Abstract Submitted for the MAR07 Meeting of The American Physical Society

Strain Hardening and Plastic Deformation in Polymer Glasses¹ ROBERT S. HOY, MARK O. ROBBINS, Johns Hopkins University Department of Physics and Astronomy — Although entropic network models are often used to fit stress-strain curves for polymer glasses, we show that these models do not correctly capture the physics of glassy strain hardening. We examine the relationship between strain hardening and plastic deformation in model polymer glasses over a wide range of entanglement densities and temperatures. While the total stress in densely entangled samples is well fit by the Langevin model, the dissipative component of the stress is always Neohookean. This indicates that the nonlinear corrections to the stress are associated with internal energy storage, contrary to entropic models. In the athermal limit, plastic dissipation is directly proportional to the rate of damage of van der Waals bonds. At large strains, both are proportional to entanglement density. The energy dissipated per damaged bond is independent of entanglement density and strain at moderate strains, but increases at high strains for the more densely entangled systems due to increased energy barriers. The partitioning of plastic events into strain-activated and thermally-activated events is discussed.

¹This material is based upon work supported by the National Science Foundation under Grant No. DMR-0454947.

Robert Hoy Johns Hopkins University Department of Physics and Astronomy

Date submitted: 20 Nov 2006

Electronic form version 1.4