PLASMAMODIFICATION OF THERMOPLASTIC FOR IMPROVE BONDING PROPERTIES

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In this work the influence of atmospheric pressure plasma activation and plasma polymerization processes on the rubberthermoplastics bonding was investigated. Chemical and physical properties of the modified surfaces were confirmed through contact angle measurements, infrared spectroscopy and atomic force microscopy. It was shown, that plasma activation and polymerization affect the surface properties and were able to improve the bonding between the investigated materials.

Introduction

The industrial use of plasma processing has been known since late 1960. Most of the progress was done by the use of low pressure plasma. The disadvantage here is, that this is not suitable for the commercial technology. A new entry in this field is given by the non-thermal atmospheric pressure plasma process. From begin it was clear, that this new technique will have a favorable affect in improving material properties in the bonding technology. The focus of this research is the influence of atmospheric pressure plasma discharge on the properties of rubberthermoplastic bonding.

Results

The plasma processes lead to the following effects: cleaning, activation and functionalization of the thermoplastic surfaces. All this factors have a genuinely influence during the composite preparation via gluing or vulcanization. Practical adhesion of SBR on polypropylene by use of CR adhesive equal to zero. The activation alone of the material in air or nitrogen plasma induce the adhesion forces between the bonded surfaces. However, the best effects are observed after plasma polymerization process using fluor- or aliphatic precursor.

The vulcanization of NBR on thermoplastic materials can be realized by using a 2-components adhesive system, where one of the components is the primer. Without the primer the bonding can not occur. The latest experiments with various plasma polymerization precursors showed, that plasma give the opportunity to successfully replace the primer (Scheme 2) leading to a 1-component (1C) system.

The surface analysis confirms the chemical and physical changes of the treated materials. Wetability measurements are showing a correlation between the experiment conditions and surface energy. This gives an ability to control the process outcome and to "adjust" the surface energies of partners, what have a relevant influence during bonding process. Morphological images from atomic force microscopy showed a different thickness and shape of deposited layers as a function of precursor flow rate and the type of precursor itself. Scheme 3 shows the polypropylene surface with a typical layer of plasmapolymer based on an aliphatic precursor.

Conclusion

It has been confirmed, that the plasma technique can be an effective surface treatment for promoting adhesion between thermoplastic and rubber. The most successful results were obtained during the plasma polymerization process with aliphatic substances as precursors for the bonding of NBR and SBR on PP, PBT and PA6. However, at the moment this technique can not substitute the complete adhesive system.

Acknowledgement: We thank the following companies for financial support: REMA TIP TOP GmbH, Artemis Kautschuk- und Kunststofftechnik GmbH, SKF Sealing Solution GmbH, Maschinenfabrik Herwarth Reich GmbH, Vulkan Kupplungs und Getriebebau GmbH & Co. KG, Stromag AG, helsacomp GmbH, Berleburger Schaumstoffwerke GmbH, PlasmatreatGmbH.

Dipl.-Ing. Anna Misiun (WE)
am DIK seit 09/2007

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- Kontaktwinkelmessungen, physikalische Prüfungen, Spektroskopie, chemische Synthesen