Shear banding is observed in many soft materials. We recently developed a two-fluid model for semidilute entangled polymer solutions by using the generalized bracket approach of nonequilibrium thermodynamics. This model assumes that Fickian diffusion and stress-induced migration generate a nontrivial velocity difference between the polymers and the solution, thereby resulting in shear band formation. A straightforward implementation of the slip boundary conditions is possible because the differential velocity is treated as a state variable. Numerical calculations showed obvious shear banding in the polymer concentration profile. Increasing the pressure gradient reduces the inhomogeneity of the concentration profile and moves the transition region toward the center of the channel. Moreover, the velocity deviates from the typical parabolic form and shows a plug-like profile with a low shear band near the center and a high one near the walls. The lack of hysteresis in the profiles of the volumetric flow rate calculated with the increasing and decreasing pressure gradient demonstrates the uniqueness of the solution. In addition, the flow rate exhibits a spurt at a critical pressure gradient, as experimentally observed for shear banding materials. The
simplicity of the new model encourages us to analyze it in more complicated flows.

Stichworte: Channel flow Shear banding, Polymer solutions, Nonequilibrium thermodynamics

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