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Rheology and Flow-Induced Crystallization of Polyolefins

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This talk will give an overview of melt rheology in shear and extensional flow kinematics as well as flow-induced crystallization (FIC) behavior of polyolefin systems relevant to polymer processing. Examples for both polypropylene (PP) and polyethylene (PE) systems will be discussed. The effect of shear on FIC of several PP resins of various microstructures is studied using parallel-plate and capillary rheometry. Generally, an increase in strain and strain rate or decrease of temperature is found to decrease the thermodynamic barrier for crystal formation enhancing the crystallization kinetics at temperatures between the melting and crystallization points. FIC kinetics were enhanced with increased PP molecular weight indicating the importance of the high-end tail of the MWD on FIC. Various dies of different contraction angle and different length-to-diameter (L/D) ratios were used to investigate the effect of flow (mainly extensional kinematics in die entrance) on FIC. Extensional strain is found to be a key parameter influencing FIC. The effect of different molecular structures (from linear to long chain branched) on melt rheology and FIC response of several PE systems will be discussed. The melt rheology and FIC characteristics of thermoplastic materials are important for their processability performance in conventional and advanced fabrication processes such as Additive Manufacturing.