

Laser Micromachining Excellence

**New Solutions for Glass and
Semiconductor Manufacturing**

Uwe Wagner, 3D-Micromac AG



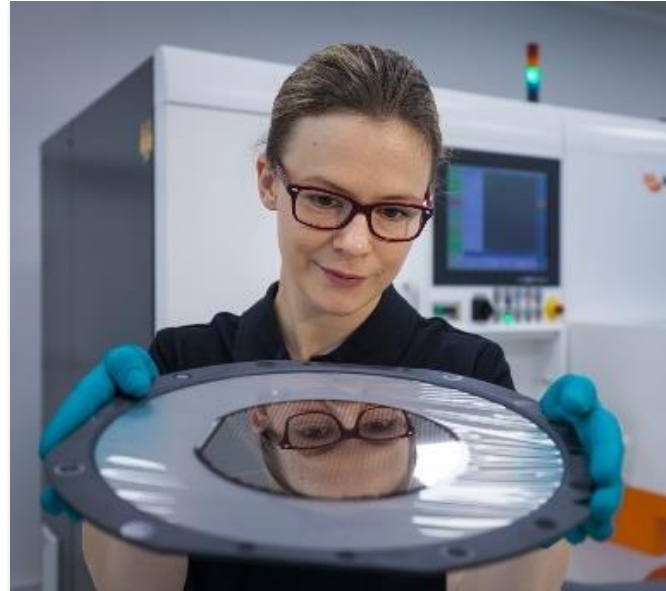
Your partner for Laser Micromachining

Process Development



- 200+ experts, 60% engineers
- From idea to fab-ready process
- Solution provider for laser micromachining

Contract Manufacturing



- From prototype to volume production
- Second source provider
- ISO 9001 certified

Industrial Machines



- 650+ systems worldwide
- R&D to high-volume fabs
- Higher yield, lower cycle time

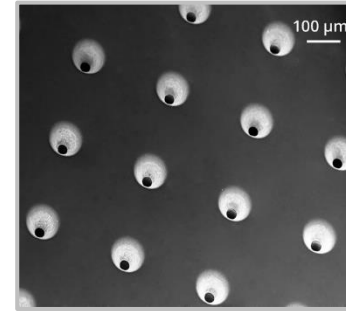
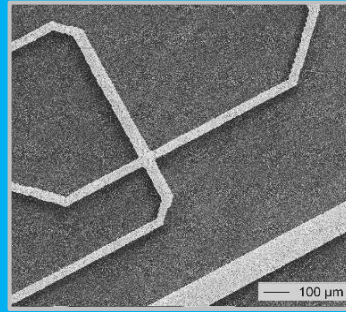
Headquartered in Chemnitz (Germany) with a global service network

Our Micromachining Competencies

Laser Structuring

Markets: Photovoltaics, medical device technology, semiconductor, etc.

Application: Selective ablation of conductive lines for microfluidics



Laser Drilling

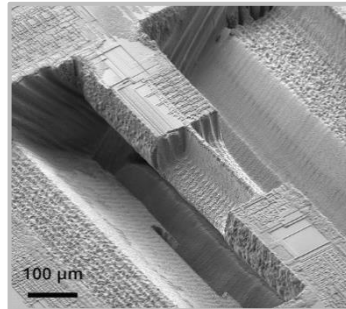
Markets: Automotive, medical device technology, photovoltaics, etc.

Application: Drilling of inkjet nozzles with defined geometrics

Laser Thinning

Market: Microdiagnostics

Application: Laser-based sample preparation for TEM analysis & micromechanical testing



Laser Cutting/Separation

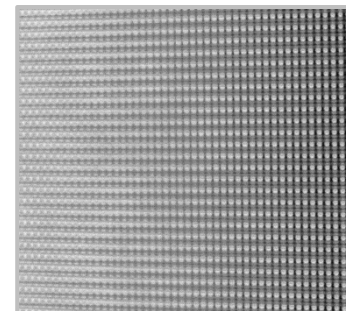
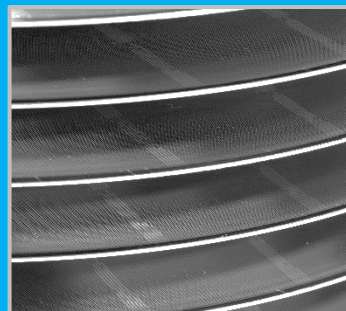
Markets: Display & smart glass, photovoltaics, semiconductor

Application: Cutting of smartphone and tablet displays, PV cells, wafer dicing

Laser Annealing

Market: Semiconductor

Application: Selective laser annealing for magnet sensor formation and ohmic contact formation (OCF)



