MAR14-2014-020815

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

The versatility in morphology and physical properties offered by chain shuttled olefin block copolymers

JEFFREY WEINHOLD, The Dow Chemical Company

Chain shuttling catalysis enables the production of olefin block copolymers (OBCs) with a wide range of block compositions. Unique morphology and property combinations can be achieved with highly crystalline hard blocks and low crystallinity or fully amorphous soft blocks. The effect of the amount of comonomer in the soft blocks on phase behavior, morphology and properties will be the focus of this presentation. In one class of materials, the soft blocks contain just enough octene comonomer to give elastic behavior but, unlike a random copolymer-based olefin elastomer, the soft segments are held together by thick crystals formed by the hard blocks. In addition to strengthening the network, these crystals provide temperature resistance and, by solidifying at higher temperature, they allow faster product fabrication. Increasing the soft block's octene content yields the next class of materials which have improved compatibility with polypropylene. This property allows the formation of fine, uniformly-dispersed OBC elastomer particles in PP. Since the impact strength of toughened PP increases as the particle size is reduced, a lower amount of elastomer is required to achieve an application's target for toughness. The direct benefit of lower elastomer loading is an increase in modulus, which enables lightweighting in applications. With further increases in the soft block's octene content, the incompatibility between the hard and soft blocks becomes large enough to cause the OBCs to form ordered melt morphologies. In the solid state, the alternating crystalline and amorphous regions have surprisingly large domain spacings and, due to the difference in refractive index between the domains, the periodicity results in a partial photonic band gap for frequencies in the visible spectrum. Comparisons to the morphology of monodisperse block copolymers and the predictions of theories will be presented. Also, the results of an extension to strong segregation theory will be shown, providing greater insight into the behavior of these polydisperse block copolymers.