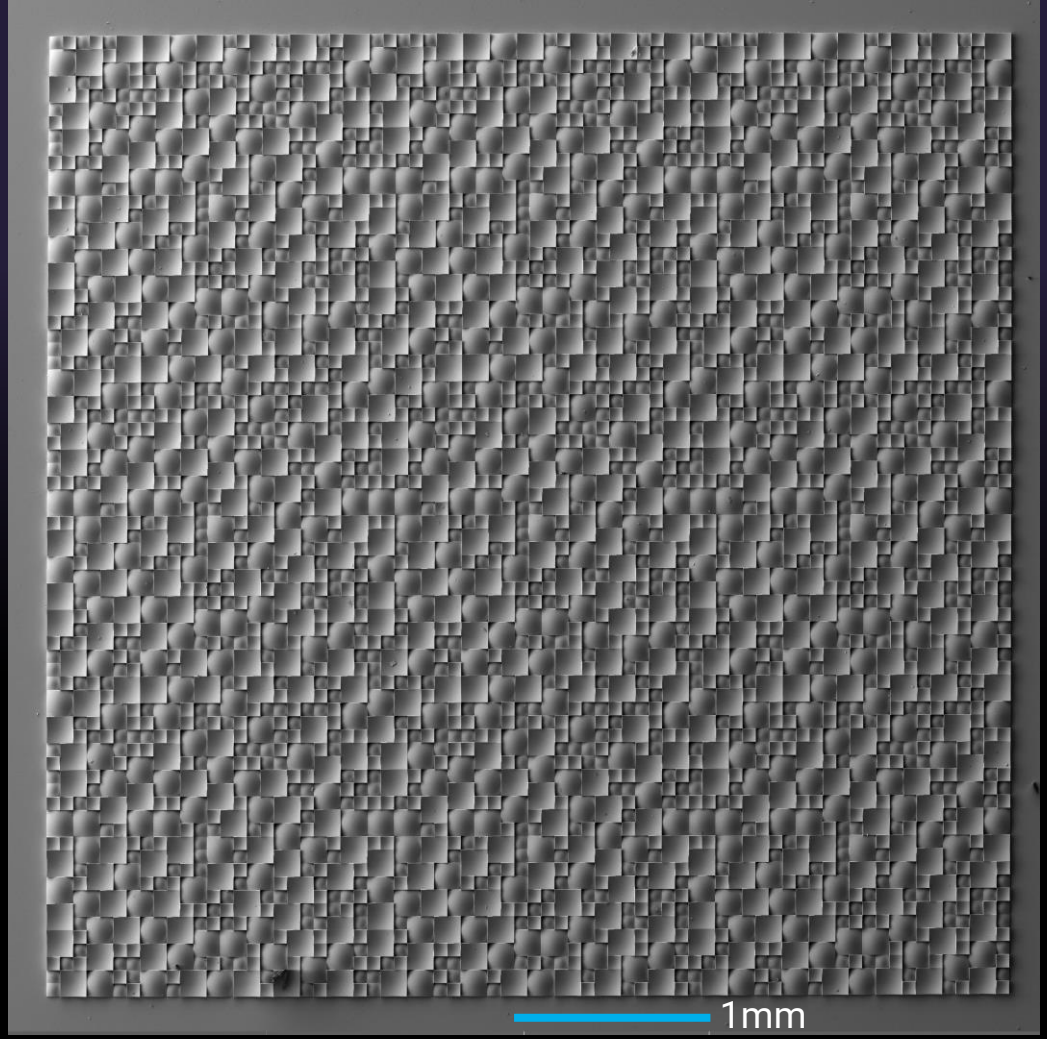


Concave

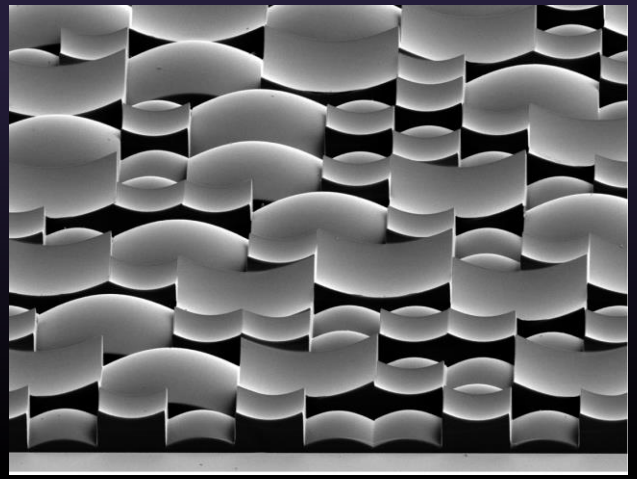


Mixed



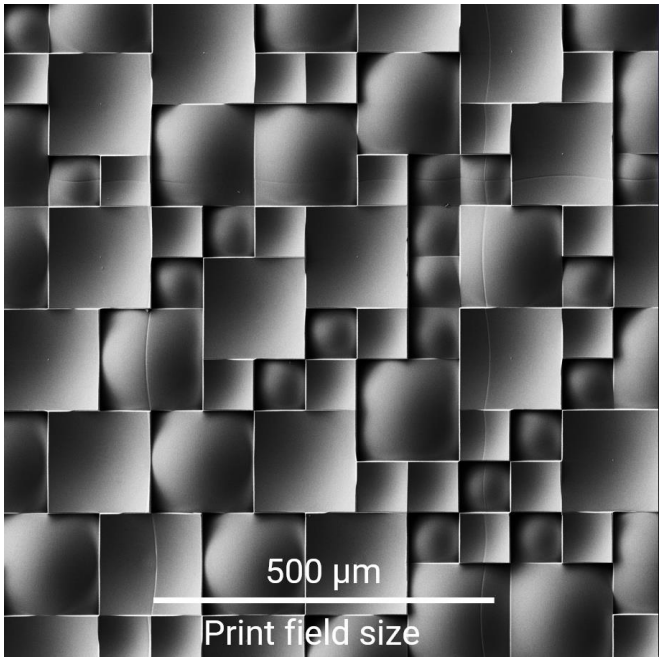


