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## GENERATING COMPLEX STRUCTURES IN GLASS THROUGH SELECTIVE LASER-INDUCED ETCHING

### Task

To micro-structure dielectrics, such as glass and crystals, mask-based and impressing processes as well as direct ablation are commonly used today. These processes are confined, however, on account of their limited ability to produce undercuts, pre-assembled components or internal cavities. In contrast, the simplified manufacture of such structures directly from CAD data (Digital Photonic Production) opens up new possibilities to fabricate micro-fluidics or assembled micro-mechanisms. Selective laser-induced etching is a process that is suited to producing 3D structures in glass.

### Method

Selective laser-induced etching (SLE) is a two-stage process. In the first step, the transparent material is modified by the laser radiation. To do this, ultra-short pulsed laser radiation is focused into the inside of the workpiece ( $\varnothing 1 - 2 \mu\text{m}$ ). As the beam focus moves, a continuous volume is modified, which has a contact to one of the outer surfaces. In the second step, the modified material is removed by wet-chemical etching. To produce complex component parts with digital photonic production, our software routine automatically creates the

track data derived from digital CAD data. The laser beam is deflected by the micro-scanner system, thereby exposing the glass according to the track data. The micro-scanner system and the component parts are available commercially from the spin-off company LightFab.

### Result

It is now possible to manufacture a mounted, double-helical planetary transmission in quartz glass. The diameter of the demonstration model is 10 mm. A possible drive can occur through a six-round formed drill hole in the sun gear (Figure 2). Microfluidics with features of 3-dimensional geometry, such as bridging in micro-channels, enable a larger functional integration density for lab-on-chip applications (Figure 1).

### Applications

Users for the newly developed processes come from micro-system technology, bio- and medical technology, as well as chemical analysis and process technology.

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1 Micro-channel bridge inside a biochip.

2 Double-helical planetary transmission in quartz glass.