LOW ELECTRICAL PERCOLATION THRESHOLD AND CHARGE CARRIER TRANSPORT IN MULTIWALLED CARBON NANOTUBE POLYMER NANOCOMPOSITES

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ABSTRACT

Carbon nanotubes (CNT) based polymer composites present promising and interesting applications in a growing research area. The exceptional mechanical, thermal and electrical properties of CNT combined with their high aspect ratio enable them to form new functional materials when added, at low concentrations, into the polymer matrix. In this work, multiwalled CNT-polymer nanocomposites based on high density polyethylene and epoxy as matrices have been prepared. The electrical properties were first investigated by means of dielectric relaxation spectroscopy. Low electrical percolation thresholds p_c = 0.4 and 0.05 vol.% have been found in the thermoplastic and thermoset polymer respectively. The dc-conductivity of composites with different CNT ratios has been measured from 4 until 330 K using the four probe technique. The analysis of the temperature dependence of dc-conductivity shows that the charge transport is fully described as the combination in series of one-dimensional (1-D) and three-dimensional (3-D) variable range hopping (VRH) regimes. The transport is limited by the 1D-VRH regime in the low temperatures limit and by the 3D-VRH regime at room temperature. These results will be also discussed in regard with structure and morphology properties of these nanocomposites for different CNT contents.

References

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