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Properties of graphene oxide/thermoplastic starch green nanocomposites

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In the present work, the authors have made an attempt to prepare biodegradablecomposite materials with renewable source like starch, with improved propertiesand decreasing the water sensitivity preserving the biodegradability of the materialusing Graphene Oxide (GO). The authors have succeeded in developing new green nanocomposites with improved properties. Graphene Oxide reinforced Thermoplastic Starch based (TPS/GO), Green Nanocomposites were successfully prepared with different loadings of Graphene Oxide (0.1, 0.2, 0.5 and 1%) by melt extrusion followed by injection molding technique. Glycerol was used as plasticizer, and polypropylene (5 wt%) as a processing aid in the present study. In order to understand their tensile strength, thermal stability, water sensitivity and biodegradability for different loadings of GO, various analytical methods were used, such as Fourier Transform Infrared (FTIR) spectroscopy, Thermogravimetric Analysis (TGA), Tensile properties, X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Water absorption studies and Soil Degradation Studies. The FTIR analysis of the obtained nanocomposites revealed the hydrogen bond interactions between the polar groups of graphene oxide and starch, but there is no interaction with polypropylene as it is a non-polar. The TG analysis of the nanocomposites showed that the thermal stability of the composites was more than that of the matrix, indicating that the incorporation of GO has increased the thermal stability of the composites. The X-Ray Diffraction studies revealed the plasticization of starch, as crystallinity of neat cornstarch disappeared and matrix yielded only very broad and diffused pattern. The characteristic of peak of GO $2\theta=12°$ showed complete oxidation of graphite into graphene oxide. XRD analysis also revealed exfoliation of GO into the polymer matrix as the characteristic peak of GO was disappeared in composites. The SEM analysis of nanocomposites indicated uniform dispersion of GO into polymer matrix up to the GO loading levels of 0.2 wt% and agglomerated thereafter. From tensile measurements it is evident that tensile strength, modulus and elongation at break were increased with GO content up to GO loading level of 0.2 wt% and thereafter decreased with GO content because of agglomeration of GO at higher loadings. From water absorption studies it is evident that for all the specimens water absorption increased with immersion time up to a particular time and remained constant thereafter. However, when compared with the matrix, the composites reinforced with GO had lower water absorption, indicating that the GO had an interactive effect with the polymer matrix. Soil burial is a traditional and standard method for degradation of plastics, because of its similarity to actual conditions of waste disposal. From the Soil burial studies it is evident that the weight loss for both the matrix and composites increased with number of days of soil burial. After 80 days of the soil burial the weight loss was in the range 80-90% for different samples. The remaining undegraded part may belong to other materials like PP, GO etc. On the whole, these Green Composites showed good biodegradation.

Biography

K Madhukar has received his PhD, from Osmania University, Hyderabad, India in 1989. Presently he is serving as Professor (Full) at the, Department of Physics, Osmania University, Hyderabad. His research interest includes, development of new class of polymer/polymer blend nanocomposites, biodegradable Green composites using suitably functionalized and non functionalized CNTs/ GO, bio fillers, bio Nano fillers, for various applications.

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