PO1062

Surface modification of polypropylene films by atmospheric pressure dielectric barrier discharge

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Efficient plasma modification of polymeric web at atmospheric pressure is of great industrial interest, due to the environmental benefits and cost savings such a process route provides. The goal of surface treatment of polymeric webs is to provide uniform functionality without damage to the surface. However, atmospheric plasma treatments often used for this purpose are typically non-inhomogeneous processes and may lead to partial degradation of the treated films. Therefore, obtaining a homogeneous discharge is very desirable, with respect to delivering a uniform surface treatment with reduced surface damage and high functionality at higher rates over large areas.
A laboratory-scale dielectric barrier discharge reactor has been used to assess the effects of key process parameters for surface modification of polypropylene films. Nitrogen, both on its own, and with small concentrations of acetylene, nitrous oxide and carbon dioxide, were used as the process gases. Work presented here provides comprehensive analysis of process parameters, such as gas flow rate, additives concentration, power and voltage waveform on the surface properties of the polypropylene web. XRD was used to assess crystal structure changes of the polypropylene due to the treatment process, whilst FTIR spectroscopy was used to corroborate these measurements as well as examine the functional groups that have been formed on the surface of the treated polypropylene. White light profilometry was used to assess changes in surface topology, whilst surface energy calculations were made from contact angle measurements. Therefore optimum process conditions to improve atmospheric plasma treatment uniformity and functionality of the treated film have been identified.

Keywords
atmospheric plasma
dielectric barrier discharge
polymer treatment