ABSTRACT

Today, we stand at the edge of exploring carbon nanotube (CNT) based polymer nanocomposites as next generation multifunctional materials. However, irrespective of the methods of nanocomposites preparation, development of electrical conductivity at very low loading of CNT has become a great challenge due to poor dispersion of the CNT in polymer matrix. The present research work deals with the development of polycarbonate (PC)/multiwall carbon nanotube (MWCNT) nanocomposites with high electrical conductivity at minimum possible CNT loading. PC is known to form miscible blend with several polymers, such as poly(methyl methacrylate) (PMMA), poly(ε-caprolactone) (PCL), and immiscible blend with acrylonitrile butadiene styrene (ABS), styrene acrylonitrile (SAN) and poly(butylene terephthalate) (PBT), etc. On the other hand, MWCNT shows electrical conductivity in PMMA, PCL, ABS, SAN and PBT at a relatively lower loading than that of PC. Thus, preparation of PC/MWCNT nanocomposites through melt-dilution of these polymer/MWCNT masterbatches may lead to high electrical conductivity at significantly low loading of the MWCNT. In the case of miscible blend, MWCNT is expected to disperse homogeneously throughout the PC matrix and develops a continuous conducting interconnected network path after melt-dilution of PMMA/MWCNT or PCL/MWCNT masterbatches. These conducting paths help to achieve high electrical conductivity at low MWCNT loading. Nonetheless, in the case of immiscible binary polymer blends with matrix-droplet morphology, selective dispersion of the MWCNT in the minor phase (dispersed domains of ABS, SAN and PBT) may lead to the formation of conducting network of MWCNT in PC through separation of electrically conducting small dispersed domains with a thin layer of PC. Thus, percolation threshold in these PC/MWCNT nanocomposites with bi-phase structure can be achieved at very low MWCNT loading with high electrical conductivity. AC electrical conductivity and dielectric permittivity of the PC/MWCNT nanocomposites with different MWCNT loading have been studied in the broad frequency range. The nanocomposites show the characteristics of a dielectric material. Storage modulus and thermal stability of the PC in the nanocomposites were also improved in the presence of small amount of MWCNT.

KEYWORDS: PC, MWCNT, Nanocomposites, Electrical conductivity, Percolation threshold