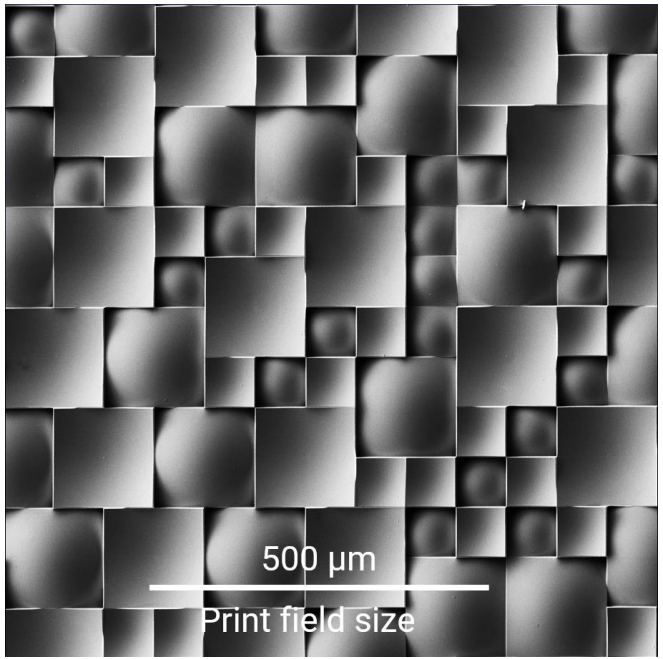
Tilt corrected sample



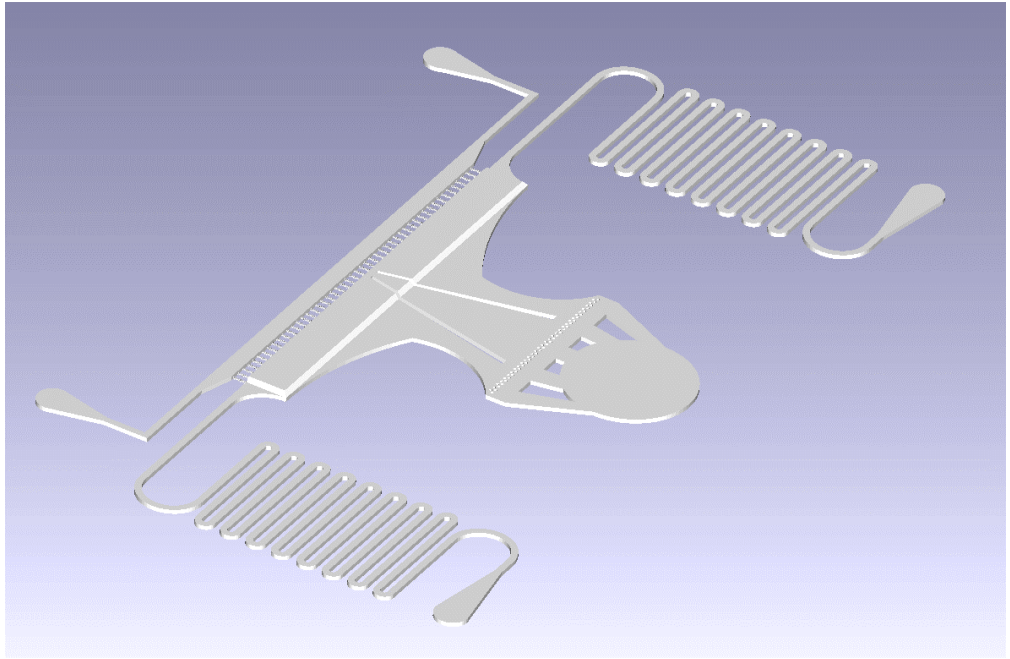
Very uniform patterning
accuracy over 5.4 x 5.4 mm²