Laser Lift-Off (LLO) & LIFT

Market: Display, sensors

Application: MicroLED manufacturing, X-ray sensor manufacturing

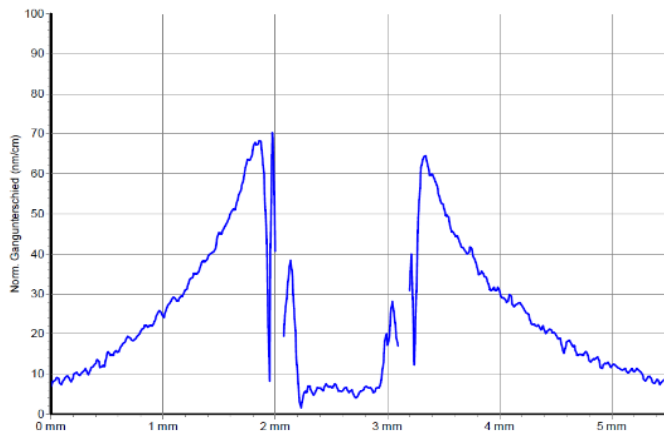
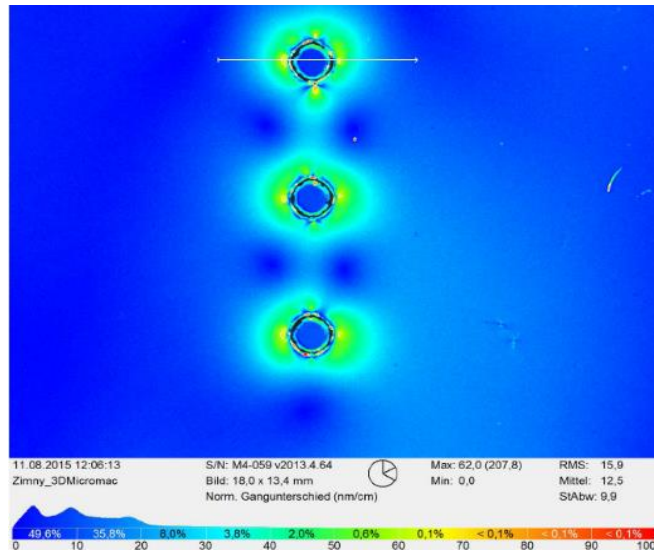


Enhancing Cavities in Glass

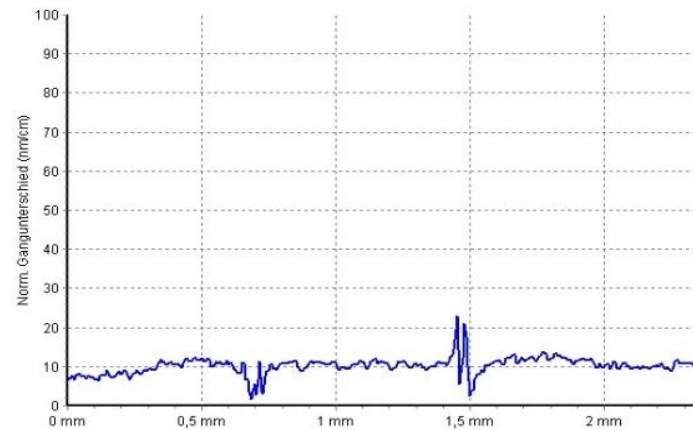
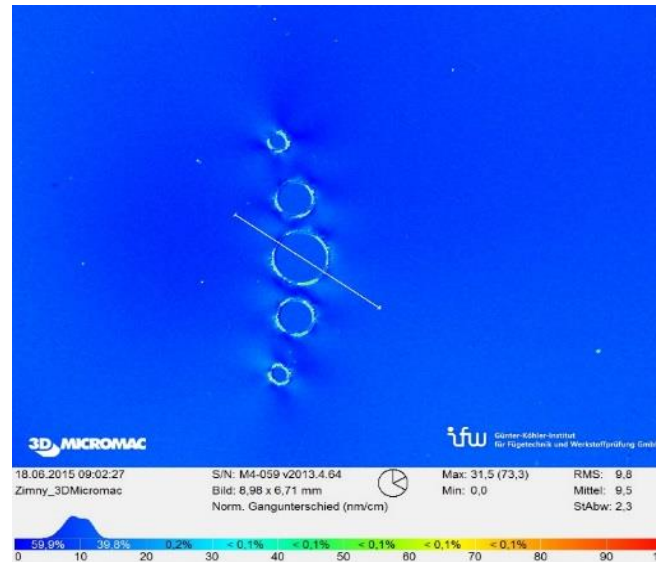
Latest Results on
Glass Volume Processing with FSLA®

Direct Patterning of 3D Bulk Material with FSLA®

Classic Ablation



FSLA®



FSLA =
Flow-Supported Laser Ablation

- Patented process for bulk removal in transparent materials
- Works without chemistry

