Processing of polymers using reactive solvents: structure development probed by simultaneous SAXS/WAXS/Raman spectroscopy

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Introduction

In polymer processing solvents can be used to reduce the viscosity during processing. Drawbacks are solvent removal after shaping and the limitation to products with a high surface-to-volume ratio. A possible solution to overcome these drawbacks is to use reactive solvents that are polymerised in-situ[1,2].

Objectives

- Extending processing window of polyethylene
- Morphology control

Experimental

Materials

High Density Polyethylene (HDPE), styrene as reactive solvent, and dicumylperoxide and tert-butyl peroxybenzoate as initiators for polymerisation.

Combined SAXS/WAXS/Raman

Time resolved SAXS&WAXS at station 8.2 of the Synchrotron Radiation Source in Daresbury, UK[3]. Raman spectra simultaneously recorded with a Kaiser Optical Systems 'Holoprobe 532'.

Results

Morphological changes during in-situ polymerisation for 20 wt% PE systems

Conclusions

The processing window of PE can be extended by using styrene as reactive solvent. Upon in-situ polymerisation of styrene, liquid-liquid (L-L) phase separation is induced, which can be followed by a liquid-solid (L-S) transition. The L-S transition can be used to fix the morphology, enabling morphology control. The onset of the L-S transition depends both on the reaction rate and the degree of undercooling.

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