2GL tilt-corrected stitching



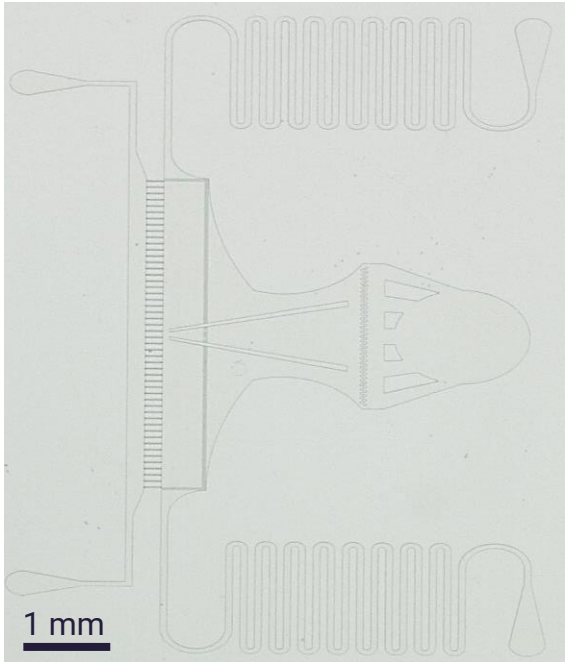


Microfluidic template by Aachener Verfahrenstechnik, RWTH

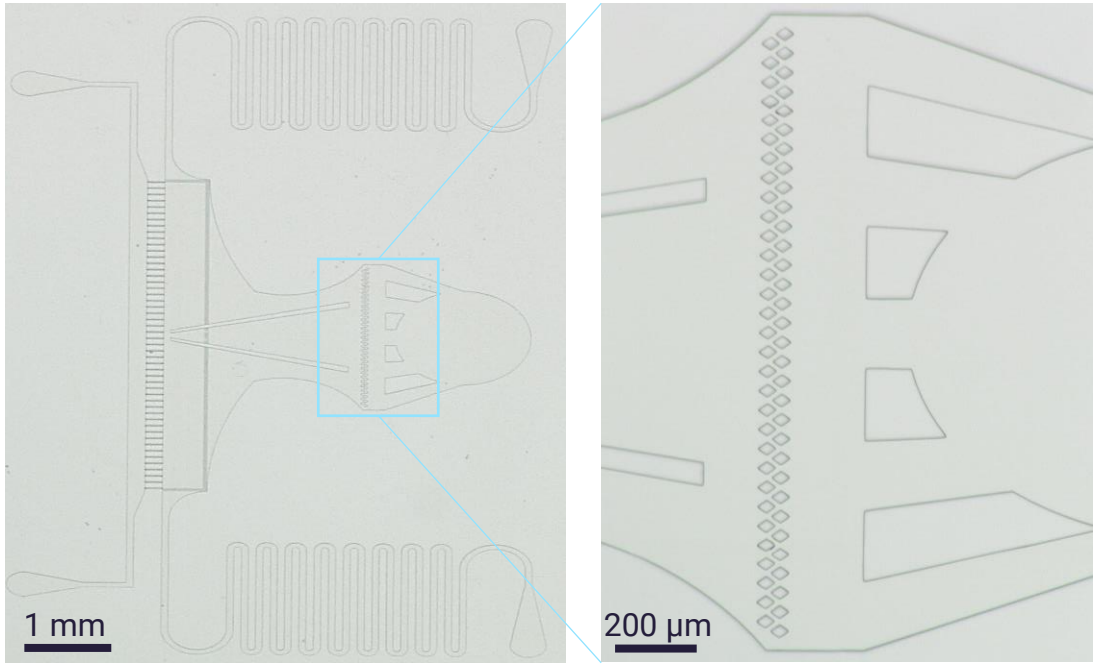


- Negative polymer template
- PDMS cast creates micro-fluidic channel structure
