OR0905

Diene and dienophile functionalized surfaces by combining atmospheric pressure plasma copolymerization and gas phase reactions for reversible adhesion.

Anton Manakhov[1], Maryline Moreno-Couranjou[1], Nicolas Boscher[1], Patrick Choquet[1], Jean-Jacques Pireaux[2]

[1]CRP - Gabriel Lippmann, Belvaux, Luxembourg [2]Facultés Universitaires Notre Dame de la Paix, Namur, Belgium

manakhov@lippmann.lu

In this presentation, optimized processes to achieve diene and dienophile functionalized surfaces will be reported and the resulting adhesion, based on Diels-Alder reaction, demonstrated. The surface grafting strategy relies on anhydride rich plasma thin films deposited using an atmospheric maleic anhydride (MA) and vinyltrimethoxysilane (VTMOS) plasma copolymerization process. As reported [1], the discharge electrical parameters allow to tune independently the chemistry and the morphology of the plasma layers. An aminolysis gas phase reaction between the anhydride groups carried by the surface and the amino group of a specific molecule lead to the formation of the diene [2] and dienophile. First, concerning the diene formation, the influence of the morphology and the anhydride surface density of the plasma thin films on the aminolysis reaction with the 5-methylfurfurylamine will be presented. The reaction was monitored by FT-IR and the yield estimated by XPS analysis. Secondly, the reactivity of the dienophile surfaces was investigated according to an interfacial Diels-Alder reaction in solution with a diene compound bearing a trace element, namely the 5-bromo-2-furaldehyde. According to XPS analysis, the yield of the reaction is nearly 60%. Secondary Ion Mass Spectrometry 3D reconstruction allows to highlight a heterogeneous in depth distribution of the trace element. Finally, a diene functionalized Kapton film was bonded to a dienophile functionalized polished aluminium foil. The pressure, time and temperature conditions of the press were optimized to achieve a high adherence level. A 4 hours contact under 60 bar at 448K led to a 1 N/mm^2 peel strength measured at room temperature. The increase of the temperature induced the depletion of the adhesion value by a factor of 20 or more. After tests, the surfaces were analyzed by Scanning Electron Microscopy, FT-IR and XPS to investigate the reversibility of the Diels-Alder reaction.
[1] A.Manakhov et al. Plasma Proces. Polym. DOI:10.1002/ppap.201100184.
[2] A.Manakhov et al. Surf. Coat. Technol. 2011, 205, 466.

Keywords
anhydride rich coating, Dielectric Barrier Discharge, pulsed plasma