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MICROPROCESSING POLYMERS USING SYNCHROTRON AND LASER PLASMA EUV SOURCES

H. Fiedorowicz

Institute of Optoelectronics, Military University Technolog, 2, Kaliskiego St, 00-908 Warsaw, Poland

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e-mail: hfiedorowicz@wat.edu.pl

Organic polymers (PMMA, PTFE, PET, and PI) are considered as important materials in micro- and nanoengineering, especially for biological and medical applications. Various techniques are used to produce mechanical or electromechanical parts in micro- or nanoscale from these materials, however, some polymers (*i.e.* PTFE) require special techniques for making microparts with a high aspect ratio and sub-micron structural accuracy. It was demonstrated that direct photo-etching using synchrotron radiation can be applied in high aspect ratio micromachining of PTFE. In the experiments it was found that the photons with lower energy (below 350 eV) dominate the processing. In direct photo-etching of polymers with radiation in this wavelength range a single photon carries enough energy to break any chemical bond and create in this way small fragments of a polymer chain. Because of very low penetration-depth of low-energy photons the material is removed only from the surface and a very thin near-surface layer. Radiation in this wavelength range (extreme ultraviolet – EUV) can be also produced in laboratory plasma sources, including discharge and laser plasmas. In this paper we present the results of the experiments on direct photo-etching of organic polymers with EUV radiation from laser plasma sources. The sources are based on a laser-irradiated gas puff target approach. The use of the gas puff target eliminates the target debris problem. The laser plasma EUV source producing radiation in the wavelength range from 5 to 20 nm in result of irradiation of a gas puff target with 0.8 J/3 ns laser pulses from a Nd:YAG laser in 10 Hz operation rate was used for microprocessing polymers. The source could be equipped with various EUV optical systems. Strong enhancement of the processing was observed for the samples heated up to 200ºC. The results of investigations using laser plasma EUV sources are presented and compared with experiments with synchrotrons.