PREPARATION AND PROPERTIES OF CONDUCTIVE POLYMER NANOCOMPOSITES BASED ON POLYOLEFIN MATRICES REINFORCED WITH EXPANDED GRAPHITE

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ABSTRACT

In this study advanced composite materials based on polyolefin matrices filled with nano-structured expanded graphite (EG) were prepared by melt mixing using a Brabender Plastograph mixer. The amount and mixing proportions of the expanded graphite reinforced systems have been varied to determine the influence on the achievable level of electrical and thermal conductivities. The polyolefin/EG nanocomposites exhibit a sharp transition from an insulator to a conductor at an electrical percolation threshold of 4.8 wt%, but with sodium dodecyl sulphate (SDS) surfactant modification the electrical conductivity is extremely low. The dependence of the thermal conductivity on EG content shows a linear increase. The structure and morphology of the composites were characterized using scanning electron microscopy (SEM), transmission electron microscopy (TEM) and X-ray diffraction (XRD). The SEM results show an improved extent of interfacial adhesion between the polymer and the EG in the presence of SDS, but this is not helpful for obtaining materials with high electrical conductivity. The TEM images depict some nano-platelets agglomerated on the surface of the matrix, while in the presence of SDS such behaviour was not noticed. The diffential scanning calorimetry (DSC) results reveal that both EG and SDS do not seem to have any influence on the melting and crystallization behaviour of the EVA18. The incorporation of EG has a remarkable influence on the crystallization temperature of the PP, and slightly increases the crystallinity of PP. The thermogravimetric analysis (TGA) results show that the addition of EG evidently enhances the thermal stability of both EVA18 and PP, while in the presence of SDS these matrices are less stable than their nanocomposites. The stress and strain at break show an apparent decrease with increasing filler content for both EVA18 and PP, while Young's modulus increases much more significantly with increasing EG content for both polyolefin matrices.