PLASMA SURFACE TREATMENT FOR IMPROVED ADHESION IN RUBBER-METAL AND RUBBER-POLYOLEFINE BONDING

Cihan Kaplan^{1,2}*, Anna Misiun^{1,3}*, Dr. Sören Schmid^{1,4}, Dr. Harald Geisler^{1,5}, Prof. Robert H. Schuster^{1,6}

¹Deutsches Institut für Kautschuktechnologie e.V., Eupener Straße 33, 30519 Hannover, Germany: ^{2*} Cihan.Kaplan@dikautschuk.de, ^{3*} Anna.Misiun@dikautschuk.de, ⁴Soeren.Schmid@dikautschuk.de, ⁵Harald.Geisler@dikautschuk.de, ⁶Robert.Schuster@dikautschuk.de

In the last decades there has been a strong interest in the improvement of bonding in composites between rubber and materials like metal or plastics. The use of plasma techniques has proven some success in this field. Unfortunately most of the progress is done by the use of low pressure plasma. This approach has the disadvantage that it is not suitable for in-line production processes. A new entry in this field is given by the non thermal atmospheric pressure plasma process. Especially the effects of surface cleaning, chemical modification and etching during the plasma modification and the deposition of plasma polymers by the plasma polymerization process are of interest for the improvement of the adhesion between rubber and other materials. In this work the influence of plasma activation and plasma polymerization processes on the rubber-metal and rubber-polyolefin bonding were investigated. The samples were treated using various process gases (nitrogen, air and argon). Plasma polymerization experiments were performed with a long list of different monomers suitable for this process under various conditions. The effectiveness of experiments was measured using the contact angle method. The treated metal and polyolefin surfaces were also examined using atomic force microscopy (Fig. 1) to characterize the substrate topography and the thickness of the polymer films after the treatment.

RESULTS

Plasma activation can improve the wettability of metal surfaces, the cleaning of metal and polyolefin surfaces and increase the adhesion in rubber-metal bonding up to 50%. Plasma Polymerization can replace the primer component of industrial used adhesion systems and simplify the bonding by generation of functional groups that simulate the primer ingredients. It is also possible zo substitute different pre-treatment methods normally used to compitibilize metal surfaces. (Fig. 2).

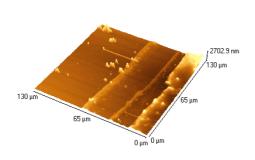


Fig. 1: : AFM-picture of deposited toluene-layer.

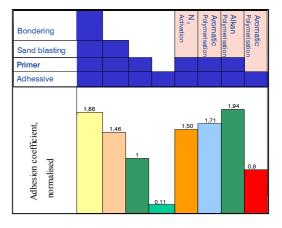


Fig. 2: Rubber-Steel Bonding with plasma activation and polymerisation



M. Sc. Cihan Kaplan (WE) am DIK seit 07/2007

- Oberflächenmodifizierung von Gummi und Metall mittels Atmosphärendruckplasma
- Kontaktwinkelmessungen