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Influence of nucleation and growth mechanisms on the heat deflection temperature of a reactively processed polypropylene nanocomposite

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Abstract

The development of a reactively processed polypropylene nanocomposite (PPNC) with consequential improvements in the heat deflection temperature (HDT), Vicat softening temperature (VST), and crystallization peak temperature (Tc) is reported herein. Neat PP without nanoclay was also reactively processed to elucidate the effects of fillers on the improvement in physical properties. The results show a considerable improvement in the HDT of PPNC (77.9 °C) compared to those of neat PP (62.6 °C) and reactively processed branched PP (BPP; 69.2 °C). Moreover, the Tc of PP in PPNC improved by ~14% compared to that of neat PP. Various models of nonisothermal crystallization kinetics were employed to elucidate the nucleation and crystal growth mechanisms, and to correlate them with the observed HDT improvement in PPNC. Thermal transitions investigated by modulated differential scanning calorimetry explained the changes observed in the VSTs of all the samples. To the best of our knowledge, this is the first report on a significant improvement in HDT along with a marked increase in Tc. Such simultaneous improvements in HDT, VST, and Tc are highly desirable for applications involving the use of PP-based materials in rigid packaging.