OP-3-1120

Wednsday, May 11, 2011, 09:25-09:45 am
Room: Fez 1

ROLE OF SPECIFIC INTERACTION IN ACHIEVING DEBUNDLING AND UNIFORM DISPERSION OF MULTIWALL CARBON NANOTUBES IN MULTICOMPONENT POLYMER BLENDS

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Polymer blends involving polyamide 6 (PA6), polypropylene (PP), acrylonitrile-butadiene-styrene (ABS) and high density polyethylene (HDPE) with purified multiwall carbon nanotubes (MWNT) were prepared by melt-mixing in a conical twin-screw micro-compounder to achieve conducting composites. MWNT were either compounded directly or by masterbatch dilution approach in binary (PA6/ABS), ternary (PA6/PP/ABS) and quaternary (PA6/PP/ABS/HDPE) blends. In order to facilitate 'network-like' structure, MWNT were modified with either sodium salt of 6-aminohexanoic acid (Na-AHA) or octadecyl tri-phenyl phosponium bromide (OTPB). Multicomponent blends with modified MWNT utilizing masterbatch dilution approach showed significant improvements in the bulk electrical conductivity as compared to blends prepared by direct addition approach at 2 wt % MWNT content. Bulk electrical conductivity of blends with OTPB modified MWNT (1:1) was significantly higher than blends with Na-AHA modified MWNT (1:1) at 2 wt % MWNT content. The higher electrical conductivity of blends with OTPB modified MWNT is presumably due to the longer chain length of organic tail of OTPB as compared to Na-AHA. Phase morphology of these blends revealed co-continuous type of morphology wherein MWNT were found selectively in the PA6 phase. The heteronucleating action of MWNT resulted in an increase in crystallization temperature of mainly PA6 phase of the blends indicating preferential localization of MWNT in the PA6 phase. The mechanism of improved dispersion of MWNT in presence of Na-AHA has been presumably through electrostatic charge repulsion and steric stabilization. However, steric stabilization involving the longer chain length corresponding to 18 'C' atoms of OTPB possibly led to the debundling of MWNT in presence of OTPB. The adsorption of OTPB on MWNT surface was facilitated either through 'cation-?' type of interaction between ?-electron cloud of MWNT and phosponium ion or through '?-?' interaction between ?-electron cloud of MWNT and phenyl rings of OTPB.