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Morphology Development During Isothermal Crystallization of "Mixed Melting" Polypropylene Blends

R.Phillips (Basell USA, Inc.)

Beamline(s): X27C

Introduction: Previous studies conducted at X27C showed that equimolecular weight blends of isotactic polypropylene (iPP) differing widely in melting point show clear evidence of cocrystallization by differential scanning calorimetry (DSC), and that the cocrystallization is coupled to an enhanced crystallization rate of the lower melting component in the blend relative to the pure component as evidenced by simultaneous synchrotron small angle and wide angle x-ray scattering measurements (SAXS/WAXS) [1]. In this previous work, the melting points of the two components differed by $\sim 14\text{C}$, where the lower melting point component was the result of decreased regio-specificity. This study extends the study to "mixed melting" blends of similar molecular weight and component melting points as the previous work, but where melting point depression of the lower melting component is driven by copolymerization of ethylene or butene comonomer. This expands the range of defects for investigation of the role of inter-chain tacticity/composition distribution on the crystallization behavior of iPP.

Methods and Materials: Melt stabilized Ziegler-Natta iPP ($M_w \sim 200,000$, $T_m \sim 162\text{ C}$) and Ziegler-Natta random copolymers with ethylene or butene comonomer ($M_w \sim 200,000$, $T_m \sim 148\text{ C}$) were investigated as individual components and in 50:50 melt mixed blends of the high melting and low melting components. Melt mixed product was compression molded into plaques, from which samples were cut for the synchrotron measurements. Simultaneous SAXS/WAXS measurements were conducted at beamline X27C using two linear position-sensitive detectors (European Molecular Biology Laboratory) with simultaneous data acquisition. Isothermal crystallization measurements were carried out with a dual-chamber temperature jump apparatus described elsewhere [2]. Melt temperatures were 200 C , and crystallization temperatures ranged from $\sim 115\text{-}140\text{ C}$. Parallel DSC investigations were also conducted.

Conclusions: At the same molecular weight and melting point differential, "mixed melting" blends with ethylene and butene comonomer in the low melting component show qualitative similarities (depending on crystallization temperature) with respect to cocrystallization (DSC) and rate promotion (SAXS/WAXS) of the low melting component as previous investigations based on the regio defect.

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