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Swelling and Elasticity of Entangled Polymer Networks MICHAEL RUBINSTEIN, University of North Carolina, JONATHAN CAMPBELL, Massachusetts Institute of Technology, SERGEY PANYUKOV, Russian Academy of Sciences — We develop and solve a molecular model for nonlinear elasticity of entangled polymer networks, called non-affine slip-tube model. Each chain passes through a sequence of slip-links. The topological constraints imposed by neighboring network chains on a given one are represented by the confining potential acting on the slip-links. This topological potential restricts fluctuations of the network chains to the non-affinely deformed confining tube and changes upon network deformation. The non-affine tube model puts softer restriction on swelling gels, leading to larger equilibrium swelling ratio. It also predicts that weakly-entangled networks initially swell following the dependencies of entangled gels, but as soon as affine length reaches the size of network strand, further swelling is described by unentangled gel relations. The non-affine tube model predicts stronger concentration dependence of elastic modulus, G, than affine model, as well as weaker dependence of G on preparation concentration. The non-affine tube model also predicts a crossover at the preparation condition to a much stronger concentration dependence of elastic modulus, G, upon de-swelling and weaker dependence of G on preparation concentration.

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