

**Adams and Olmsted Reply:** Wang [1] makes the following points about our Letter [2]: (1) He infers that, “contrary to its title, shear banding [in [2]] emerged from monotonic curves only if there was a stress gradient,” and he points out that nonquiescent relaxation was found (experimentally) after step strain in geometries *without* a stress gradient [3]. (2) He disagrees with the values of the parameters we used. (3) In some recent experiments the flow was homogeneous after cessation of step strain, and only *subsequently* developed nonquiescent macroscopic motion [3]. We only showed step strains that developed an inhomogeneity *before* cessation of flow, as in [4].

(1) As our title stated [2], we showed that a fluid with a monotonic constitutive curve based on Doi-Edwards (DE) theory can have signatures similar to shear banding. These signatures arise from a stress gradient (e.g., the bowed steady state velocity profile obtained in the stress gradient of a cone and plate rheometer [5] or transient bandinglike profiles during startup). Flat geometries can have *transient* bandinglike signatures: e.g., two clearly defined bands of shear rates during large amplitude oscillatory shear (LAOS) [2,6], or inhomogeneous bandinglike transients during startup flows in the presence of inhomogeneous spatial fluctuations (noise) (Fig. 1) [2].

(2) Our parameters were matched to experiment, for a nonlinear model in which the parameters  $\tau_d$  and  $\tau_R$  roughly correspond to their rigorously defined counterparts in linear rheology. Because we use (the best available) crude nonlinear theory, the parameters do not correspond precisely. We used  $\epsilon = \eta/(G\tau_d) \approx 10^{-5}$  based on a plateau modulus  $G \approx 3$  kPa, reptation time  $\tau_d \approx 20$  s, and solvent viscosity  $\eta \approx 1$  Pa s [7]. Although  $\tau_d/\tau_R \sim 10^3$  implies too many entanglements, it fits the nonlinear constitutive behavior of the experiments well [5]. This inconsistency is an unsatisfactory feature of current theory.

(3) The step strain results in [2] should be compared with [4] (Fig. 5), where the velocity profile became inhomogeneous before cessation. Figure 2 shows a calculation in which inhomogeneities develop only after cessation of flow, during a strong recoil. This is for startup in a flat geometry with noisy initial conditions, and resembles [4] (Fig. 3) if there were no experimental wall slip.

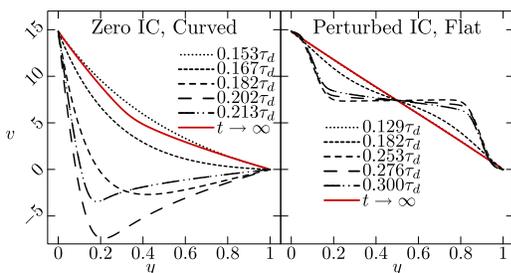


FIG. 1 (color online). Startup transients for (left) a cone angle of  $4^\circ$  ( $q = 2 \times 10^{-3}$ ); and (right) a flat geometry with noisy initial polymer shear stress  $\Sigma_{xy}(0)$  of a few percent, with  $\dot{\gamma}\tau_d = 14.8$ ,  $\beta = 0.728$  and  $\epsilon = 10^{-5}$ , and  $\tau_d/\tau_R = 10^3$ .

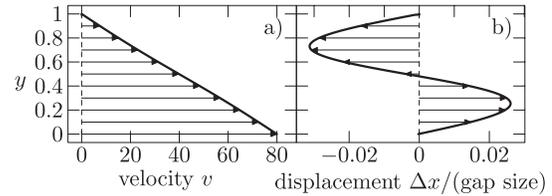


FIG. 2. Recoil displacement (b) at  $t = 0.08\tau_d$  after cessation of homogeneous shear (a) at  $t_{\text{stop}} = 0.0375\tau_d$  with  $\dot{\gamma}\tau_d = 80$ , i.e.,  $\gamma = 3$  for the Rolie-Poly model with  $\beta = 0.728$ ,  $\epsilon = 10^{-5}$ , and  $q = 0$ , with initial noise.

Wang’s newest experiments show dramatic rupture and internal fracture, despite a homogeneous velocity before cessation [3] (similar fracture planes could be interpreted in [8], Fig. 3(f), but in a cone-and-plate geometry; moreover, those data are also consistent with wall slip and simple recoil). Our calculations (Fig. 2) go some way towards modeling this phenomenon, but do not capture the rupture, and have not yet been adequately modified to incorporate slip. It remains a strong challenge to distinguish which experimental features are captured by tube models, and which (e.g., rupture) require new physical insight. One suggestion is the “elastic yielding” in [1] which may be similar to modifying the DE model to incorporate the instability of the spatial distribution of entanglement [9]. In fact, the instability in the DE model occurs when the shear rate greatly exceeds the reptation time, which is one criterion for elastic yielding postulated in [1].

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