- Design by AVT, RWTH
- Printed with Quantum X, 2GL process, with
  - 2GL tilt correction
  - 2GL stitching

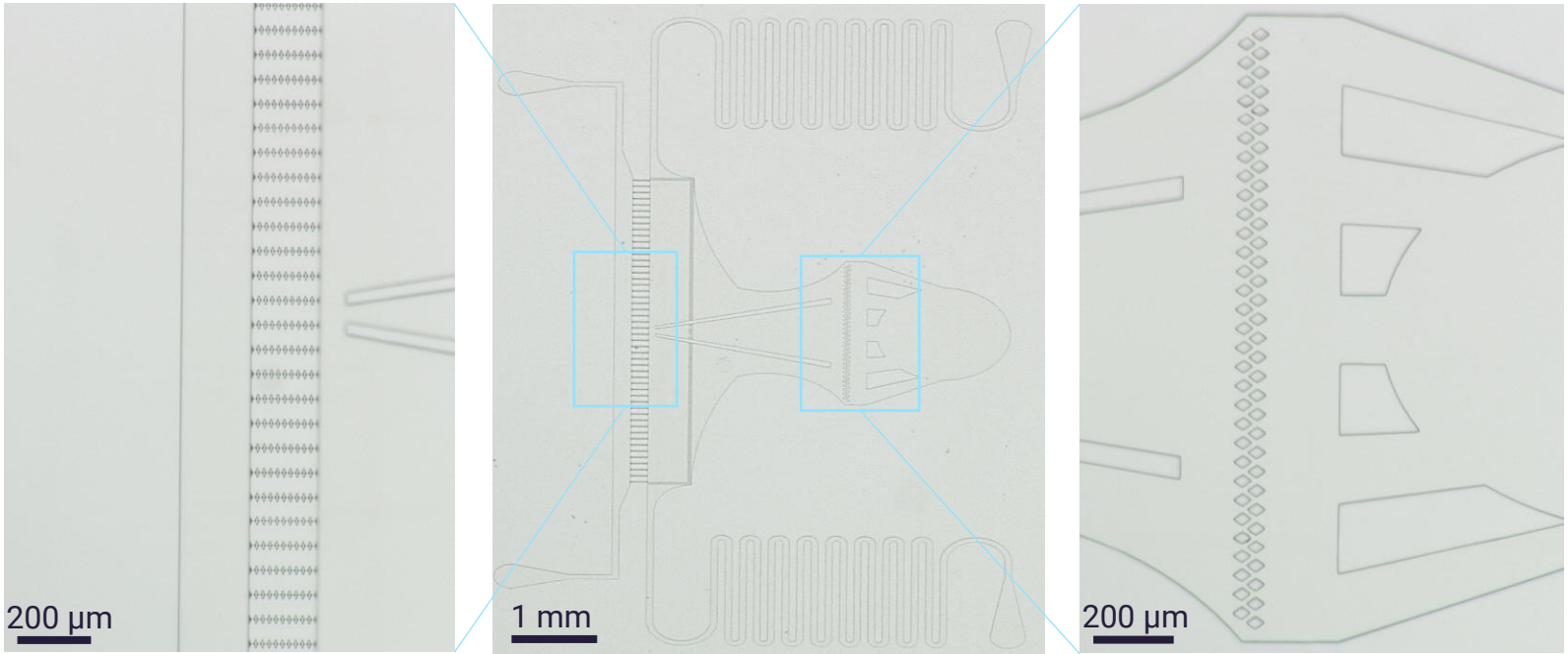
Microfluidic template by Aachener Verfahrenstechnik, RWTH



