ABSTRACT

Conducting polymer composites (CPCs) are increasingly replacing metal sheets in the electromagnetic interference (EMI) shielding industry. CPCs for EMI shielding can be tailor-made as per the absorption/reflection requirement by controlling the nature and composition of fillers and the embedding matrix. As compared to thermosetting plastic composites, thermoplastic composites are environment-friendly and offer the advantages of reformability, increased chemical resistance and improved recyclability. Thermoplastic CPCs with graphene sheets have superior shielding properties due to their better dispersion, higher aspect ratio, surface area, thermal conductivity and electrical conductivity.

In this work, highly-filled graphene nanocomposite films are prepared with PMMA, PVC and PVA matrices with different graphene loadings are prepared by solvent casting method. The mechanical, thermal, and electrical properties of these composites are studied to evaluate their suitability for EMI shielding solutions. The nanocomposite films are hot-pressed to obtain multi-layered structures of 2 mm thickness and tested for their EMI shielding effectiveness (EMI SE) in X band frequency. Hybrid nanocomposites are prepared with graphene/MWCNT, graphene/Bentonite and graphene/Fe3O4 fillers and their multi-layered structures tested for their EMI SE. Synergetic effect of the fillers defined the absorption-reflection contribution in the overall EMI SE. MWCNT addition resulted in significant changes in the mechanical and wear properties of the composites. There have been notable changes in the dielectric permittivity and thermal stability of PMMA and PVC composites with graphene/Bentonite and graphene/Fe3O4 hybrid fillers. Gradient multi-layered composites have been prepared with PMMA/graphene and PVC/graphene nanocomposites with different stacking arrangements. These gradient structures exhibited exceptional shielding properties when compared to their homogeneous counterparts and can be tailor-made to our shielding requirements. A novel attempt has been successfully made to develop sustainable composites with the addition of ball-milled jute fibres in PVA based CPCs. Since PVA is a biodegradable polymer, these CPCs have a great promising future as environment-friendly shielding solutions.

Keywords: EMI shielding, Polymer composite, Graphene, Carbon nanotubes, Hybrid composite