Solution-blended polyethersulfone–graphite hybrid composites Formation of nanographite and electrical characterization

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Abstract

Solution-blended hybrid composites with carbon black (CB) as the second conducting filler in polyethersulfone (PES)-graphite have been prepared by first dissolving PES in dichloro methane. Addition of 1 wt% CB to solution-blended PES-7 wt% graphite results in decrease in the direct current electrical resistivity by four orders compared to the addition of 0 wt% CB. The particle size of graphite is reduced from few micron to nano level as evidenced by transmission electron microscopy analysis resulting in better dispersion. Without the addition of CB, the binary composite namely PES-7 wt% graphite exhibits finite conductivity due to increase in the contact between graphite particles as a result of reduction in the particle size. Comparison of electrical conductivity of PES-7 wt% graphite-2 wt% CB composites prepared by both solution-blending and powder-mixing routes proves the above-mentioned point. The alternating current behaviour, both conductance and effective dielectric constant studies shows that solution-blended composites exhibit higher value of conductance and effective dielectric constant at 0.01 Hz. This can only be attributed to better graphite dispersion in solution-blended composites. The enhancement is due to only particle size reduction of graphite that decreases the interparticular distance as the solution-blended binary composites with CB act as insulators up to 10 wt%. The charge transport at low concentrations of CB in solution-blended hybrid composites is dominated by the interfacial barriers and capacitance effects, while at higher concentrations it is mainly of hopping type at room temperature. The interfacial capacitance increases from 37.6 pF with 0 wt% CB addition to 96 pF with 2 wt% CB addition in PES-7 wt% graphite. Differential scanning calorimetry result suggests that more than 10°C enhancement in the glass transition temperature of PES is obtained for PES-7 wt% graphite-1 wt% CB.

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