Gisela and Erwin Sick Chair of Micro-Optics

Prof. Hans Zappe

Research Area
Laser Polishing of Quartz Glass

Relevant Tasks
- ☒ Optical experiments
- ☒ Test setup development
- ☒ Device characterization
- ☒ Material characterization
- ☐ Optical simulations
- ☐ FEA simulations
- ☐ Clean room fabrication
- ☐ CAD/CAM
- ☐ Polymer fabrication
- ☐ Programming
- ☒ Analytical analysis / Theory
- ☒ Literature research
- ☐ Teaching

Eligible Departments
- ☒ Microsystems technology
- ☒ Mechanical engineering
- ☒ Process engineering
- ☒ Chemistry
- ☐ Physics
- ☐ Electronics and IT
- ☐ Computer science
- ☐ Industrial engineering

Requirements
Ability to work independently

Basic optics knowledge

Starting Date
Immediately

Contact Person
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Bachelor's Thesis

Laser Polishing of SLE Surfaces on Quartz Glass

Selective Laser Etching (SLE) is a subtractive 3D printing of glass, including two processing steps: 1) exposure process is selective modification of 3D volume by fs laser radiation; and 2) developing process is removal of modified volume by wet chemical etching in KOH 30%. In general, this is the 3D lithography with quartz glass as positive-tone resist. The etch rate of laser-induced modified material is 1400 times higher than the unmodified material. A high selectivity means high precision in manufacturing. "Impossible designs" are now possible with micro-meter precision in glass.

However, as the result of structuring and etching process, the roughness of the fabricated surface is too high (approximate 0.5µm rms). To fulfil the optical quality for many applications, a smoothing process is necessary.

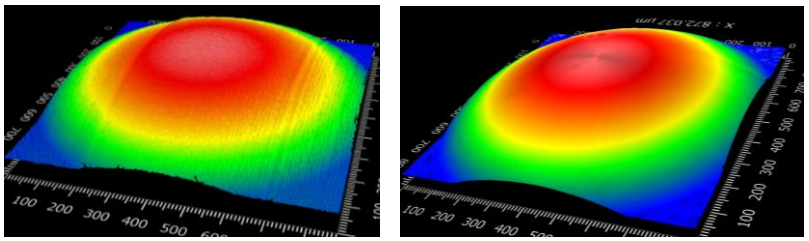
Laser polishing using CO_2 laser radiation is based on the absorption of the laser radiation at the thin surface layer of the material. Due to the high absorption, the temperature at the border layer increases above the softening temperature. As the result, the roughness melts and the surface is smoothened due to surface tension.

By combining SLE and laser polishing, complex arbitrary optical surfaces can be produced. Aspherical micro-lenses will no longer out of hand.

The tasks in this project will be: receiving a set of micro-lenses from SLE; testing different parameters for the polishing process, including irradiation power, scanning speed, size of laser beam; characterizing the surface roughness of micro-lenses before and after polishing by white-light interferometer; adjust the polishing parameters; characterizing the optical performance of the samples after being polishing. At the end of the project, the student is expected to assemble the measurement results according to the parameter input.

The work will be coordinated by an internal team of researchers who will support the project in terms of target mission/specifications definition and characterization. The project duration is 3 months.

If you are interested in further information, please contact Dr. Phuong-Ha Cu-Nguyen.



White-light interferometry measurement of micro-lens surface before (left) and after (right) laser polishing

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