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Onset of excluded volume in poly(ethylene oxide) elasticity measurements ANDREW DITTMORE, Materials Dept., UCSB, DUSTIN B. MCINTOSH, Physics, UCSB, OMAR A. SALEH, Materials Dept., UCSB — We use magnetic tweezers to control tension in an 80 kDa poly(ethylene oxide) (PEG) chain. In good solvent, force effectively transforms the swollen coil into a series of smaller polymers ("tension blobs") and progressively diminishes self-avoidance interactions between distant parts of the chain. Excluded volume effects dominate the low-strain elasticity, where the extension follows a 2/3 power law in force in accordance with scaling predictions. These effects disappear as the polymer first enters a linear power-law regime, and then a high-force asymptotic regime well described by the Marko-Siggia wormlike chain model. All told, we observe two transitions between three elastic regimes. We show that the transition forces can be used to determine the polymer's Kuhn length, excluded volume, and thermal blob size, and find that PEG requires roughly 30 Kuhn lengths before self-avoidance becomes significant. Thus, we show that single-molecule elasticity can quantify the onset of a polymer's excluded volume, a problem that has eluded bulk measurement techniques.

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