OR0703

Oxidative degradation during the deposition of SiOx barrier films in polymer surface near-regions: Correlation between plasma and surface diagnostics

Felix Mitschker[1], Jan Dietrich[2], Berkem Ozkaya[2], Ignacio Giner[2], Christian Hoppe[2], Teresa de los Arcos[2], Guido Grundmeier[2], Peter Awakowicz[1]

[1]Ruhr-Universität Bochum / AEPT, Bochum, Germany [2]Chemical Engineering and Macromolecular Chemistry, University of Paderborn, Paderborn, Germany

mitschker@aept.rub.de

Widely used polymers, like polypropylene (PP), offer only limited gas barrier performance. The plasma deposition of thin silicon oxide (SiO_x) films is one approach to enhance the barrier properties. SiO_x is of great interest, as it is transparent and offers significant increase of barrier performance. The deposition is performed by means of a microwave-driven low pressure plasma using gas mixtures of HMDSO and oxygen. Decisive for growth and adhesion of the coating are the initial stages of thin film deposition. To enlighten this, both, plasma diagnostics and surface analytics have to be applied. Hence, determination of absolutely quantified fluences of reactive species and tracking of interfacial changes in the polymer surface-near regions are necessary.[1,2] As the oxygen to HMDSO ratio determines structure and barrier performance of the resulting film, investigations are performed for different ratios. OES is performed in order to characterize the plasma properties, like electron density and temperature, and absolutely quantified atomic oxygen fluences.[2] An aliphatic polymer is mimicked by means of a sensor layer that consists of crystalline aliphatic self-assembled monolayers (SAMs) of octadecanethiol (ODT).[1] Interfacial changes can be monitored by polarization-modulation infrared reflection-absorption spectroscopy (PM-IRRAS), due to self-organization of the ODT-SAMs. It is revealed, that the surface sustains a critical fluence of atomic oxygen before significant degradation occurs. Furthermore, degradation can be prevented if an interlayer is deposited before deposition of SiO_x barrier films. Support by the German Research Foundation (DFG) within the framework of the SFB TRR 87/1 is acknowledged.

[1] B. Ozkaya, F. Mitschker, O. Ozcan, P. Awakowicz, G. Grundmeier, Plasma Process. Polym. 2015, 12, 392–397.
[2] F. Mitschker, J. Dietrich, B. Ozkaya, T. de los Arcos, I. Giner, P. Awakowicz, G. Grundmeier, Plasma Process. Polym. 2015, 12, 1002–1009

Keywords
interface