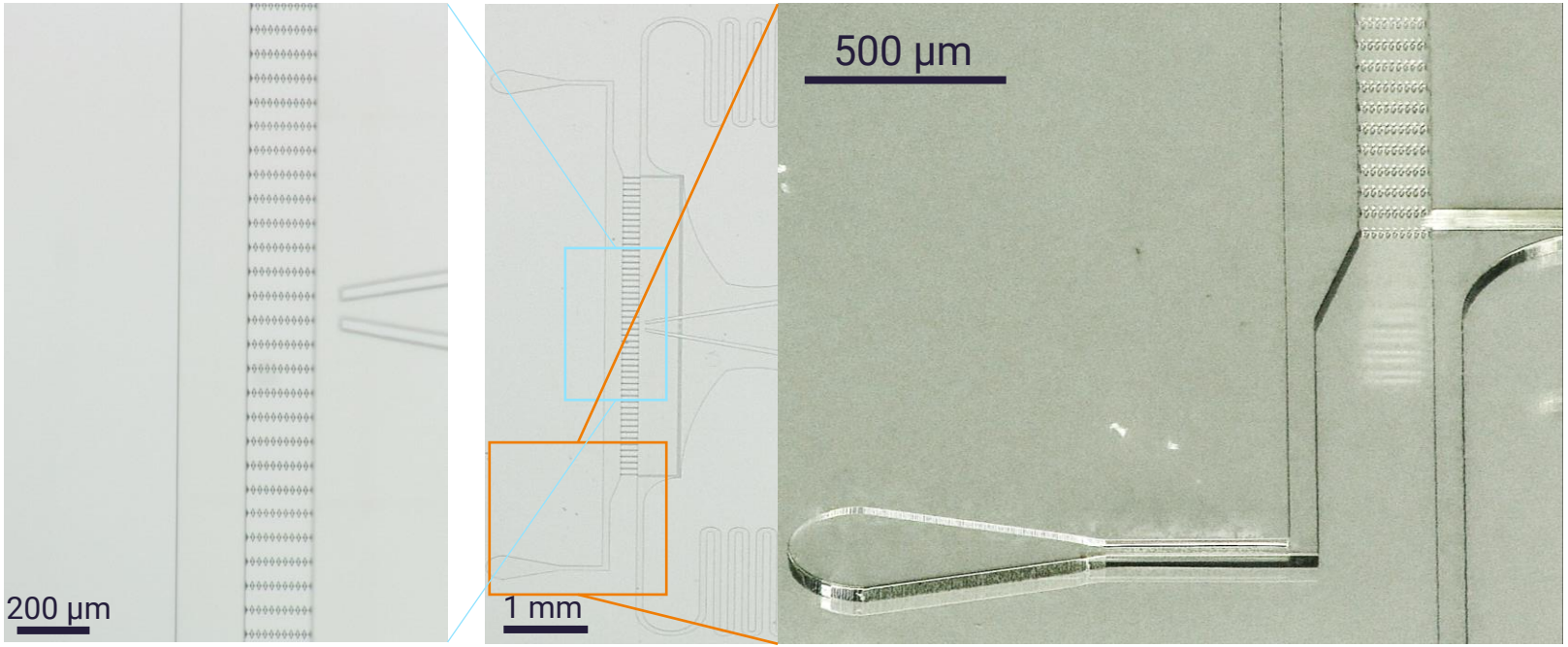
Microfluidic template by Aachener Verfahrenstechnik, RWTH