No tension introduced
during processing

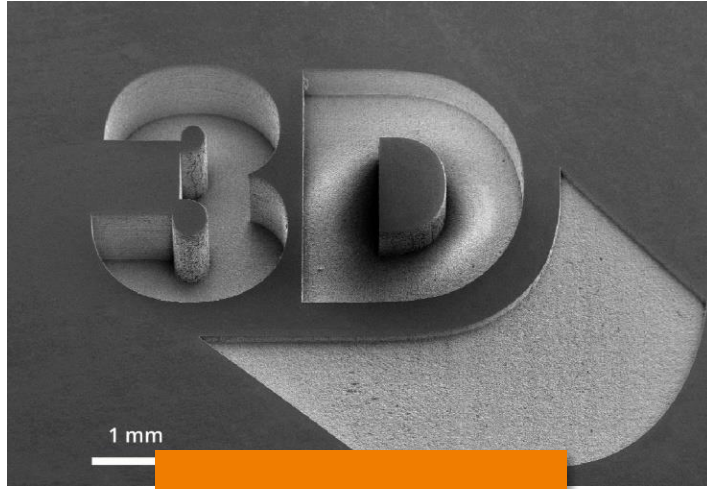


No damages or
thermal stress

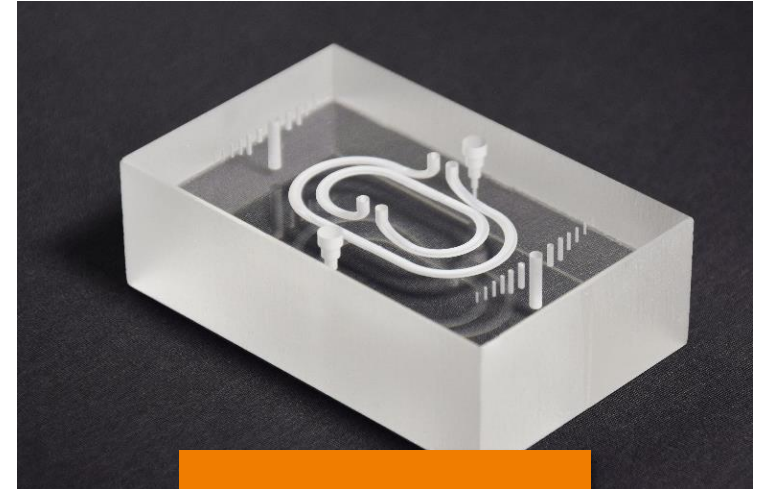
Direct Patterning of 3D Bulk Material with FSLA®



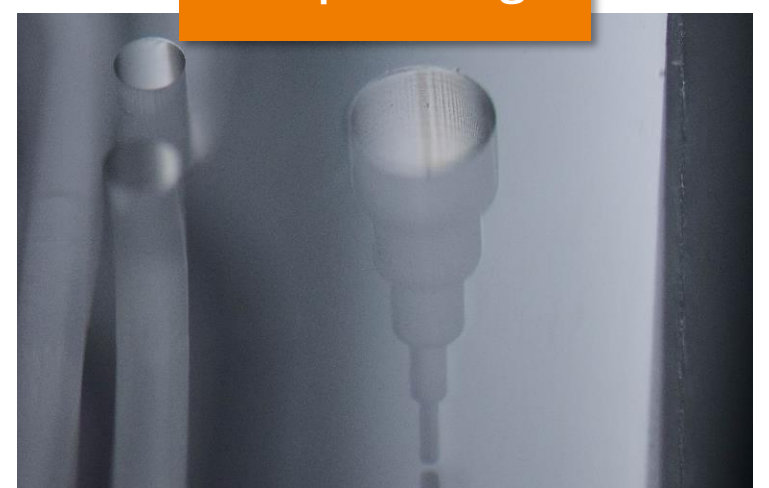
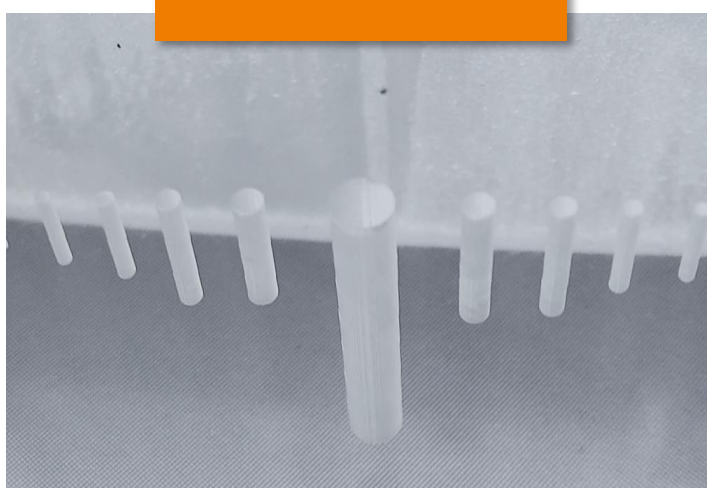
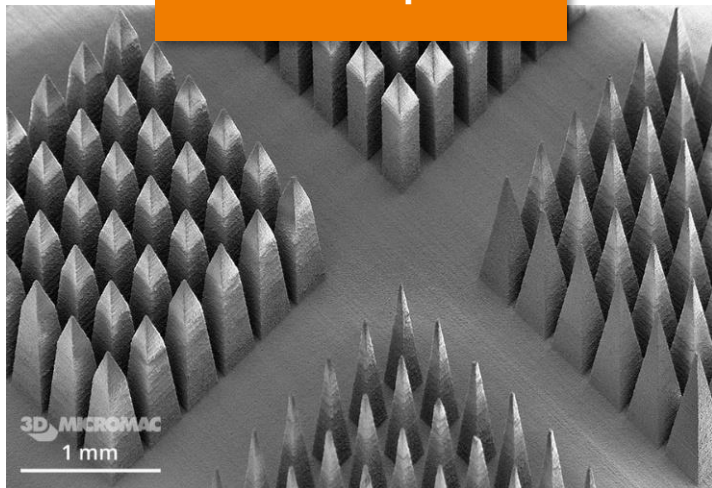
3D-Shapes



