ABSTRACT

A number of research work on polymer/CNT nanocomposites revealed the potential of CNTs as highly conducting filler in developing electrical conductivity in insulated polymer matrix. The high electrical conductivity in nanocomposite is not only because of the intrinsic property of CNTs but also depends on the extent of dispersion and individualization of CNTs in the polymer matrix. Different methodologies were reported for achieving higher electrical conductivity at low CNT loading, which involves solvents, modification of CNTs, surfactants etc. However, the chemical modification of CNTs results in structural defects in them which reduce the electrical conductivity of CNT itself. Solvent casting process or surfactants is used for better dispersion of CNTs although presence of residual traces of solvent or surfactants in the nanocomposites is a disadvantage which in general is sought to be avoided.

In order to avoid the above mentioned disadvantages, we have demonstrated a new *in-situ* polymerization method in which the polymerization of monomers occurs in the presence of CNTs as well as beads of same polymer. This method effectively achieves high dispersion of CNTs which results in a low percolation threshold and at the same time avoids the need to either chemically modify the CNTs or to use any hazardous solvents or surfactants. These advantages made this processes as an innovative straightforward, industrially feasible and environmentally safe method. Selective dispersion of the MWCNT in the *in-situ* polymerized phase develops a continuous conducting interconnected network path and beads can be considered as an 'excluded volume' which is devoid of CNTs and hence, plays no part in the conductivity. Thus, the percolation threshold has been achieved lowest possible values.

In this work we successfully implement the process with two pure polymers (PS and PMMA) and with a co-polymer (SAN) and interpenetrating co-polymer network (IPN) based polymer (HIPS, ABS) system. Consequently, the percolation threshold of the nanocomposites was reduced to a lower value 0.045 wt% MWCNT for the PS/MWCNT nanocomposites, 0.12 wt% MWCNT for the PMMA/MWCNT nanocomposites, 0.032 wt% MWCNT for SAN/MWCNT nanocomposites, 0.54 wt% MWCNT for HIPS/MWCNT nanocomposites and 0.42 wt% MWCNT for ABS/MWCNT nanocomposites, which are best to our knowledge, the lowest value ever reported for these nanocomposites system at this low level of CNT loading with unaligned, unmodified, commercially available MWCNTs of similar qualities (carbon purity, aspect ratio). The morphology, electrical and other properties of the nanocomposites have been discussed in detail in the thesis.

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