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Surface modification of cellulose nanowiskers with organosilane to fabricate high-performance polylactic acid nanocomposite materials

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ABSTRACT

Cellulose nanowisker (CNW) treated by organosilane (aminopropyltriethoxysilane (APS)) reinforced polylactic acid (PLA) via solvent casting evaporation process were developed. The effects of APS concentration and modified nanocellulose content in the nanocomposites were investigated. APS modified CNW (designated as A-CNW) was confirmed using Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM) and X-ray photoelectron spectroscopy (XPS) measurements, which provided further evidences about the efficiency of CNW surface modification. Nanocomposites were prepared by casting the N, N-dimethylacetamide (DMAc) solutions onto glass plates and evaporating the solvent at 80°C. The interfacial adhesion between CNW and PLA was obviously improved, which can be clearly observed by scanning electron microscope (SEM) analysis. Tensile properties and thermal/dynamic mechanical thermal properties of the composites were studied theoretically and experimentally to see how APS concentration and CNW content affected the resulting PLA/A-CNW nanocomposites. The tensile strength and elongtion increased from 35.7 MPa to 50.6 MPa and from 2.5% to 5.2%, respectively, for nanocomposites with 2% v/v APS and 3 wt % CNW. Dynamic mechanical thermal analysis revealed a decrease in damping and an increase in storage modulus for treated nanocomposites. The presence of A-CNW favored its dispersion in the PLA matrix.

Keywords: Polylactic acid; Cellulose nanowiskers; Organosilane treatment; Nanocomposites; Solvent casting evaporation process

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