Effects of micrometre-sized graphite flake to reinforce the performances of poly (lactic acid) thermoplastic biocomposites

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ABSTRACT

Biocomposites of poly(lactic acid) (PLA) and micrometre-sized graphite (GP) flake powder with 0–30 wt% GP contents have been prepared using extrusion moulding followed by compression moulding. The pure PLA and PLA-GP composites (PGC) have been examined by Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy (RS), X-ray diffraction (XRD) technique, scanning electron microscopy (SEM), transmission electron microscopy (TEM), mechanical and micromechanical testing, differential thermal analysis (DTA) and thermogravimetric analysis (TGA). FTIR spectra confirm the physical bond formation between GP and PLA. RS distinguishes the D-band spectra of pure PLA and PGC. XRD shows a partially crystalline structure in the PLA. SEM and TEM exhibit a clear dispersion of GP particles in PLA matrix at lower loading and aggregates at higher loading. With an increase of filler content, the tensile and flexural strengths decrease, but the Young's and tangent moduli are observed to increase by 58% and 77%, respectively. These increments represent an increase in the stiffness of the materials and are found to be consistent with the theoretical values. A decrease in microhardness with increase in filler content is also observed. Both the DTA and TGA reveal an increased thermal stability of the composites.

KEYWORDS

Poly(lactic acid); Graphite flake; Biocomposites; Mechanical properties; Thermal properties

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