Phase-separating polymer blends at interfaces

Phase-Separating Polymer Blends at Interfaces

A. Saalbrink, J.G.P. Goossens and H.E.H. Meijer

Eindhoven University of Technology,
Faculty of Mechanical Engineering,
Section Materials Technology,
P.O. Box 513, 5600 MB Eindhoven, the Netherlands

Introduction

Phase separation in homogeneous thermoplast-monomer blends is induced by in-situ polymerisation of the monomer, figure 1. The morphology resulting from this reaction-induced phase separation is controlled by:

- phase separation kinetics
- reaction kinetics

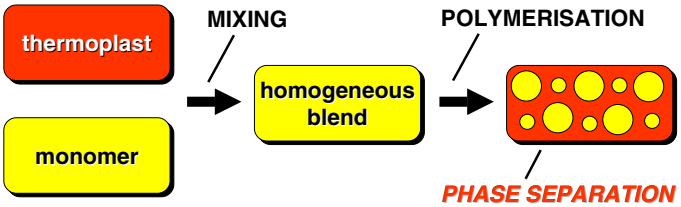

Figure 1. *Reaction-induced phase separation process*

Phase separation is sensitive to flow and surfaces. The presence of a solid surface interferes with the phase separation process by:

- breaking the isotropic bulk symmetry
- inducing concentration gradients

Objective

Study the reaction-induced phase separation of polymer blends at interfaces with solid substrates.

Experimental

Materials

Homogeneous blends of polystyrene (PS) and thermosetting monomer, figure 2, are pressed between solvent-cleaned glass plates and subsequently cured at elevated temperature (160 °C and 220 °C).

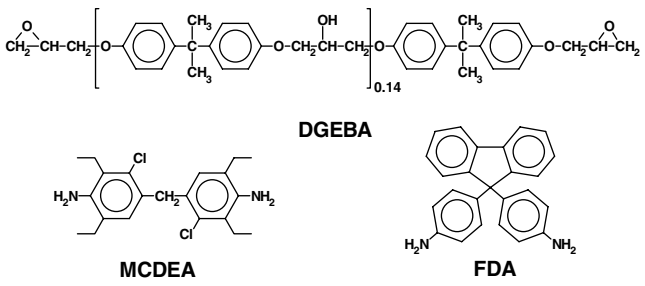

Figure 2. *Thermosetting monomer system: DGEBA epoxy resin, MCDEA hardener and FDA fluorescent hardener.*

Characterisation

The cured samples are studied using confocal scanning laser microscopy (CSLM). CSLM allows high resolution optical sample sectioning, figure 3. The sectional scans are represented in various ways.

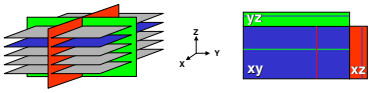

Figure 3. *CSLM sectional scans of samples and presentation of cross-sections.*

Results

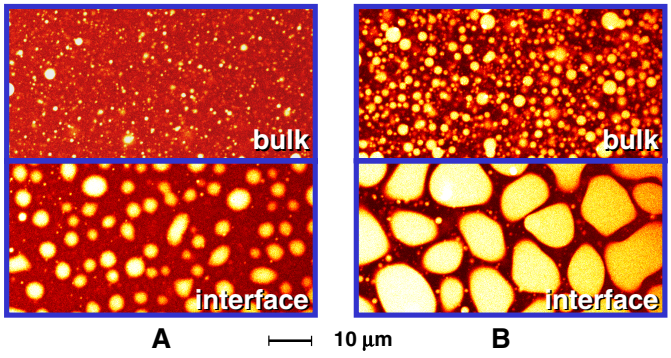

Figure 4. *XY cross-sections of PS/epoxy 60/40 in bulk and at glass surface cured at (A) 160 °C and (B) 220 °C, showing bulk and interface morphology (epoxy bright).*

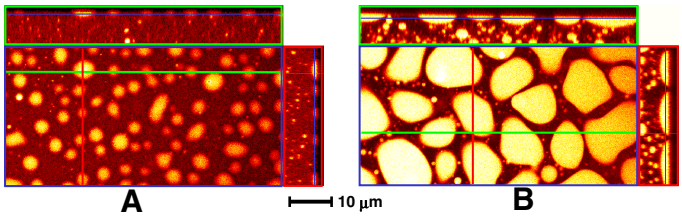

Figure 5. *CSLM cross-sections of PS/epoxy 60/40 cured at (A) 160 °C and (B) 220 °C, showing epoxy phase morphology (bright) at glass substrate.*

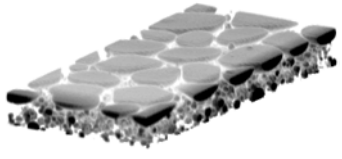

Figure 6. *Surface-rendered CSLM scan of PS/epoxy 60/40 blend cured at 220 °C on glass substrate.*

Conclusion

Reaction-induced phase separation of a polymer blend near a solid substrate results in a morphology different from the bulk morphology.