Direct Nano-structuring of Solid Surface by Extreme Ultraviolet Ar^{8+} Laser

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The submitted paper describes our approach to "direct patterning" of solid surfaces by pulse, high-current, capillary-discharge-pumped Ar^{8+} ion laser (λ = 46,9 nm). Its radiation is focused by a long-focal spherical mirror (R = 2100 mm) covered by 14 double-layer Sc-Si coating [1].

At our experiments in interaction of focused extreme ultraviolet (EUV) laser pulse with solid surface two regimes can be distinguished [2] - the desorption regime and the ablation one, when by turns less than and more than half of penetration-depth-layer is removed by one shot. Moreover, such regimes can be distinguished even on a more complicated sample like substrate with thin surface layer of different material (e.g. polymethylmetacrylate (PMMA) covered by 50 nm gold layer). The nano-patterning is demonstrated on 2D diffraction pattern, which is created on the substrate-surface in windows (7.5 μm x 7.5 μm) of the with-substrate-in-contact-standing grid (see Fig. 1). It turned out that the pattern is created in the "distant" desorption zone only.

Finally, our plans on creating periodic nano-structure by interference nano-patterning will be mentioned. The interferometer scheme will not be published (because of patent pending), but an interference pattern resulting from ray-tracing and its sensitivity to de-tuning (misalignment) of the interferometer will be shown.

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[1] K. Kolacek, J. Straus, J. Schmidt, O. Frolov, V. Prukner, A. Shukurov, V. Holy, J. Sobota, T. Fort, Laser and Particle Beams **30**, 1 (2012)

[2] R. F. Haglund, Appl. Surf. Sci. 96-98, 1 (1996); J. Chalupsky et al., Optics Express 17, 208 (2009)

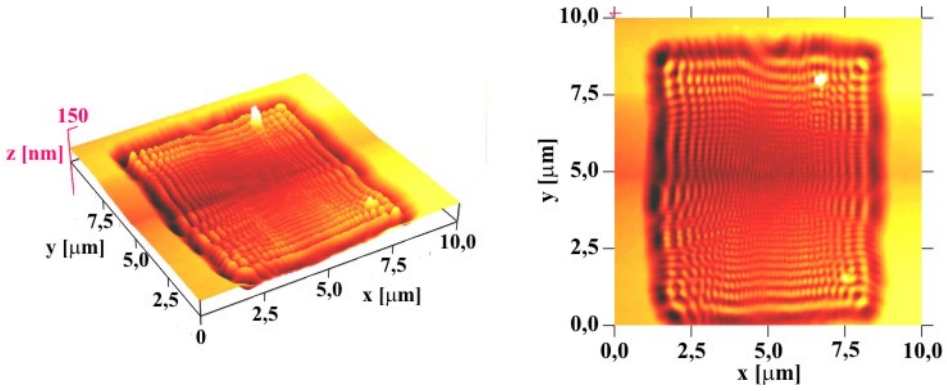

Figure 1: 2D diffraction pattern created in window 7.5 μm x 7.5 μm of the with-substrate-in-contact-standing grid and recorded by atomic force microscope (AFM); Left: 3D plot, Right: 2D plot.