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Enhanced alignment and mechanical properties through the use of hydroxyethyl cellulose in solvent-free native cellulose spun filaments

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Abstract: In this study, the addition of hydroxyethyl cellulose (HEC) in cellulose nanofiber filaments is shown to improve the solvent-free processing and mechanical properties of these biobased fibers as well as their compatibility with epoxy. An aqueous dope of cellulose nanofiber (CNF) with HEC was spun and the resulting filaments cold-drawn. The HEC increased the wet strength of the dope allowing stable spinning of low concentrations of CNF. These lower concentrations promote nanofiber alignment which is further improved by cold-drawing. Alignment improves the modulus and strength and an increase of over 70% compared to the as-spun CNF only filaments was achieved. HEC also decreases hydrophilicity thus increasing slightly the interfacial shear strength of the filaments with epoxy resin. The result is continuous biobased fibers with improved epoxy compatibility that can be prepared in an upscalable and environmentally friendly way. Further optimization is expected to increase draw ratio and consequently mechanical properties.

Keywords: A. Fibers; A. Nanocomposites; B. Mechanical properties D. Scanning electron microscopy (SEM); Dry spinning.