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Length-Scale Dependent Viscosity in Semidilute Polyelectrolyte Solutions RYAN POLING-SKUTVIK, RAMANAN KRISHNAMOORTI, JACINTA CONRAD, Univ of Houston — Using optical microscopy and particle tracking algorithms, we measured the mean-squared displacements (MSDs) of fluorescent polystyrene particles with diameters ranging from 300 nm to 2 μm suspended in semidilute solutions of high molecular weight partially hydrolyzed polyacrylamide. The solutions had polymer concentrations ranging from 0.67 to 67c*, where c* is the overlap concentration, and estimated correlation lengths of $\sim$ 100 to 900 nm. At short times, the particles exhibited subdiffusive behavior characterized by MSD $\sim t^\alpha$ with $\alpha < 1$. On long time scales, the particles transitioned to Fickian diffusion ($\alpha = 1$) and their diffusivity was calculated from the slope of the MSD. Whereas the large particles agreed with predictions using the Stokes-Einstein equation and bulk zero-shear viscosity, the smaller particles diffused much faster than predicted. The relative diffusivities do not collapse onto a single curve, but rather form a continuum that varies with particle size. This indicates that the particles experience a size-dependent effective viscosity mediated by the ratio of particle diameter to characteristic length scales in the polymer solution.

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