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Reinforcing properties of bacterial polyester with different cellulose nanocrystals via modulating hydrogen bonds

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ABSTRACT: This work provides a direct evidence to investigate relationship between hydrogen bonding interactions and property enhancement of cellulose nanocrystals (CN) based bionanocomposites. Cellulose nanocrystal citrates (CN-C) with more hydroxyl (O-H) and carboxyl groups, CN and cellulose nanocrystal formates (CN-F) with less O-H groups were extracted from commercial microcrystalline cellulose using citric/hydrochloric acids, hydrochloric acid and formic/hydrochloric acids, respectively. Then different nanocrystals were incorporated into bacterial polyester poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) for tuning hydrogen bonding interactions and properties of PHBV nanocomposites. As expected, at the same loading contents, CN-C had stronger reinforcing capability on PHBV matrix than CN and CN-F. Compared to neat PHBV, tensile strengths of 10 % CN-F/PHBV, 10 % CN/PHBV and 10 % CN-C/PHBV were improved by 146 %, 166 % and 187 %, respectively. Especially, the maximum decomposition temperature of 10 % CN-C/PHBV was increased by 48.1 ^{o}C, and this nanocomposite showed superior barrier properties with a 64% reduction in water vapour permeability (WVP). Besides, the

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