

Nucleation of High Pressure Crystallization of Polypropylene with Sorbitol Derivative

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ABSTRACT

The orthorhombic γ -form of isotactic polypropylene (PP) is unique because of non-parallel chain alignment. γ -PP can exhibit higher yield strength and elastic modulus than usual α -PP solidified in the monoclinic form [1,2]. Crystallization of PP in the γ -form is facilitated under high pressure. Previously we have demonstrated that nucleants able to nucleate the α -form under atmospheric pressure (P_{atm}) efficiently nucleated the crystallization in the γ -form under high pressure [3, 4]; α -lamellae were nucleated first and served as seeds for the γ -form [4].

The study focuses on the nucleation of high pressure crystallization of PP with 1,3: 2,4-bis (3,4-dimethylbenzylidene sorbitol (DMBS). PP 3250MR1 from Atofina and Millad 3988i from Milliken Chemical were used in the study. Crystallization of PP with 0.2-1 wt.% of Millad under pressure up to 300 MPa was carried out in a high pressure crystallization cell [3], under various thermal conditions. Samples in the cell were compressed using an Instron machine. Following a cross-head displacement and a volume change due to crystallization allowed to determine the temperature of maximum crystallization rate, T_c , during cooling. The samples were analyzed ex-situ by DSC, PLM and WAXD. It was found that Millad ability to nucleate high pressure crystallization of PP depended on its concentration. A higher content of Millad, at least 0.4 wt%, is required to nucleate crystallization of PP in the γ -form under high pressure, whereas 0.2 wt% is sufficient to nucleate crystallization of PP under P_{atm} in the α -form. The results demonstrate that it is possible to increase T_c and to drastically decrease a grain size during high pressure crystallization of PP in the γ -form using DMBS as a nucleating agent.

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