Blind Holes



Step Drilling





Semiconductor Dicing

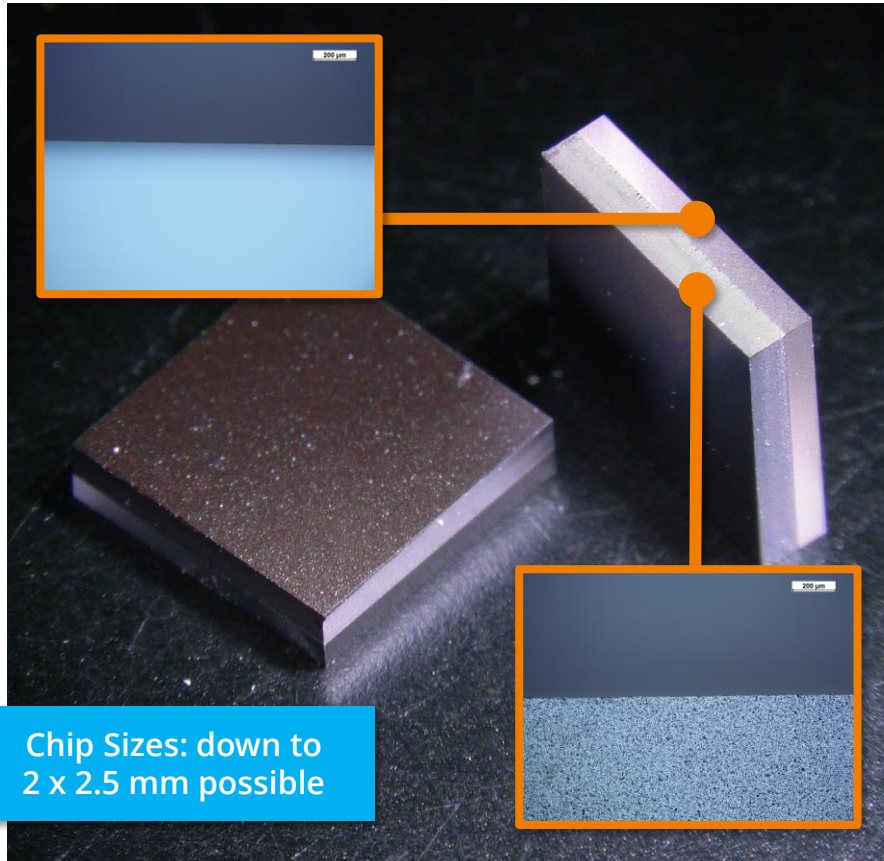
Latest Results & Outlook

Dicing – 3D-Micromac Approach



Current Examples of Application

Si-Glass-Bond



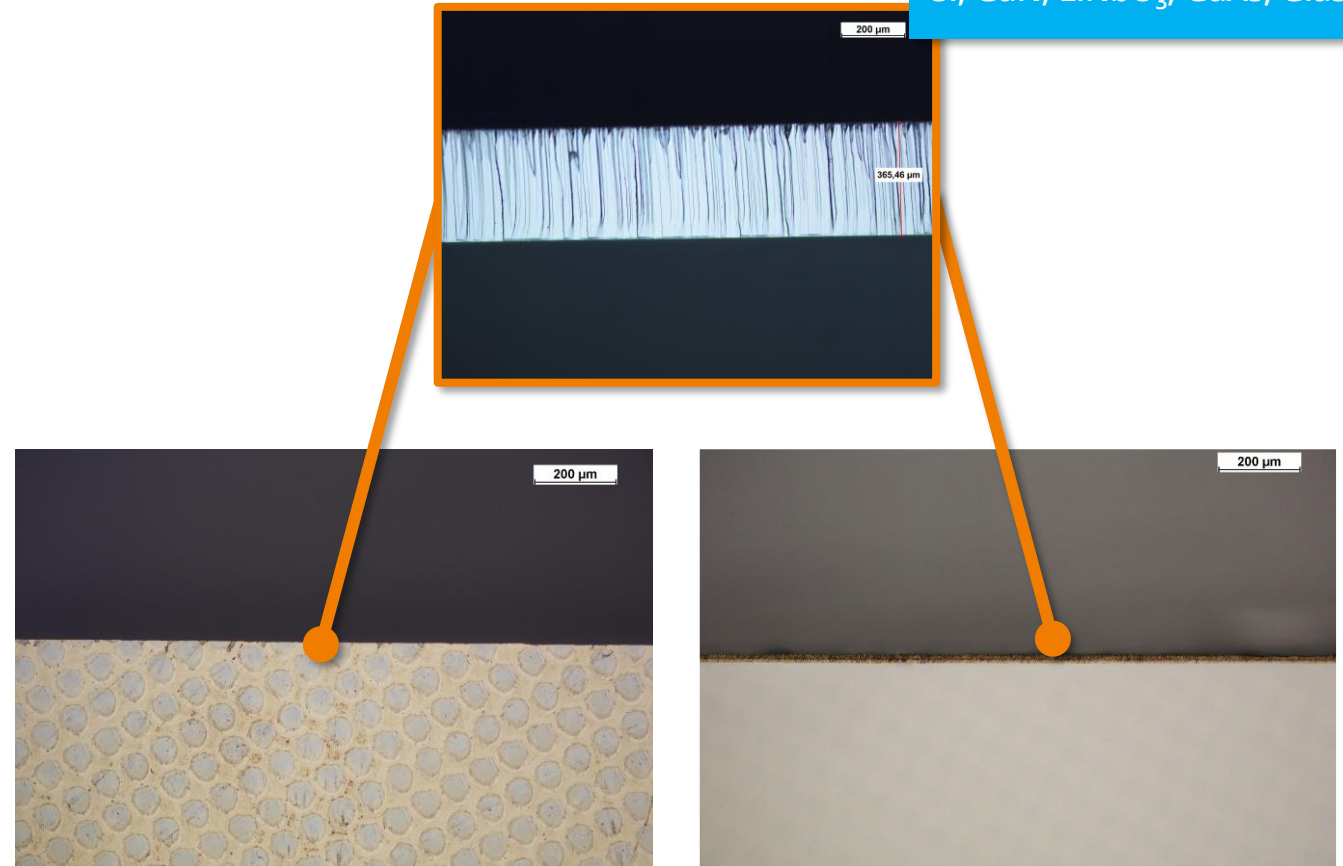
Chip Sizes: down to
2 x 2.5 mm possible

Si 725 μm /BF33 500 μm

$R_a \approx 0.5 - 1 \mu\text{m}$
 $V_{\text{res}} \approx 100 - 200 \text{ mm/s}$
