Macromolecular Materials and Engineering

Supramolecular poly(cyclotriphosphazene) functionalized graphene oxide/polypropylene composites with simultaneously improved thermal stability, flame retardancy, and viscoelastic properties

Malkappa, Kuruma
Council for Scientific and Industrial Research
Pretoria, 0001, South Africa
Email: MKuruma@csir.co.za

Abstract

A novel crosslinkable supramolecular poly(cyclotriphosphazene) functionalized graphene oxide (FGO) is synthesized and melt-processed with polypropylene (PP), which results in a PP composite with simultaneously improved flame retardancy, smoke-suppression, and thermal and viscoelastic properties. The cone-calorimetry test results reveal that the peak heat-release rate and total heat release of the composite (2 wt% FGO) are reduced by 39.7% and 29.9%, respectively, compared to those of the neat PP. Meanwhile, the total smoke released and total smoke production of PP are significantly (42.7% and 34.9%, respectively) reduced after composite formation with 2 wt% FGO. Similarly, the PP/FGO composite shows an improved maximum weight loss temperature of 392.4 °C, compared to that of neat PP (361.4 °C). Thermogravimetric Fourier-transform infrared spectroscopy (TG-FTIR) analysis further confirms that the composite reduces the evolution of the flammable components and toxic gases, especially CO gas, indicating that the FGO significantly decreases the fire hazards of the PP. The thermomechanical and melt-rheological analyses reveal that the composite has higher mechanical stiffness and viscoelastic properties than the neat polymer. In summary, FGO is shown to have potential as an advanced additive to obtain PP composites with multifunctional properties; however, higher FGO loading would be needed to improve UL-94 rating from V-2 to V-0.