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Morphological development and enhancement of thermal, mechanical, and electronic properties of thermally exfoliated graphene oxide-filled biodegradable polylactide/poly(ε-caprolactone) blend composites

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ABSTRACT:

Graphene nanosheets with relatively high surface areas and few layers were prepared by the thermal shocking of graphene oxide at 700 °C for the development of biodegradable polylactide/poly(ε-caprolactone) (PLA/PCL) blend composites via a melt-blending method. A 60PLA/40PCL blend was selected as a model blend system and the effects of graphene oxide nanoplatelet incorporation (0.05–0.25 wt%) on the morphological development, thermal stability, tensile and rheological properties, and thermal and electrical conductivities were investigated. Morphological studies using transmission electron microscopy and optical microscopy indicated that the graphene oxide particles were located mainly in the minor PCL phase, where the interphase between PLA and PCL acted as a compatibilizer. In addition, characterization of the composites confirmed significant improvements in ductility, with an improved balance between the tensile modulus and strength; however, the composite containing 0.05 wt% graphene oxide exhibited a superior improvement in thermal stability and thermal conductivity compared to the other blend composites. This study therefore gives us an opportunity to design biodegradable polymer-based advanced composite materials with desirable properties by the careful selection of filler loadings, which further widens the application of PLA matrices.