Wall angle $\approx 90^\circ$

SiC

Also applicable on:
Si, GaN, LiNbO₃, GaAs, Glass ...



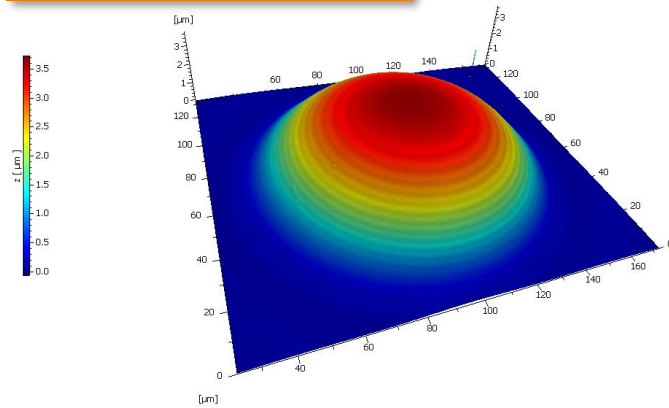
4H-SiC Si 350 μm
(possible: 60 - 350 μm)

$R_a \approx 0.5 \mu\text{m}$
 $V_{\text{res}} \approx 150 - 200 \text{ mm/s}$

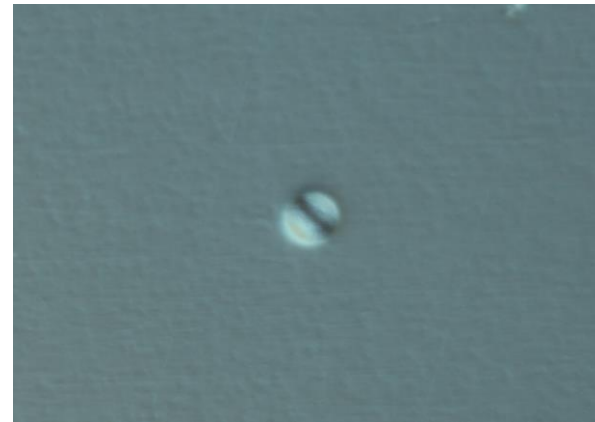
Changing the Game of Making Lenses, Fundamentally

