

Shear Thinning of Polymers in the Θ -Condition Due to Long-Range Bond Correlation

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Shear thinning is one of the most fundamental nonlinear rheological behaviors of polymer liquids. In this study, we point out that shear thinning of polymers in the Θ -condition can be caused by the long-range bond correlation. A theory is proposed to explain the nonlinear shear rheology based on the chain elasticity of the Θ -condition polymers, which exhibit chain stiffening with the increase of tension even before the onset of finite extensibility. The theoretical predictions are validated by the single-chain Brownian dynamics (BD) simulation data, in comparison with the shear rheology of the ideal chain model with only the finite extensibility effect. We then apply this concept to explain the weak expansion factor of chain dimension as a function of shear flow as observed experimentally in dilute Θ solutions. Our theory also provides a new starting point for explaining the origin of shear thinning in multi-chain polymers, like unentangled polymers.