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Similarity and difference between simple shear and uniaxial extension of entangled polymers[1] HAO SUN, SHI-QING WANG, Department of Polymer Science, University of Akron — There is ample evidence to show that the essential physics governing yielding of entangled polymers is the same, independent of the mode of deformation, e.g., shear versus extension. In either of these two most commonly studied forms of deformation, the elastic retraction force associated with the chain deformation cannot grow without bound during continuous deformation. In practice, a transition from the initial dominantly elastic deformation to flow (irreversible deformation) inevitably takes place. Such yielding can produce strain localization in large deformation of well entangled polymer melts. Apart from the superficial difference related to the confusion about the "strain hardening" behavior, a true difference in the respective responses of entangled melts to shear and extension arises when the strain rate is sufficiently high. The entanglement network can still yield on its path to the eventual flow state upon startup shear. However, startup extension could cause the entanglements to lock in, and the melt undergoes rubber-like rupture instead of yielding. This presentation raises the question of whether shear is an intrinsically different deformation from uniaxial extension in the extremely high rate limit.

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