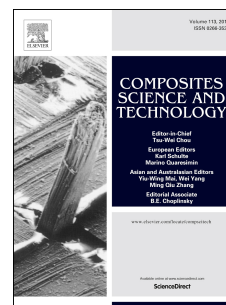


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Functionalized MWCNTs modified flame retardant PLA nanocomposites and cold rolling process for improving mechanical properties

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Abstract

10-hydroxy-9, 10-dihydro-9-oxa-10-phosphaphenanthrene-10-oxide (DOPO-OH) has been successfully covalently grafted onto the surfaces of multi-walled carbon nanotubes (MWCNTs) to obtain DOPO-functionalized MWCNTs (MWCNT-DOPO-OH) by a three-step process. The resultant core-shell nanostructured MWCNT-DOPO-OH was introduced into aluminum hypophosphite/poly(lactic acid) (AHP/PLA) flame retardant systems via melt blending to improve both flame retardancy and mechanical properties. AHP/PLA/MWCNT-DOPO-OH nanocomposites with synergistic effect of 1 wt.% MWCNT-DOPO-OH and 14 wt.% AHP were shown to be effective in improving flame retardancy with UL 94 V-0 rating and limiting oxygen index (LOI) value of 28.6. And these flame-retardant nanocomposites show a usable T_g higher than 57.8 °C and much higher char yield for preventing the anti-dropping. Moreover, a cold rolling process was performed for AHP/PLA/MWCNT-DOPO-OH nanocomposites to further improve the mechanical properties for secondary processing. For 1 wt.% MWCNT-DOPO-OH loading PLA nanocomposites, the tensile strength increased from 69.5 MPa to 77.9 MPa and 82.0 MPa, and the fracture strain increased from 17.9% to 27.5% and 120%, at rolling ratios of 30% and 50%, respectively, indicating that MWCNT-DOPO-OH modified PLA was homogenized plastic deformation during the rolling process.

Keywords: Nano composites; Synergism; Mechanical properties; Thermal properties; Plastic deformation.

1. Introduction.

Poly(lactic acid) (PLA) has been promoted to be one of the most widely used biodegradable polymers in packaging engineering,¹ biomedical fields,² household and automobile engineering,^{3,4} electricity industry⁵ and so on, because of their outstanding properties and renewable resources (mainly starch and sugar).⁶ However, the need for high level of thermal, mechanical and flame retardant properties greatly promotes the research on PLA and its composites for further application and development.^{7,8} The improvement of above

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