

Title: Enhancing Crystallization Rate of Polyethylene in Immiscible blends with Polypropylene: The Role of Self-Nucleation of Polypropylene and Polyethylene Chain Regularity

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References:

Reference 1: Yan S, Lin J, Yang D, Petermann J. Critical epitaxial layers of different kinds of polyethylene on highly oriented isotactic poly(propylene) substrates. Macromol Chem Phys. 1994;195:195–201
Reference 2: Carmeli E, Fenni SE, Caputo MR, Müller AJ, Tranchida D, Cavallo D. Surface Nucleation of Dispersed Polyethylene Droplets in Immiscible Blends Revealed by Polypropylene Matrix Self-Nucleation. Macromolecules. 2021;54:9100–12
Reference 3: _____
Reference 4: _____
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Abstract:

Polyolefin blends find widespread use in various industrial applications, and optimizing their crystallization behavior is crucial to achieve the desired mechanical, thermal, and barrier properties. This is particularly important for recycled polyolefin blends obtained from mechanical recycling, which often consist of mixed polypropylene (PP) with polyethylene (PE). In this study, we investigate the effect of self-nucleated PP on the crystallization behavior of various industrially relevant polyethylene (PE) grades. We compare the behaviors of eight different PEs with varying molecular architecture mixed with PP in a 20/80 PE/PP weight ratio.

This work offers a new approach to optimize the crystallization behavior of polyolefin blends by controlling the self-nucleation of the PP, which acts as a nucleating template for the PE phase. We shed light on the mechanism of nucleation from the PP surface and identify the factors that influence the efficiency of nucleation. An increase in the crystallization temperature of the PP matrix leads to an enhancement of the crystallization rate of PE, which is attributed to the epitaxial nucleation of PE droplet domains at the interface with the PP matrix.

We found that only polymers with a density above approximately 920 kg/m³ and melting temperatures exceeding 115 °C can efficiently nucleate onto the PP substrate, and that the presence of a high amount of branches or comonomers along the PE chains hinders the epitaxial matching between PE and PP.