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Molecular orientation of commercial thermotropic liquid crystalline polymers in transient shear flow STANLEY RENDON, WESLEY BURGHARDT, Northwestern Univ., ROBERT BUBECK, Michigan Molecular Inst.
— There is still limited fundamental understanding of the rheology of commercial main-chain thermotropic LCPs. Limited physical and chemical stability at the high melt temperatures of commercial LCPs have to date rendered fundamental 'monodomain' studies impossible, and complicate conventional shear rheometry. It is not established whether commercial thermotropes are of the shear-tumbling or shear-aligning classification. In studies on idealized materials, direct measurements of molecular orientation in transient shear flows (reversals, step-changes and flow cessation) have often shed light on the underlying director dynamics. Here we report attempts to apply such methods to two commercial thermotropic LCPs (Vectra A950 and B950). Synchrotron x-ray scattering in conjunction with a high speed detector provides sufficient time resolution to reduce the total time spent in the melt during testing, while enhancements to an x-ray capable shear cell provide a robust experimental platform for working with LCP melts at high temperatures. The transient orientation response to changes in flow condition do not yield definitive signatures of either tumbling or alignment. However, Vectra A shows clear responses to step-increase or step-decrease in shear rate, which contrasts with expectations and experience with shear-aligning nematics. The two polymers show opposite trends in orientation following flow cessation, which are correlated with evolution of dynamic modulus.

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