UV sub-ps laser pulses patterning of Mo/Si and W/Si multilayers for soft X-ray gratings

E. Majkova, S. Luby, Y. Chushkin, M. Jergel
Institute of Physics, Slovak Academy of Sciences, 845 11 Bratislava, Slovak Republic
(majkova@savba.sk)

I. Zergioti(a), D. Papazoglou, A. Manousaki, C. Fotakis
Institute of Electronic Structure and Laser, Foundation for Research and Technology – Hellas,
P.O. Box 1527, 71110 Heraklion, Greece
(a) National Technical University of Athens, Physics Department, Iroon Polytexneiou 9, 15780 Zografou,
Athens, Greece (zergioti@central.ntua.gr)

We present herewith micropatterning of multilayer gratings (MLG) using ultraviolet sub-ps laser pulses. A micromachining system operating with a 0.5 ps KrF laser at 248 nm was used to etch grating structures with a groove width of 0.8 – 0.9 µm in Mo/Si, Si/Mo, W/Si and Si/W multilayers with five periods, each 7 – 10 nm thick. The applied laser fluences on the sample were varied between 100 and 500 mJ/cm². The MLs were locally ablated up to the Si or oxidized Si substrate, i.e. to the depth of approx. 50 nm using from 1 to 5 pulses. The width of grooves was even lower than the demagnified slit mask spot (0.9 µm) on the ML surface, which is explained by the inhomogeneous distribution of laser energy in the beam cross-section. The roughness on the surface of MLG lines and in the grooves increased with the depth of ablation up to 15 nm. Atomic force microscopy, scanning electron microscopy and X – ray reflectivity were used to characterize the microetched patterns. The ω – scans around the 1st Bragg maximum show symmetric satellites up to 3rd order. Short pulse laser processing is advantageous for the fabrication of high spatial resolution microstructures.