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Separated effects of ions, metastables and photons on the properties of barrier layers on polymers

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Analyses of a-C:H /a-Si:H multilayers on polymer substrates indicated that prolonged ion bombardment influences negatively the properties of the barrier layer, while a short plasma pretreatment can improve the barrier effect^[1]. This work is motivated by these results and investigates the influence of different reactive plasma components, namely ions, metastables and (V)UV-photons, on the properties of the grown barrier layer.

To separate the different species and their influence on plasma pretreatment and film growth, we build an ion-repelling grid system, which repels the ions from the substrate, so that only metastables and (V)UV-photons have an effect on the layer.

In a second approach we separate the effect of argon metastables from the effect of (V)UV photons. In addition to the before mentioned ion-repelling grid we use a collimator with a high aspect ratio and an argon or helium gas-shower in front of the substrate. With this setup it is possible to reduce the metastable and ion density in front of the substrate, so that only (V)UV-photons have an effect.

An integral part of this investigation is to measure the photon fluxes to the substrate by an absolutely calibrated VUV monochromator. For that, a differentially pumped VUV spectrometer with a spectral range 30 – 300 nm is used, where, for example, the absolute emission intensities of the two most prominent argon lines at 104.9 and 106.8 nm can be measured.

In this approach we are able to study the different effects of the plasma species and also possible synergy effects, to improve the properties of the barrier layer.

[1] H. Bahre et al., J. Phys. D: Appl. Phys. 46, (2013) 084012,
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