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Modification of polymer surfaces using a compact laser plasma EUV source

Henryk Fiedorowicz[1], Andrzej Bartnik[1], Roman Jarocki[1], Jerzy Kostecki[1], Anna Szczurek[1], Miroslaw Szczurek[1], Przemyslaw Wachulak[1]

[1]Institute of Optoelectronics, MUT, Warsaw, Poland

hfiedorowicz@wat.edu.pl

We report the first results on modification of polymer surfaces with extreme ultraviolet (EUV) generated from a compact laser plasma EUV source. The EUV radiation in the wavelength range of about 5 to 50 nm was produced by irradiation of xenon or krypton gas puff target with Nd:YAG laser operating at 10 Hz and delivering 4 ns pulses of energy up to 0.8 J per pulse. The use of the gas puff target instead of a solid target allows for the generation of EUV light without debris associated with the ablation of solid targets. The source was equipped with a grazing incidence axisymmetrical ellipsoidal mirror to focus EUV radiation in the relatively broad spectral range with the strong maximum near 10 nm. The EUV radiation was focused in a spot of about 0.5 mm in diameter with the maximum fluence of about 70 mJ/cm2. The experiments on irradiation of various polymers with extreme ultraviolet have been performed using the compact laser plasma EUV source. The polymer samples to be EUV-irradiated were placed near the focus of the optical system. Modification of polymer surfaces was achieved, primarily due to direct photo-etching with EUV photons and formation of micro- and nanostructures onto the surface [1,2]. The mechanism of the interaction is similar to the UV laser ablation where energetic photons cause chemical bonds of the polymer chain to be broken. However, because of very low penetration depth of EUV radiation, the interaction region is limited to a very thin surface layer (<100nm). This makes it possible to avoid degradation of bulk material caused by deeply penetrating UV radiation. Formation of self-organized nanostructures on the surfaces was observed. The results of the studies should be applicable in biomedical engineering.

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