Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Elucidating the Molecular Deformation Mechanism of Entangled Polymers in Fast Flow by Small Angle Neutron Scattering YANGYANG WANG, LUIS SANCHEZ-DIAZ, SHIWANG CHENG, KUNLUN HONG, WEI-REN CHEN, Oak Ridge National Laboratory, JIANNING LIU, PANPAN LIN, SHI-QING WANG, University of Akron — Understanding the viscoelastic properties of polymers is of fundamental and practical importance because of the vast and ever expanding demand of polymeric materials in daily life. Our current theoretical framework for describing the nonlinear flow behavior of entangled polymers is built upon the tube model pioneered by de Gennes, Doi, and Edwards. In this work, we critically examine the central hypothesis of the tube model for nonlinear rheology using small angle neutron scattering (SANS). While the tube model envisions a unique non-affine elastic deformation mechanism for entangled polymers, our SANS measurements show that the evolution of chain conformation of a well-entangled polystyrene melt closely follows the affine deformation mechanism in uniaxial extension, even when the Rouse Weissenberg number is much smaller than unity. This result provides a key clue for understanding the molecular deformation mechanism of entangled polymers in fast flow. Several implications from our analysis will be discussed in this talk.

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Date submitted: 05 Nov 2015 Electronic form version 1.4