Asymptotic Analysis of Colloid Diffusivity Altered by Polymer Depletion TAI-HSI FAN, University of Connecticut, REMCO TUINIER, Institute of Solid State Research, Germany — Self-diffusion of Brownian particles plays an important role controlling transport in many biological and colloidal systems. In a homogeneous fluid, single particle' long-time self-diffusivity is characterized by the Stokes-Einstein relation. In polymer solutions, such a prediction is not accurate because particle dynamics is strongly affected by the background polymer chains suspended in the medium. For solutions containing non-adsorbing chains, a depletion zone immediately adjacent to the surface can reduce the viscous drag a particle experiences. This is known as non-Stokes-Einsteinian behavior. Based on the mean-field approximation, once the molecular weight, the degree of polymerization, intrinsic viscosity, and the correlation length of the polymer chains are found, the depletion zone can be characterized by a polymer density function. By bridging the microscopic thermodynamic theory and continuum fluid flow analysis, we present theoretical prediction of the resistance force a moving sphere experiences within non-adsorbing polymer solutions, for both translational and rotational modes. We develop the Green function based second-order perturbation approximation by solving the modified Stokes equation with nonuniform viscosity. The analytical result can be easily applied to quantify how polymer depletion alters the long-time diffusivity of Brownian particles.

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