DYNAMICS OF ENTANGLED LINEAR POLYMERS AT FASTS DEFORMATIONS: INFLUENCE OF MATRIX VISCOELASTICITY

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Abstract

In order to further understand the relaxation and dynamics behavior of linear entangled chains under fast/large deformations, the results of a series of nonlinear start-up shear experiments of four diluted melts and four binary blends of long linear polystyrene (PS 820kg/mol) while varying their concentrations and the molar mass of the linear matrix is investigated. As recently explored by the transient experiments of Costanzo et al. [Macromolecules 49. 10, 3925-3935 (2016)] and even before by the shear startup rheometry of Boukany et al. [J. Rheol. 53, 617 (2009)] and from this work and supporting reptation-based constitutive equations for entangled melts and solutions [van Ruymbeke et al., J. Non-Newtonian Fluid Mech. 128 (2005) 7–22], in the elastic regime of deformation $(\dot{\gamma}\tau_R(M) \gg 1)$**, there is a fractional power law scaling of the overshoot due to coupling effect of orientation, stretched and delayed chain retraction process on the dimension of the long entangled polymer chains. While the steady state levels of shear viscosity manifest dramatic increasing of strain-softening behavior as the entanglement density increases which can eventually lead to a macroscopic shear-banding phenomenon and collapses the shear rate-dependent steady viscosity curves. The inherent viscoelastic role of a matrix on the viscoelastic property of the long chains is studied here experimentally and by comparing with Time Marching Algorithm (TMA) model and with several literature datasets on entangled solutions (diluted melts) having similar numbers of entanglements with melts. The T.M.A model does a reasonable quantitative job at describing the nonlinear shear steady state datasets; however, further**

study is needed in order to well predict the different relaxation dynamics under transient flow.