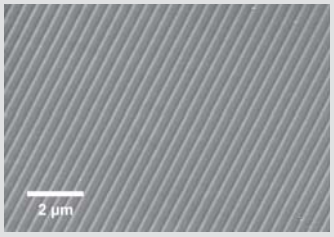
Laser Fabrication of Micro-Optics

Excimer laser micro machining

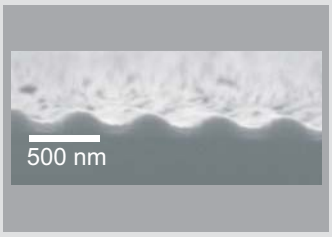
Laser induced material ablation enables processing of plastics, ceramics, glass, metals, and semi-conductors with high precision. UV excimer lasers facilitate micro machining with feature sizes in the sub micron range. Due to short pulse durations the thermal damage of the material is minimized. Fast and flexible processing using mask projection techniques open up numerous applications in micro-optics, micro-fluidics, and MOEMS. For the generation of optical structures on transparent materials, the application of deep UV and vacuum UV wavelengths is essential.

Gratings

Fused silica



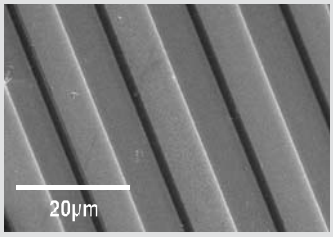
Ta_2O_5 waveguide

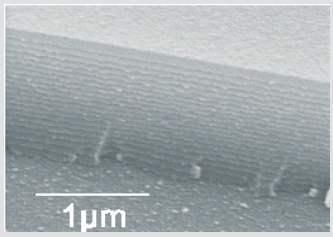


Gratings with periods of about 500 nm are made by projection of a master grating on fused silica (laser wavelength 193 nm) and on a Ta_2O_5 waveguide layer (femtosecond laser at 248 nm).

Dielectric masks

Al_2O_3/SiO_2 multilayer

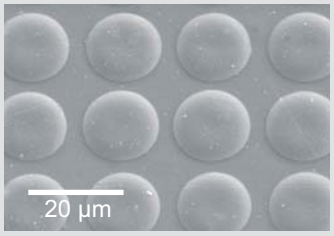




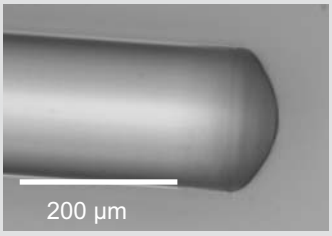
Dielectric masks fabricated by patterning a highly reflective multilayer stack (Al_2O_3/SiO_2) using 193 nm ablation. In the closed-up view of the edge (right), the multilayer structure becomes visible.

Micro lenses

PMMA



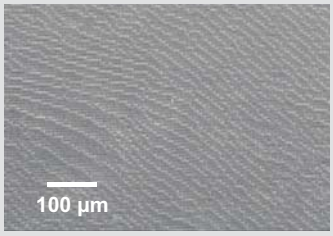
Fused silica fiber

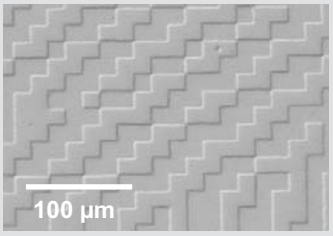


Polymer micro lens array made by 308 nm -laser induced surface swelling (left). Micro-lens on the end face of a multi-mode silica fiber excised by F_2-laser ablation (157 nm) (right).

Diffractive phase elements

Fused silica





Four level diffractive phase element fabricated by F_2-laser ablation (157 nm) (left), and a binary element made by a special process allowing for the patterning of silica at 248 nm (right).

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