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BOOTSARA PARCHANA: RELATIONSHIPS BETWEEN THE EXTENTS OF MISCIBILITY AND THE MELT-FLOW INDUCED PHASE MORPHOLOGIES OF INJECTION MOULDED POLYOLEFIN BLENDS. THESIS ADVISORS: RICHARD A. VENABLES, Ph.D., ARUNEE TABTIANG, Ph.D., 116 p. ISBN 974-665-161-7

The melt-flow induced phase morphologies in selected polyolefin blends under injection moulding conditions have been investigated. For blends comprising high-density polyethylene and an elastomeric poly(ethylene-co-1-octene) resin, containing 25 mol% of octene and long chain branching, that were biphasic under quiescent conditions, cooling after melt flow led to the formation of morphologies ranging from those comprising fine globular or interconnected phases with length-scale in the elastomer-rich domains of 156 nm to near homogeneous morphologies, depending upon the cooling rate. The theoretical length-scale for demixing of a homogeneous melt undergoing spinodal decomposition was 92 nm, based upon the estimated spinodal temperature under quiescent conditions. The growth rate of fluctuations, R_m, was calculated from the self-diffusion rates of the constituent polymers. The solidification times, t, of the samples were calculated from Fourier analysis and crystallisation rates. The early stages of coarsening may be considered as the period when the growth exponent, R_mt, is approximately unity. In the samples investigated, R_mt ranged from 2.4 to 196. The former value was close to the early stage of coarsening and was associated with the near homogeneous morphologies in rapidly cooled samples, whereas the latter value corresponds to a later stage associated with the nodular morphologies from samples that cooled more slowly. Dynamic mechanical analysis showed that each system was phase separated in the solid state. These observations led to the inference that the morphologies were the consequence of concurrent liquid-liquid and solid-liquid phase separation followed by coarsening of partially miscible melts that underwent homogenisation under melt flow, resulting in the formation of an interpenetrating morphologies comprising amorphous polyethylene, copolymer, and crystalline polyethylene. Moreover, the coarsening rates under quiescent conditions in the melt were strongly affected by the temperature at which melt flow took place.

The solid-state morphologies of isotactic polypropylene (iPP) / elastomeric poly (ethylene-co-1-octene) (EOC) blends were of the dispersed droplet-type with mean diameters in the range 0.2 to 0.6 μm. The domain sizes were influenced by the plasticisation conditions during injection moulding. They had a pronounced effect upon impact energies at 0°C, with a critical value of 0.3 μm, below which specimens underwent ductile failure through hinging. For mean domain diameters above the critical size, brittle failure took place; the associated impact energies were one fifth of those for the samples possessing domain sized below the critical value.