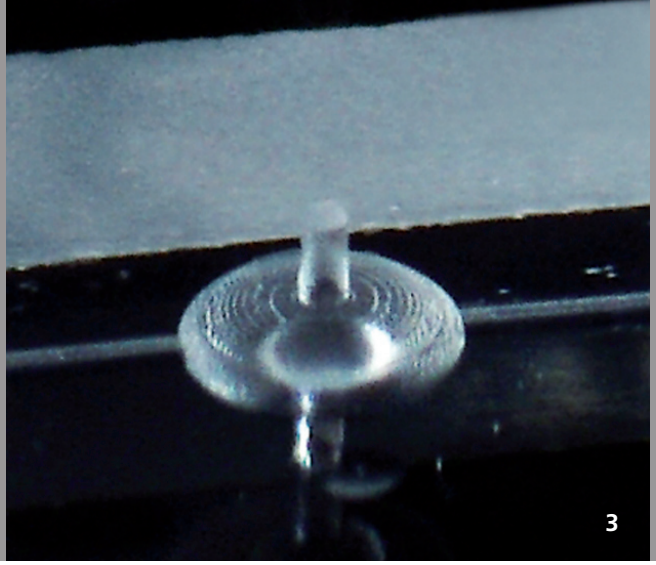

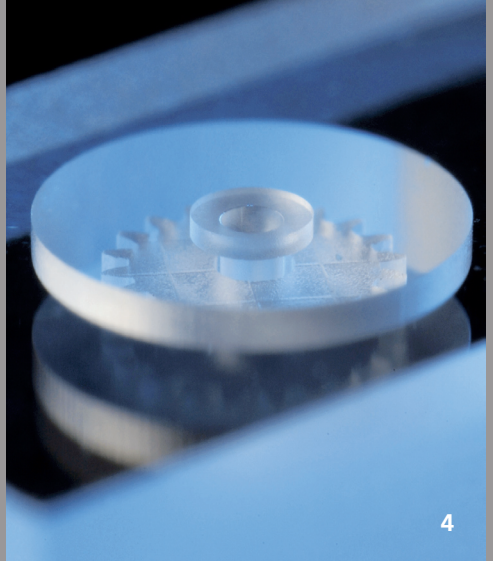

ASSEMBLED MICROCOMPONENTS MADE OUT OF GLASS

Task

Microcomponents are manufactured for micromechanical systems using mask-based or molding processes; these processes are often not suitable for prototypes and small production volumes. The subsequent assembly of the microcomponents to create a micromechanical system is time-consuming and costly if the components are small and complex. As such, the manufacture of preassembled micromechanical systems is advantageous, particularly for prototypes and small series. The aim is to implement customized production of complex structures by means of digital photonic production, in other words laser-based manufacturing directly from digital data (CAD). In-volume Selective Laser Etching is a process that is suitable for digital photonic production for transparent materials.

Method

In-volume Selective Laser Etching is a two-stage process: in the first stage the material that is transparent to the laser radiation is modified inside. This involves focusing ultrashort pulsed laser radiation (500 fs - 5 ps) to focal radii of ~ 1 µm. Moving the focus allows modification of a continuous volume that has contact with the outer surface of the workpiece. In the second stage, the modified material is removed selectively by means of wet-chemical etching. For the digital photonic production of complex components, the path data for the laser focus is generated from the digital CAD data and the microscanner system is synchronously controlled using CAM software. The microscanner system and the components are marketed commercially by the spin-off LightFab.

Result

A gear wheel with a diameter of 4 mm has been manufactured in silica glass; the gear wheel is assembled on its axis so it can rotate following etching (Fig. 4). Along similar lines to this demonstrator, complex micromechanical systems such as transmissions can be manufactured on the basis of CAD data. For microfluidic applications a three-dimensional micromixer with four channels and a movable glass sphere inside the mixing volume has been manufactured (Fig. 3).

Applications

Applications include micromechanics for customized and preassembled microcomponents as well as microfluidics in which hollow structures are used.

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3 Movable glass sphere in the micromixer.

4 Movable assembled gear wheel in glass.