Customized Direct Writing of Microlenses using IR Laser Modification

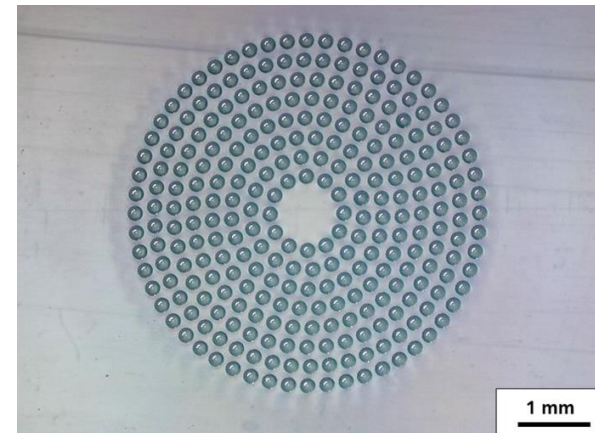
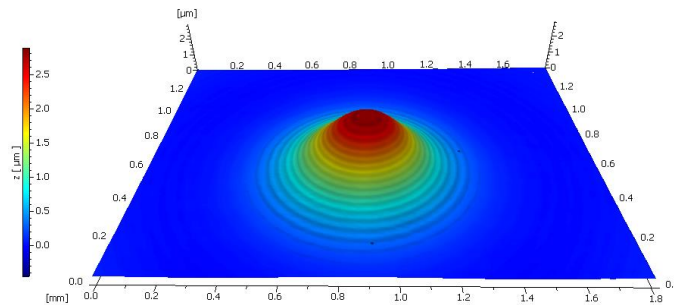
Spherical Lenses



COC: $d_{\min} = 15 \mu\text{m}$



Aspherical Lenses

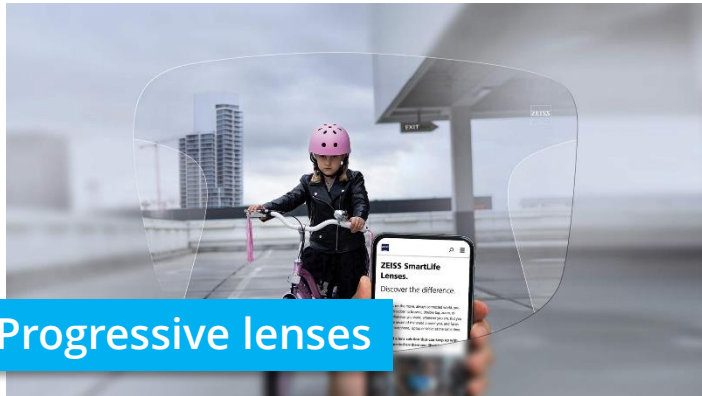


Laser swelling

- Local temperature increase
→ swelling of polymers
- Ablation-free → no microplastics
- Highly customizable
- Applicable to thermoplastics
(COC, PMMA, PEEK, CR39, MR-7, MR-8, MR-174, PC, PVB etc.)
- Patent protected
(Fraunhofer IMWS; PCT: US, JP, KR, CN, EP)

Microlens-Matrices by Laser Swelling

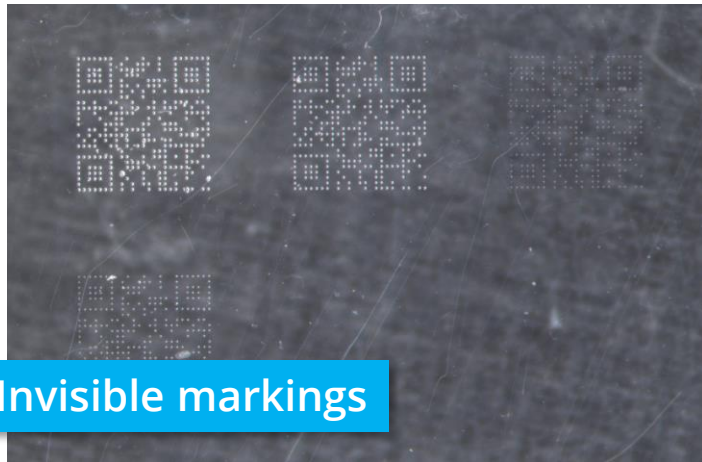
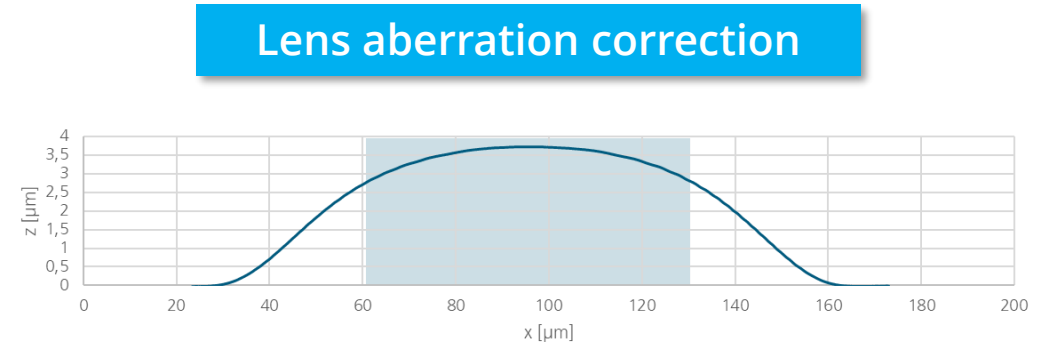
Huge Spectrum of New Possibilities



