

## **ABSTRACT**

In this study, nanocomposites based on MWNTs with different commercial grades of poly(ethylene-co-methyl acrylate) (EMA) having variable methyl acrylate (MA) contents ranging from 9 wt% to 30 wt%, have been prepared. The mechanical properties of nanocomposites are substantially improved by the incorporation of nanotubes. The morphologies of the nanocomposites have been evaluated by FESEM, SEM and HRTEM. The results showed that melt blending after solution mixing offers a simple and effective means to fabricate MWNT/EMA nanocomposites. The states of dispersions of the unmodified MWNTs are found to be inferior with increasing MA content in the EMA matrix. Better dispersions of MWNTs in EMA matrix lead to increased crystallite size and increased temperature of crystallization. The storage moduli of the nanocomposites drop very sharply with increasing % strain for EMA with 30% MA content and it reflects the typical Payne effect. The storage modulus of the nanocomposite is significantly increased by the incorporation of MWNTs particularly at higher temperatures. Dynamic and steady shear rheological characteristics of various EMA/MWNTs have been evaluated to understand shorter and longer range flow properties. The capillary rheological parameters have also been correlated with the developed morphology under steady shear conditions. This reveals that MWNTs become more aligned along the direction of flow after extrusion leading to improved dispersion. The thermo-mechanical and electrical properties of the nanocomposites improve with increase in wt% of MWNT loading. Thermal stability and degradation kinetics have also been studied using TGA to evaluate the kinetic parameters of degradation. A promising mechanism is proposed over different range of temperatures of degradation. The significant improvements in the mechanical and electrical properties of the polymeric matrix have been observed by addition of commercially available functionalized (hydroxyl and carboxyl) MWNTs. However, the states of dispersion of the functionalized MWNTs are turned out to be inferior in EMA matrix having lower MA. The MWNTs are also modified by the plasma,  $\gamma$ -ray irradiation and chemical treatment. These modified MWNTs have been characterized by FTIR, Raman spectroscopy and XPS. The morphology and properties of EMA/modified MWNTs based nanocomposites have also been investigated. Improvement of technical properties of the matrix has been found to be highest with the plasma modified MWNTs amongst the modification techniques used here. It is also found that electrical conductivity and EMI shielding effectiveness depend heavily on the type of functional groups present on the surface of MWNTs and also on MA content in EMA.

The EMA/MWNT nanocomposites are proposed to have potential applications especially, as semi-conductive layer in nuclear power plant cables, as EMI shielding materials or as reinforced functional nanocomposite materials.

**Keywords:** Carbon nanotubes; EMI shielding, Ethylene methyl acrylate; Functionalization of MWNTs; Matrix polarity; Morphology; Nanocomposites; Rheology.