ABSTRACT

Thermoplastic Polyurethane (TPU) is one of the most versatile block copolymers (consisting of alternating hard and soft segments) having multifaceted commercial and biomedical applications. In view of above, the present work intended to focus on development of high performance TPU and its blend nanocomposites with 3D hybrid fillers. In view of this, present work involves the preparation of multiwalled carbonnanotube(MWCNT)-montmorillonite(MMT) and MWCNT-graphene 3D hybrid fillers by simple dry grinding and solution mixing methods respectively. This is followed by investigation of synergistic effect of these hybrids on the physicochemical properties of TPU nanocomposites prepared by solution intercalation method. These hybrid filled TPU nanocomposites exhibits improved mechanical, dynamic mechanical and thermal properties compared to either neat TPU or individually MWCNT, MMT, graphene filled TPU nanocomposites due to synergistic effect. Our findings also showed that TPU/MWCNT-graphene exhibits overall superior properties compared to TPU/MWCNT-MMT nanocomposites. Another effective approach in the present work involved the synthesis of 3D MWCNT-layered double hydroxide(LDH) [MgAl LDH and ZnAl LDH] and carbon nanofiber(CNF)-LDH [MgAl LDH and ZnAl LDH] hybrids through noncovalent assembly of MWCNT (or CNF) and LDH. Subsequently, their reinforcing effect has been explored in development of TPU/NBR (nitrile butadiene rubber) blend nanocomposites. The investigations on mechanical and thermal properties have shown that all the properties are enhanced in all hybrid filled TPU/NBR blend nanocomposites compared to either neat blend or individually MWCNT, CNF, LDH filled blend nanocomposites. These enhanced properties are attributed to the synergistic effect, exerted by the hybrid fillers. Overall, TPU/NBR blend containing MWCNT-MgAlLDH hybrid show maximum enhancement in mechanical properties, whereas dynamic mechanical and thermal stability are maximum improved in TPU/NBR blend containing MWCNT-ZnAlLDH and CNF- ZnAlLDH hybrid respectively. In conclusion, 3D hybrid nanofillers significantly enhance the mechanical and thermal properties of TPU and its blend nanocomposites.

Key words: Multiwalled carbonnanotube, Carbon nanofiber, 3D Hybrid, TPU, Blend, Nanocomposites