Complex Structured Polymers in Extensional Flow – Rheology and Small-Angle Neutron Scattering

Kell Mortensen [1], Jacob Kirkensgaard [1], Anine Borger [1], Ole Hassager [2], Kristoffer Almdal [2], Qian Huang [2], Andriy Dorokhin [2], and Christopher J. Garvey [3]

[1]*Niels Bohr Institute, University of Copenhagen, Denmark*

[2]*Technical University of Denmark, Denmark*

[3]*Australian Nuclear Science and Technology Organisation, Australia*

Small-Angle Neutron Scattering are used to investigate stretched macromolecular fluid filaments to show how the extensional properties are related to the molecular architecture and properties. We have combined structural and rheological studies of a series of model polymers with different composition and architectures. The project entails synthesizing model polymer systems of specific architecture, subjecting these materials to controlled extensional flows and to measure the molecular deformation under controlled flow situation bySANS. We have targeted different systems: a ”simple\" sample of homogeneous high-molar mass polymers, where only the central part of a fraction of the polymers were D-labelled with the aim to highlight the polymer deformation and avoid influence of fast relaxation near the polymer ends [1]. Another exampleis a bimodal mixture of linear polymer chains with respectively high and low molar mass [2], and we have studied samples with more complex geometry, including 3-arm star architecture. The linear chains show typically 2D-SANS pattern with Lozenge shaped contour. The 3-arm star polymers show novel, unexpected correlations perpendicular to the flow axis. The structure and rheology are measured both as a function of strain flow velocity, final Hencky strain ratio and during the relaxation after cessation of extensional flow.

References

[1] Hassager et al. Rheologica Acta 51, 385, 2012

[2] Kirkensgaard etal. *Phys. Rev. E* 94, 020502(R), 2016.