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Synergistic effect of chitin nanocrystals and orientations induced by solid-state drawing on PLA-based nanocomposite tapes

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Abstract

Uniaxial solid-state drawing was used to orientate plasticized polylactic acid (PLA) and its nanocomposite tapes with 1 and 5 wt.% chitin nanocrystals (ChNC). Microscopy studies confirmed the orientation and formation of a 'shish-kebab' morphology in the drawn tapes. The mechanical properties demonstrated that the drawing led to stronger and tougher nanocomposites compared to plasticized PLA. The tensile strength increased from 41 MPa to 71 MPa, and the elongation at break increased from 5 % to 60 % for the nanocomposite with 5 wt.% ChNC and a draw ratio of 3. The ChNC had a positive effect on the thermomechanical properties; the tan delta peak shifted to a higher temperature with an increasing ChNC content. These improvements in the mechanical and thermal properties are expected synergistic effects of both the ChNC in the nanocomposite and the alignment of the ChNC together with the polymer chains induced by the solid-state drawing.

Keywords: A. Nanocomposites; B. Mechanical properties; B. Thermal properties; Orientation