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Understanding the growth of ultra-thin plasma polymers on molecularly defined polymer surfaces

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The nucleation and film growth of PECVD deposited SiO_x films as a function of the substrate surface chemistry (SAMs, acting as a polymeric model system) was investigated. Ultra-thin SiO_x films were deposited by microwave plasma in a mixture of HMDSO and O_2 and the films were characterized by PM-IRRAS. Cyclic voltammetry was used to probe the defect density of the bare SAMs and the SiO_x-covered SAMs. Furthermore, the evolution of the SiO_x surface morphology for increasing film thickness as function of the substrate chemical termination is investigated by AFM. A strong influence of the surface chemistry on the SiO_x nucleation and film growth was observed. While $-CH_4$ and -COOH terminated SAMs were degraded during the nucleation leading to defect rich ultrathin films, the $-Si(OCH_3)_3$ group protected the aliphatic chain of the SAM and lead to ultra-thin SiO_x-films with a lower defect density [1]. A mechanistic explanation of the results was provided. Following, the results were transferred to the adhesion of a PECVD-SiO_x coating deposited onto injection-molded PP. The surface chemistry was modified by the by-mixture of PP with small amounts of PDMS to create a Si-enriched top layer. The substrates were characterized by XPS, ATR and ToF-SIMS. The adhesion of the SiO_x coatings to the PP/PDMS substrates was greatly enhanced with respect to the non-functionalized PP, which shows that adhesion to polymer substrates can be improved without the need to deposit intermediate adhesion layers, and without the need to include a plasma pre-treatment step into the process [2]. The support provided by the German Research Foundation (DPG) within the framework of the Transregional Collaborative Research Center TRR 87/1 (SFB-TR 87) is acknowledged.

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[2] Hoppe, C., 2017, J. Phys. D: Appl. Phys. 50 (20), S. 204002. DOI: 10.1088/1361-6463/aa69e5.

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