Impact of thermal processing or solvent casting upon crystallization of PLA nanocellulose and/or nanoclay composites

Here, we present how processing (solvent casting or isothermal crystallization) impacts crystallinity of poly(lactic acid) (PLA) and its nanocomposites (PLA/1 wt % cellulose nanofibers (CNFs), PLA/1 wt % nanoclay (C30B) or PLA/1 wt % CNF/1 wt % C30B. Polarized optical microscopy demonstrated a heterogeneous nucleation process during isothermal crystallization leading to smaller homogeneously distributed spherulites. With solvent casting, no effect on morphology was observed with respect to the nanoparticles, but an increased spherulite size was observed at higher temperatures. This fact raises significant concerns regarding the suitability of solvent casting as a lab-scale procedure to investigate materials. Additionally, combining the reinforcing agents, CNF, and C30B, did not increase nucleation rate, in contrast with the general tendency, where the incorporation of both particles led to improved properties (e.g., thermomechanical and barrier properties). However, a combination of C30B and CNF did lead to an overall increase in the rigid amorphous fraction and a reduced mobile amorphous fraction. © 2019 Wiley Periodicals, Inc. J. Appl. Polym. Sci. 2019, 136, 47486.