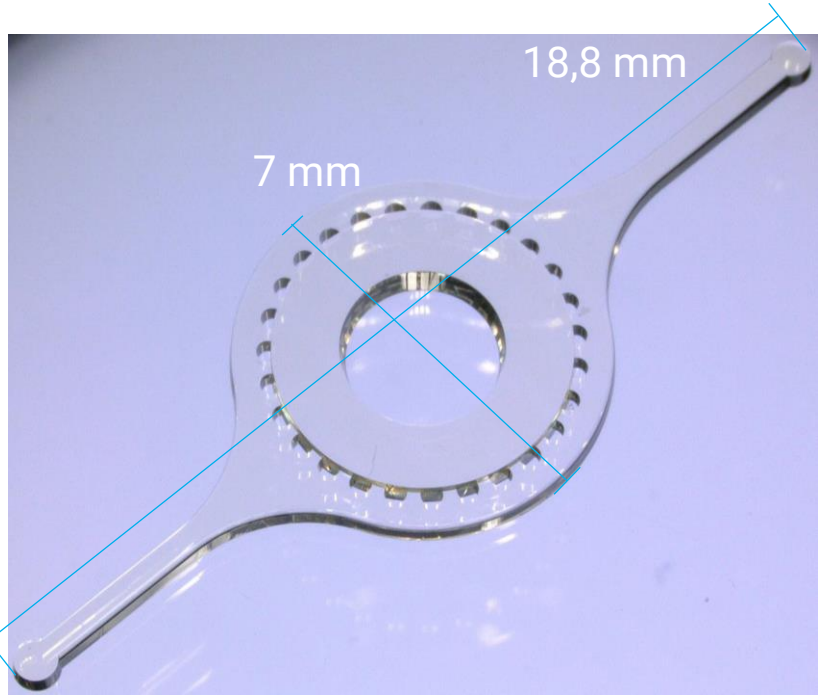
Microfluidic template by Aachener Verfahrenstechnik, RWTH



