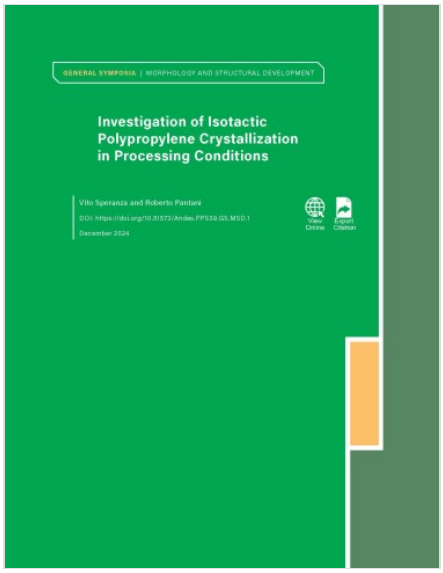
Investigation of isotactic polypropylene crystallization in processing conditions

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Sinopsis

Flow and pressure applied during polymer transformation processes of semi-crystalline polymers can significantly affect the kinetics of crystallization, final morphology, and properties of the part. In commonly used polymer transformation processes, the molten polymer is subjected to high pressure and thermal stress, as well as intense shear and elongational flow fields. The effect of pressure on crystallization kinetics is significant from both scientific and technological perspectives since the polymer solidifies under high pressure in important industrial processing techniques. On the other hand, the high shear rates experienced during the polymer processing can lead to the development of a highly non-uniform morphology that is typically very different from what is observed for quiescent crystallization of the same polymer. One example is injection molding, where the high shear rates experienced by a polymer melt close to the cold walls of the cavity can lead to a highly oriented layer (“skin” layer), whereas the low flow field close to sample mid-plane can lead to an isotropic layer (“core” layer) developing the so-called “skin-core” morphology. Thus, an understanding of polymer crystallization behavior with respect to the processing conditions is required to enable the rational design of materials and to optimize the final properties of the parts.



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This work explored the effects of the pressure and flow field on the kinetics of crystallization of isotactic polypropylene (i.e., iPP). The study of the effect of pressure on the crystallization kinetics of iPP was conducted using a dilatometer in the pressure range from 10 MPa to 100 MPa. Several isothermal flow experiments were carried out using two different devices: the Linkam shear cell and the Multi-Pass Rheometer (MPR). To describe the evolution into isotropic structures and fibrillar structures, a Kolmogoroff–Avrami–Evans model was adopted.

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