Progressive lenses



Coating adhesion test



Invisible markings



Microfluidics



Improved adhesion

A scientist wearing a white cleanroom suit and mask is examining a circular wafer with a colorful, grid-like pattern. A microscope is visible on the right side of the frame. The background shows a cleanroom environment with computer monitors.

Laser-Based Sample Preparation

Speeding up material characterization
on chip, wafer and board level

Laser-Based Sample Preparation: Next Level

Selective laser ablation of standardized sample geometries on wafer & board-level



microPREP® PRO



microPREP® PRO FEMTO



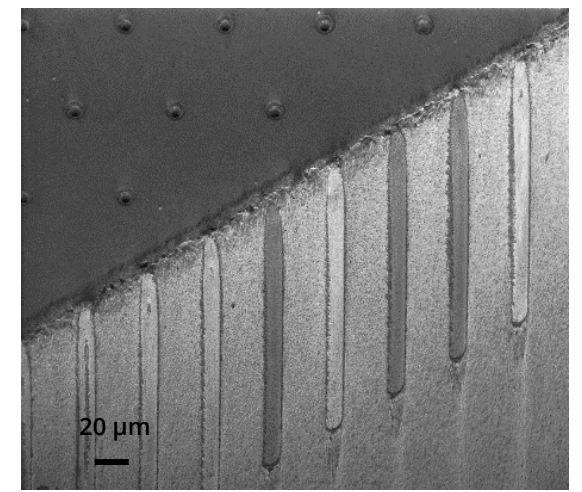
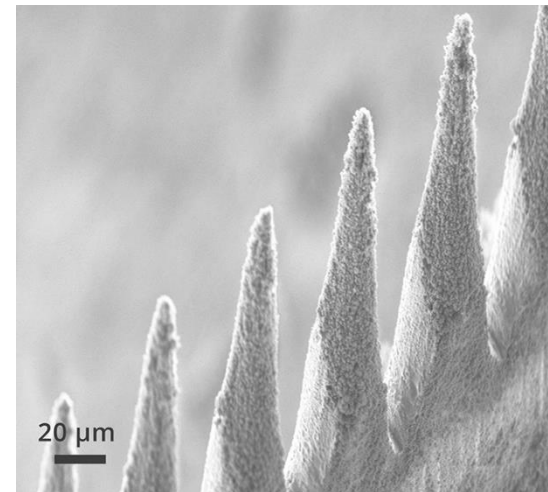
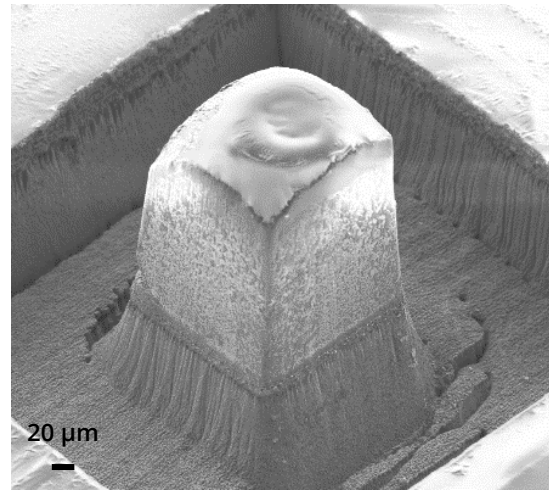
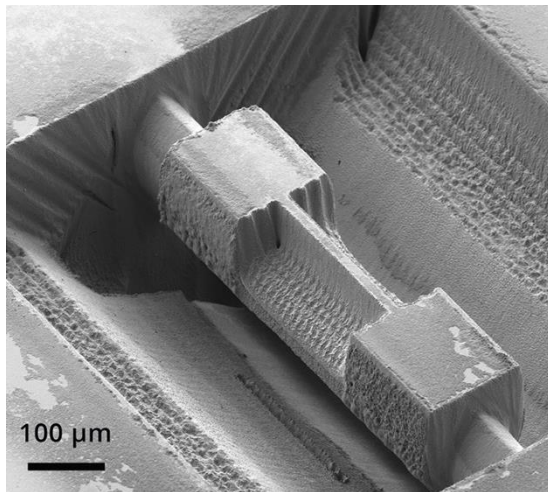
NEW: microPREP® PRO L

- Optimized tool utilization (FIB/SEM)
- In-situ materials characterization
- Automated workflows



Reduced
time-to-sample

Laser-Based Sample Preparation for...



