ULTRA-PRECISE LASER MICROMACHINING

Ultra-precise laser micromachining ::: IN GENERAL BUT ::: in particular of dielectrics is challenging due to their transparency. However, different techniques have been developed at the IOM that enables ultra-precise laser micromachining of surface down to nm depth resolution and nanometer roughness.

These techniques can be incorporated into modern laser workstations equipped with short and ultrashort pulsed laser sources in the wavelength range from NIR to UV. Hence, in dependence on the material an appropriate laser source and machining strategy can be selected.

Laser workstation for ultra-precise laser machining of dielectric materials

THE INSTITUTE

The Leibniz Institute of Surface Engineering (IOM) is well known for its competence and excellence in engineering surfaces and thin films by ion beam, electron, laser and plasma techniques. The institute performs application-oriented basic research by aiming for scientific knowledge gain related to the physical and chemical mechanisms in the preparation, synthesis and modification of insulating, metallic, semiconducting and polymeric surfaces and thin films with the goal to transfer the scientific knowledge into high-tech applications.

The laser micromachining technology (LaMa-Tech) group focus on technologies for machining, texturing and scribing of surfaces and thin films for high vertical/lateral precision, low laser-induced damage, high selectivity or 3D topographies.

Leibniz Institute of Surface Engineering (IOM)
Leibniz-Institut für Oberflächenmodifizierung e.V.
Permoserstr. 15 / 04318 Leipzig / Germany

Phone: +49(0)341 235 2308
FAX: +49(0)341 235 2313

www.iom-leipzig.de

CONTACT PERSON

Dr. Klaus Zimmer
Group Leader / Laser Micromachining and Applications

klaus.zimmer@iom-leipzig.de
Phone: +49(0)341 235 3287

Leibniz Association

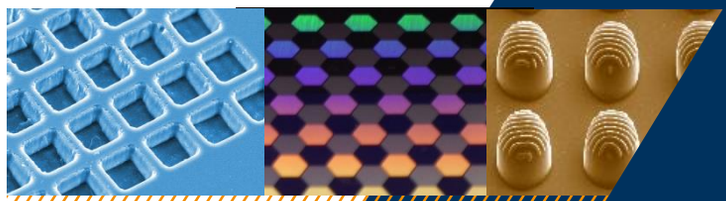
Zertifikat seit 2011
audit berufundfamilie

IOM
Leibniz Institute of Surface Engineering

ULTRA PRECISE SURFACES

BY

LASER BEAM MACHINING



TAILORED SURFACES

VERTICAL PRECISION | **HIGH RESOLUTION** | **LOW ROUGHNESS**

ULTRA-PRECISE MACHINING TECHNOLOGIES ARE APPLICABLE FOR VARIOUS MATERIALS INCLUDING:

Glass and Ceramics

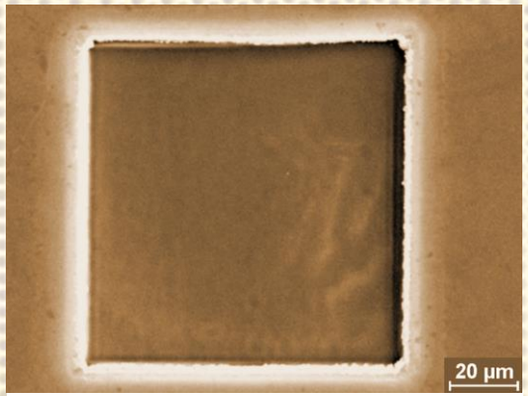
- Ultra-precise machining requires low machining rates
- Ablation is the standard of laser machining
- Advanced technologies enable the reduction of the machining rates by a factor of 100 compared to laser ablation
- Machining rates of below 10 pm/pulse can be achieved

Metals and Semiconductors

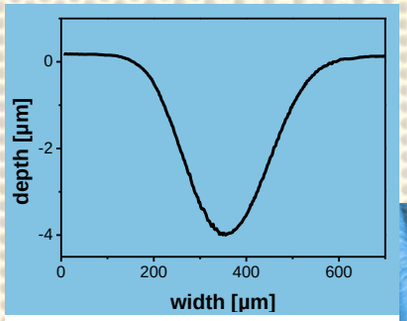
- Lateral resolution of laser machining tool down to **micrometer size**
- **~ 100 nm period** have been demonstrated on fused silica
- Tool shape and tool site adjustable to the processing requirements (contour, gray scale, interference)
- Enabling high precision, smooth patterning

Polymers

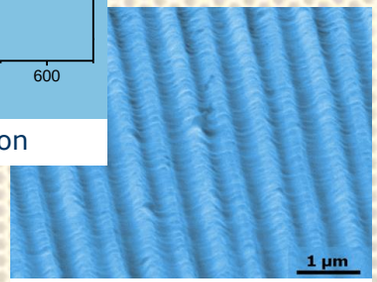
- Low machining rate enable smooth machined surfaces
- Roughness as low as 10 nm rms are achieved
- Optimized tool design for low waviness processing
- Laser-written optical elements for light shaping (WLIM)



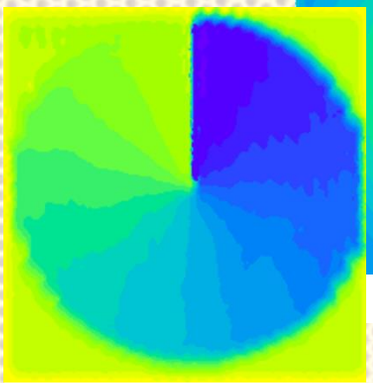
Machined **fused silica** surface

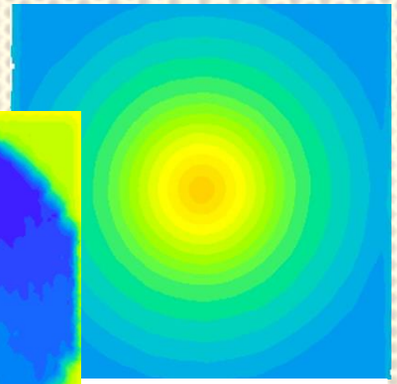


Tool cross section



Grating in **sapphire**


Spiral phase plate


Micro axicon

From basic research to new applications of laser machining