Dynamics of Star Polymers in Fast Extensional Flow and Stress Relaxation

We confirm the observation from Ianniruberto and Marrucci [Macromolecules 2013, 46, 267-275] that entangled melts of branched polystyrenes behave like linear polystyrenes in the steady state of fast extensional flow, by measuring a linear, an asymmetric star, and a symmetric star polystyrene with the same span molecular weight (180 kg/mol). We show that all three melts reach the same extensional steady-state viscosity in fast extensional flow (faster than the inverse Rouse time). We further measure stress relaxation following steady extensional flow for the three melts. We show that initially they relax in a similar way, most likely via arm retraction, at short time, but behave differently at long time due to both the length of the arm and the branch point. The terminal relaxation is described by a Doi and Edwards based model, i.e., considering pure orientational relaxation.