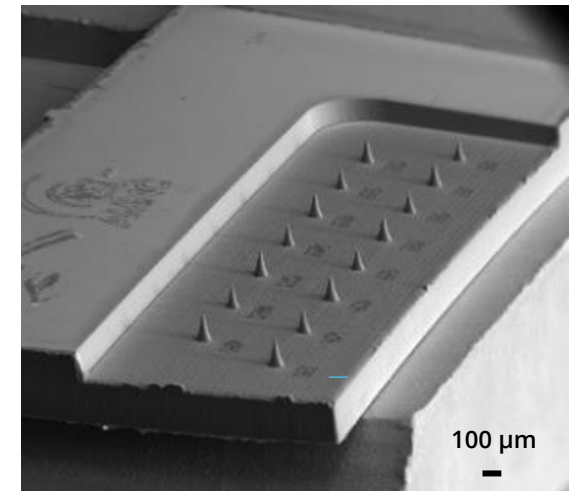
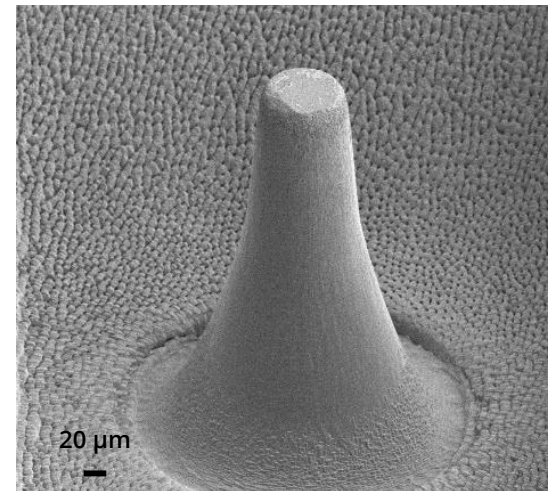
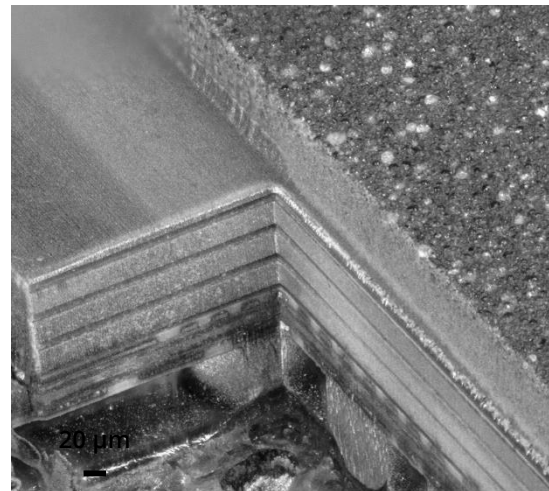
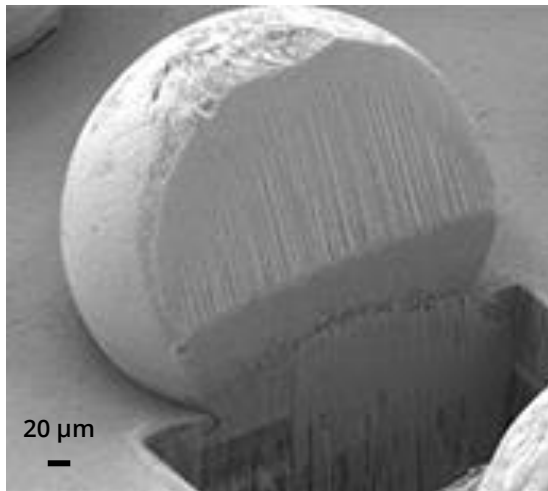
TEM Analysis

Micromechanical Testing

SEM Analysis

Atom Probe Tomography

Nano-CT



Let's Shape the Future Together

What We Can Do for EPIC Members

- Integrate specialized laser technologies
(*FSLA, dicing, link trimming, annealing, sample prep*)
- Enable high-precision, high-speed production
- Drive technology innovation

What EPIC Members Can Do for Us

- Collaborate in process chain partnerships
- Provide metrology & material science expertise
- Contribute to a European semiconductor perspective
- Co-develop R&D and industrial projects

Where can we join forces next?



Thank you for your attention!

Uwe Wagner

wagner@3d-micromac.com

+49 371 40043 14

+49 371 400 43 0

info@3d-micromac.com

www.3d-micromac.com

Headquarters 3D-Micromac AG

Technologie-Campus 8

09126 Chemnitz

Germany

