

Polymer ablation using extreme ultraviolet pulses

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Laser ablation microanalysis is well established to perform a rapid and spatially resolved microanalysis. The sample utilization efficiency (fraction of measured mass versus amount of sampled mass) is extremely inefficient, as low as a few ppm. This causes a large sample damage and limits the sensitivity. The use of short wavelength radiation has been proposed to enhance the absorption and thus eliminate the heat-affected zone.¹ Sub-destructive sampling with extreme ultraviolet radiation (EUV, $\lambda = 5\text{-}50\text{ nm}$) has potential applications in microanalysis due to its strong absorption cross-section with any matrix. This radiation can excite the electrons and ionize the surface molecules or atoms efficiently. Obviously, it is important that the sampling is stoichiometric and possibly free of matrix effects. In order to achieve a better understanding of EUV photon and material interaction as well as the chemical processing on various material surfaces, the PMMA and PTFE samples were primarily irradiated by a pseudospark XUV source without focusing in our laboratory. Time-of-flight secondary ion mass spectroscopy (ToF-SIMS) was applied to observe the chemical processing on the surface. According to the fragments from the ToF-SIMS spectra, it is obvious that EUV photon is able to break both the main chain and the side chain in the polymers. Interestingly, the fluorine in PTFE depletes after the EUV irradiation, since it can generate volatile clusters with O and H in vacuum and desorb from the surface. X-ray photoelectron spectroscopy (XPS) results presents also the surface oxidation and fluorine depletion of PTFE. Additionally, the wettability of both polymer increased after EUV treatment, because there are more O generated and remained on the surface. This study presents a wide range of possibilities for the further development of the surface modification/microanalysis by XUV irradiation/ablation.

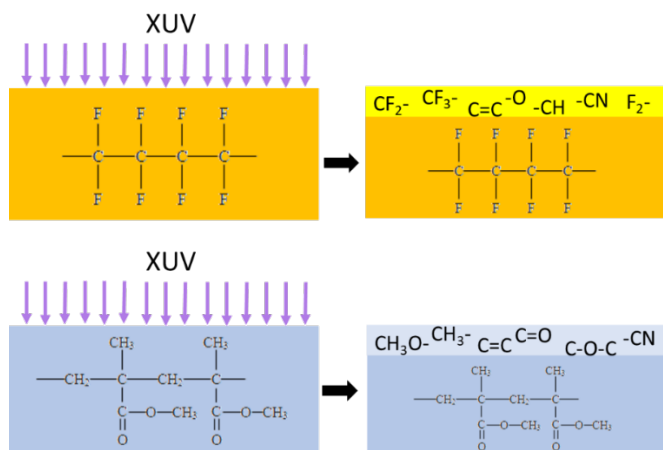


Figure 1: Schematic of the interaction between XUV and polymer matrices

[1] D. Bleiner, L. Juha, D. Qu, *J. Anal. At. Spectrom.* **2020**, 35(6), 1051–1070.