Rheology and Small Angle Neutron Scattering of model polymer systems

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We have used anionic polymerization to synthesize well defined linear and branched model polymers with polystyrene backbones. The linear viscoelastic properties have been characterized in small amplitude oscillation (ARES-G2 from TA-Instruments) and in large amplitude extensional deformations (VADER1000 from RheoFilament). We utilize the unique features of the extensional rheometer to reach steady flow conditions and to perform relaxation of true stress. Moreover we will show how the techniques may be used in combination with small-angle neutron scattering (SANS) to perform single chain structural studies after uniaxial elongation both after steady extensional flow and at several times during true stress relaxation. Specific examples will include two entangled systems: a pure melt of short chains and a bi-disperse melt composed of a 50/50 wt mixture of short and long chains. By labeling the short chains we show a pronounced nematic effect of the long chains which increases the initial short chain stretch by ~13% and delays the short chain relaxation by a factor of ~4.