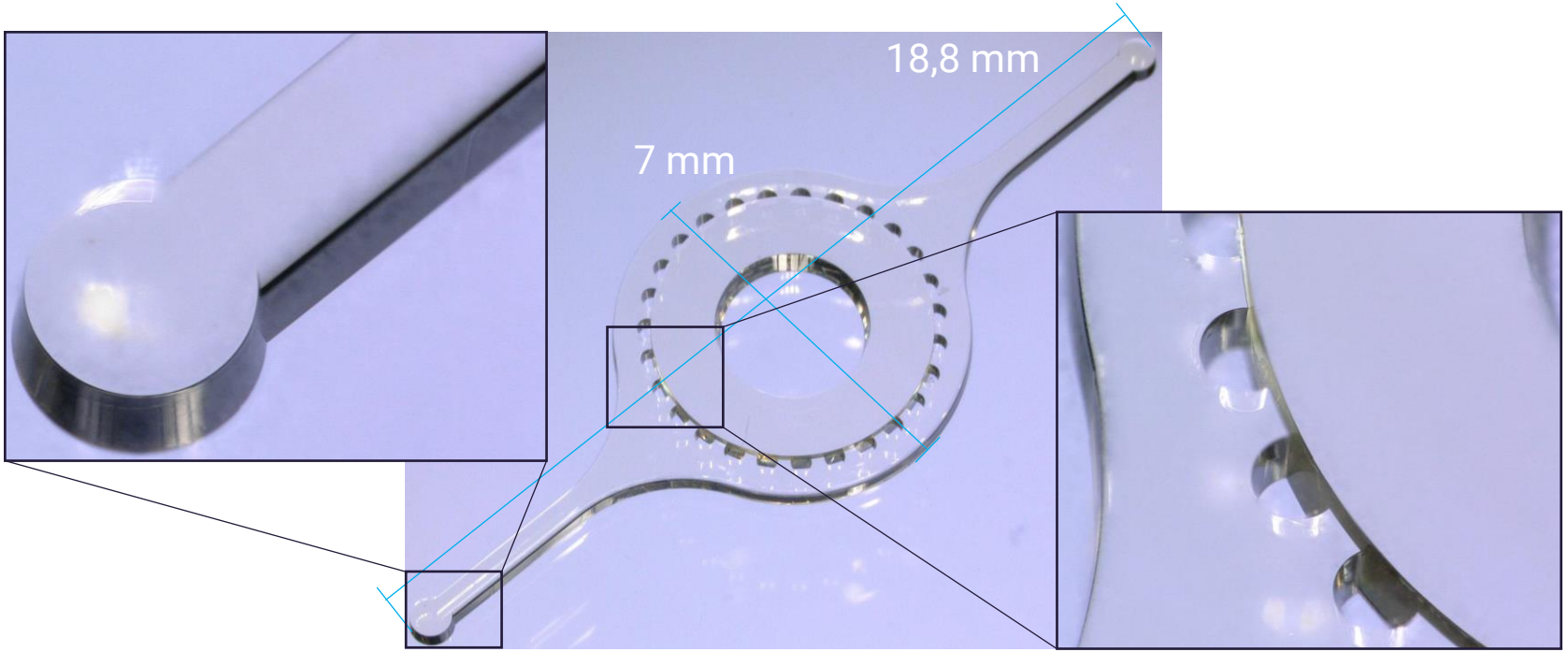
Microfluidic template by Aachener Verfahrenstechnik, RWTH



