

Abstract Submitted
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Diffusion of Particles in Polymer Solutions¹ LIHENG CAI, MICHAEL RUBINSTEIN, University of North Carolina at Chapel Hill — We use scaling theory to derive the time dependence of the mean-square-displacement $\langle \Delta r^2 \rangle$ of a probe particle of size d in an entangled semidilute polymer solution. Particles with size smaller than solution correlation length ξ undergo ordinary diffusion ($\langle \Delta r^2(t) \rangle \sim t$) with diffusion coefficient determined by the solvent viscosity. The motion of particles with intermediate sizes ($\xi < d < a$), where a is the tube diameter, is subdiffusive ($\langle \Delta r^2(t) \rangle \sim t^{1/2}$) at short time scales since their motion is affected by sub-sections of polymer chains. At long time scales the motion of these particles is diffusive and their diffusion coefficient is determined by effective viscosity of a polymer solution with chains of size comparable to particle diameter d . The motion of particles larger than tube diameter ($d > a$) at time scales shorter than the relaxation time of an entanglement strand τ_e is similar to the motion of particles with intermediate sizes. At longer time scales ($t > \tau_e$) large particles ($d > a$) are trapped by entanglement mesh and cannot move until the surrounding chains relax at the reptation time scale τ_{rep} . At longer times $t > \tau_{rep}$, the motion of large particles becomes diffusive with diffusion coefficient determined by the bulk viscosity of the entangled polymer solution.

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