Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Nonlinear Elasticity of Entangled Polymer Networks

OZAN SARIYER, University of North Carolina at Chapel Hill, SERGEY PANYUKOV, P. N. Lebedev Physics Institute, Russian Academy of Sciences, MICHAEL RUBINSTEIN, University of North Carolina at Chapel Hill — We develop a microscopic model for elasticity of entangled polymer networks. The classical models of rubber elasticity (affine network and phantom network models) take into account only the effect of cross-links, but not the entanglements between polymer chains. For uniaxial deformation, the entanglement effects can be characterized by the dependence of Mooney ratio on network deformation. Constrained network models (such as constrained-junction and diffused-constraint models), tube models (such as Edwards' tube and nonaffine tube models) as well as phenomenological models (such as Mooney- Rivlin model) have been proposed to capture the experimentally observed dependence of Mooney ratio on network deformation. One of the latest efforts in the field is the slip-tube model, in which the entanglements are represented by slip-rings that can glide along the network chains but elastically constrained in space. The model we study improves over the original slip-tube model by taking into account harmonic interactions along the chain between such slip-links. We analytically and numerically solve the new microscopic model and present our results in comparisons with experimental and simulation data for both uniaxial and biaxial deformation.

Ozan Sariyer
University of North Carolina at Chapel Hill

Date submitted: 08 Dec 2011 Electronic form version 1.4