OR1908

Effect of ion bombardement during deposition of barrier coatings on polymers

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Plasma processes are successfully applied for the deposition of barrier coatings on polymers. It is commonly found that very low permeation is achieved on PET whereas coatings on other polymers like HDPE show much higher permeation. In addition, a strong dependence on the process parameters and the reactor geometry is found. In particular, in industrial asymmetric radio-frequency discharges which develop a self-bias, the properties of the coatings depend on whether the substrate is lying on the cathode or on the anode. It is assumed that the position-dependend ion current density is the reason for the observed differences. On one hand, ion impact could result in an enhancement of the covalent bonds and therefore, a more stable interface. On the other hand, ion impact could also result in stress within the coating as well as in damage of the polymer bonds in the substrate, and therefore weakening of the interface.
In our study, we performed barrier coating processes with several polymers in different plasma reactors. During plasma processes, these reators develop a different self-bias. In addition, an external bias can be applied (kHz to MHz). In such a way, the ion current density can be varied. The ion currents were measured with a Faraday cup. The internal stress of the coatings was determined from the bending of coated foils. The morphology and composition of the interfaces between the polymer substrates and the barriere coatings were examined by SEM and XPS. Finally, these coating properties were related to the ion current density and barrier performance.

Keywords
barrier coatings
ion current density
XPS
SEM