Master Topic / Glass micropositioner actuated and fabricated by femtosecond laser

Description
Femtosecond laser can be used not only for fabricating three-dimensional flexures, but also for locally deforming materials, thanks to the net volume change induced during the laser exposure. By combining these volume changes with flexure design, it is possible to induce a controlled motion at any desired location. We are currently exploiting this principle for the design of micro-mirror positioner as shown below, which is monolithically fabricated on a sample of fused silica and has integrated flexure elements allowing it to rotate (in plane) about its own geometrical center. This device has only one degree-of-freedom.

Figure. (Left) An FEM simulation of the deformed mirror superimposed on the non-deformed one (in red). (Right) Kinematics of the overall system.

When this design is further re-exposed to the laser (on the horizontal bar), expansion occurs, pushing outwards from the region of exposure. The flexure elements transform this linear motion to an in-plane rotational motion at the center of the mirror. This allows the mirror to rotate and thus enables us to position a laser beam reflected off this mirror in a non-contact manner.

Objectives
The main objective will be to design a new positioner concept able to induce out-of-plane precise and controlled rotation of a mirror surface. In this project, you will also investigate laser parameters that can also enable out of plane bending in a user-controlled manner. Finally, you will demonstrate the non-contact tuning of the prototype positioner and observe how the structure is bending in the vertical plane in real time.

Required skills / Profile
Students with a background in microengineering or mechanics.

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