Plasma Polymer Film as a Sacrificial Interlayer to Enhance Metalized Polymers Disassembly for Recycling

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Abstract:

Metal coatings on polymers are widely used in industries such as electronics, automotive, and packaging for their conductivity, barrier properties, and aesthetics. While strong adhesion between metal and polymer is typically beneficial, it poses a significant challenge for recycling. The separation of these layers is highly challenging (e.g., shredding, pyrolysis, dissolving) and costly, often resulting in the disposal of such waste causing considerable environmental impact.

In this context, this study explores the use of plasma polymer films (PPF) as intermediate layers between metals and polymers to improve the recyclability. The PPF would ensure a strong adhesion with the metallic layer (i.e., Al) while embrittling the composite when exposed to a stimulus (e.g., water immersion, heating).

The PPFs are synthesized from two precursors, acryl acid and a gas mixture of C_2H_4 / CO_2, both known to generate PPF with a high content of carboxylic acid[1] ensuring a strong interaction with aluminum coatings[2]. The analysis of the XPS data reveals high concentrations of COOH at low power for AA while for the gas mixture, an opposite trend is observed indicating different growth mechanisms with regard to the source molecule. For both precursors, higher oxygen content results in a decrease in the cross-linking density of the coatings. The whole set of our data paves the way for the use of the PPFs as sacrificial layers with high adhesion to metals and good delamination in water.

References

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