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DEPO / Plasma - deposited coatings for optical, electronical and other functionalities

Plasma polymer for enhancing adhesion bonds of metal/elastomer assembly

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Abstract content

Plasma-enhanced chemical vapor deposition has been used to deposit polymeric films on metal or polymers whose properties can be adjusted by optimizing deposition parameters. Multilayers or single plasma layers with chemical composition gradient in thickness are credited with providing outstanding properties such as the adhesion between the plasma polymer and the substrate [1,2]. The multilayer plasma deposit is applied to different precursors (acetylene, acrylic acid, maleic anhydride) in the aim of adhesion for metal / elastomers assembly. In addition to the thermodynamic aspects of wetting, the adhesion mechanisms are based on various interactions such as the establishment of chemical bonds and the diffusion of the macromolecular chains of the adhesive and the polymeric materials. Therefore, here, four model plasma layers, representative of these mechanisms were synthesized by combining the pulsed or continuous wave for the plasma polymerization of these three precursors. Pulsed wave deposits carried out under conditions less degrading and preserving the chemical groups of each precursor should promote the chemical adhesion. Opposite continuous wave deposits with less reactive group retention play on the thickness of the deposit, i.e on duration without providing targeted chemical functionality and are in favor of the interdiffusion of macromolecular chains. The last experiment (CW + PW) is intermediate to the other methods. A thick layer about several 10 nm is first deposited on the substrate under continuous wave; then at the extreme surface the chemical functionalization is provided by the deposition in pulsed wave under optimal retention conditions. This experimental path should combine the effects of chemical anchoring and interdiffusion with a chemically controlled surface and a relatively thick film to facilitate the creation of an interphase during further adhesive vulcanization. After a full characterization of each plasma layer, the validation of these model layers is illustrated by measuring the mechanical strength of two assemblies (aluminum - poly(acrylonitrile butadiene) rubber (NBR) and stainless steel - fluoroelastomer (FKM)). It appears that the thermodynamic criteria, the hydrophobicity or the thickness depending of the plasma polymer and elastomer properties enhance the yield stress.

References

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