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Elementary surface processes during plasma treatment of polyethylene terephtalate (PET)

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Plasma treatment of polymers such as PET plays an important role for biomedical and electrical applications. Particle beam experiments were conducted in an ultra-high-vacuum (UHV) vessel, where surface modifications of spin-coated PET thin films were analyzed by in-situ-Fourier-Transform-Infrared-spectroscopy (FTIR) in reflection mode. The PET films were deposited on an optically resonant stack (optical cavity substrate) in order to enhance the signal-to-noise ratio of the reflected IR signal at surface level. An electron cyclotron resonance (ECR) plasma source provided argon ions with fluxes of the order of 10^{14} $cm^{-2}s^{-1}$ and an energy between 50 and 400 eV. Additionally, thermal atom sources were used to investigate the influence of hydrogen and oxygen bombardment during the ion beam treatment. Ar ion bombardment dominates the etch rate by sputtering. The surface is also crosslinked by ion impact. Additional O or H did not change the etch rate, but rather the chemical nature of the surface. The samples were analyzed by X-Ray photoelectron spectroscopy (XPS) before and after the treatment. These measurements revealled a good agreement with the stoichiometry of PET before the treatment. Atomic force microscopy (AFM) and cross-section scanning electron microscopy (SEM) were used to investigate the surface morphology of the samples. Water contact angle (WCA) measurements showed values lower than 10 degrees after treatment, which indicated a strong surface activation of the PET. These experiments give some insight in surface processes of PET during plasma treatment in real time. By a proper choice of parameters, the interface between the polymer and the subsequent coating can be tailored.

Keywords
plasma treatment
polyethylene terephthalate (PET)
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particle beam experiment