FLUORINATION OF POLYPROPYLENE BY REMOTE INDUCTIVELY COUPLED PLASMAS SUSTAINED IN Ar/F_2 AND Ar/NF_3 GAS MIXTURES*

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The surface energy and adhesion properties of commodity polymers such as polypropylene (PP) can be modified by functionalization of the surface by plasma-generated radicals and ions. For example affixing fluorine to the surface in a low temperature plasma lowers surface energy and increases hydrophobicity. The F atoms produced in the plasma both abstract H atoms from and adhere to the surface. In such plasma fluorination, the surface is also subject to energetic ion and photon fluxes. Another strategy is the use of a remote plasma to produce a flow of fluorine radicals which are injected into a reactor where the PP sheets are processed. For example, a remote inductively coupled plasma (ICP) sustained in mixtures containing F_2 or NF_3 produces plumes of F and NF_x radicals which functionalize the PP. In these systems, the PP is subject to only neutral species and so may have different surface properties than PP immersed in a plasma.

In this presentation, the fluorination of PP by remote ICPs will be discussed with results from a 2-dimensional plasma hydrodynamics model. The simulation is performed separately in 2 regions: one is the remote ICP sustained in a cylindrical flow tube. The second is the downstream PP fluorination reactor. The neutral output fluxes from the remote ICP are injected into the downstream fluorination chamber. The PP fluorination is quantified by the surface F/C ratio and degree of cross-linking.

Remote plasma properties were varied (e.g., power, pressure, flow rate, mixture), and the F/C ratio and cross-linking of the PP were investigated. Comparisons will be made for plasma and PP properties between Ar/F_2 and Ar/NF_3 gas mixtures. We found that the F/C and degree of cross-linking in the remote system can be quantitatively different (and controllable) compared to plasma immersed systems.

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