Microfluidic template by Aachener Verfahrenstechnik, RWTH

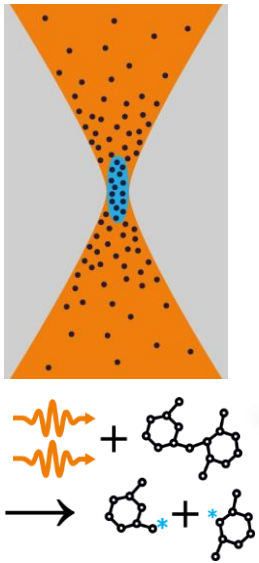


Microfluidic template by Aachener Verfahrenstechnik, RWTH



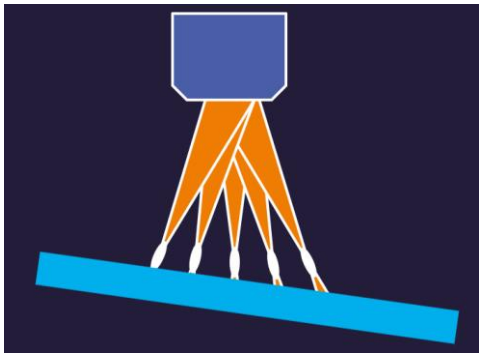
Summary

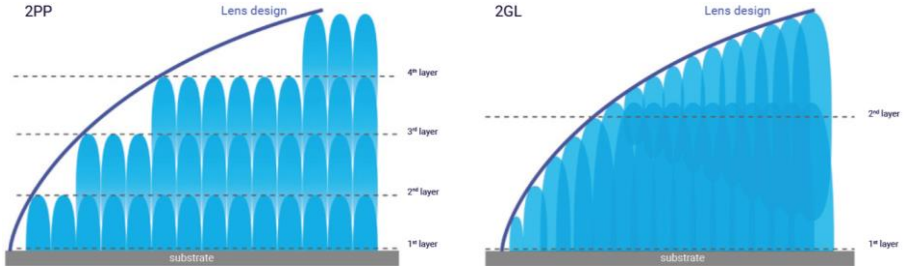
- Nanoscribe offers 3D microfabrication systems, implementing 2-Photon Polymerization (2PP)



Summary

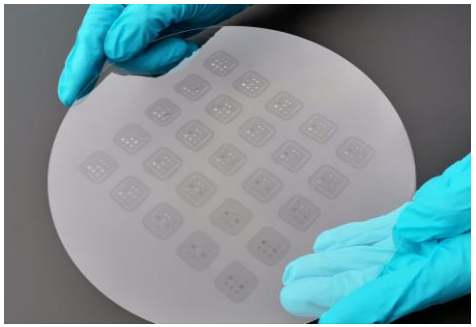
- Nanoscribe offers 3D microfabrication systems, implementing 2-Photon Polymerization (2PP)
- cm-scale smooth 2.5D structures can be printed with Quantum X with 2-Photon Grayscale Lithograpy (2GL) including tilt correction

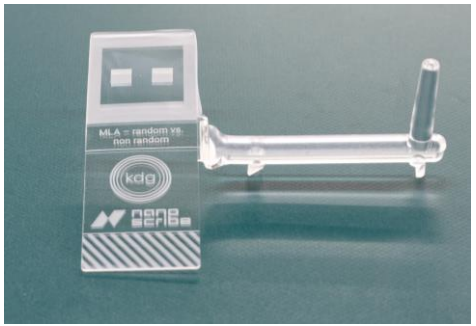




Summary

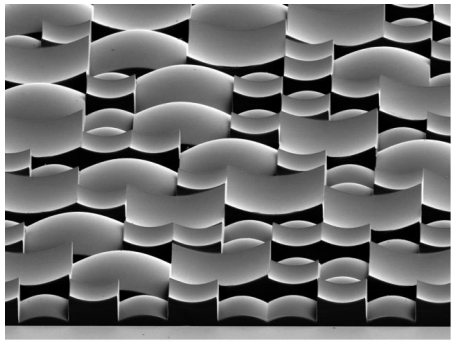
- Nanoscribe offers 3D microfabrication systems, implementing 2-Photon Polymerization (2PP)
- cm-scale smooth 2.5D structures can be printed with Quantum X with 2-Photon Grayscale Lithograpy (2GL) including tilt correction
- Printed 2.5D structures can be used as master structures / templates for small and large scale replication

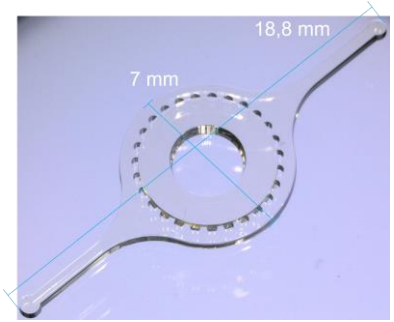




Summary

- Nanoscribe offers 3D microfabrication systems, implementing 2-Photon Polymerization (2PP)
- cm-scale smooth 2.5D structures can be printed with Quantum X with 2-Photon Grayscale Lithograpy (2GL) including tilt correction
- Printed 2.5D structures can be used as master structures / templates for small and large scale replication
- Applications include microoptics and microfluidics





nanoscribe
A BICO COMPANY

15 YEARS Think big. Print nano.

Think big. Print nano.

Contact us

Dr. Jochen Zimmer
j.zimmer@nanoscribe.com