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Investigation of the nucleation stage of plasma-deposited SiOx barrier films as function of substrate chemistry

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SiO_x is a material of great interest, since it is optically transparent and achieves a significant improvement of barrier performance against permeation of gases such as O_2 or H_2O vapor. In particular, the initial stages of polymer exposure to the plasma are crucial in order to achieve growth of thin layers with good adhesion to the polymer while at the same time, avoiding destruction of the plastic material by contact to the highly reactive plasma phase. In order to understand the processes that take place during the initial growth stages it is necessary to have (i) precise information about the flux of reactive species produced in the plasma, and (ii) to determine in which way chemical modification of the plasma-exposed substrate might influence the nucleation of the barrier film. Some of these aspects were addressed in the previous work by Ozkaya et al. [1] and Mitschker et al. [2]. The goal of this work is to investigate the interfacial processes during the initial stages of barrier coating deposition as function of the surface chemistry. To determine the chemical stability of the supporting layer, different polymer-like substrates are investigated, such as spin-coated polypropylene, and crystalline aliphatic self-assembled monolayers (SAMs) with different terminations (thiol-based C_{12}-alkyl chains with an end group like hydroxyl (-OH), carboxyl (-COOH), alkyl ($-CH_3$), etc) . In order to follow the changes depending on the end group of the SAMs, three different characterization methods are employed: atomic force microscopy (AFM), polarization modulated infrared reflection-absorption spectroscopy (PM-IRRAS) and x-ray photoelectron spectroscopy (XPS).

[1] Ozkaya et al., PPaP, 2015, 12 (4), 392-397

[2] Mitschker et al, PPaP. 2015, DOI: 10.1002/ppap.201500085

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