55a Hydrodynamic Interactions in Colloidal Dispersions of Conducting Rods under Induced-Charge Electrophoresis

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Theory and numerical simulations are used to study the dynamics of a colloidal dispersion of conducting rods in an electric field. The polarization of a conducting particle results in the formation of a dipolar charge cloud on its surface, leading to a non-linear fluid slip velocity, which causes particle alignment and creates a disturbance flow. We derive a slender-body formulation accounting for this phenomenon, which is termed 'induced-charge electrophoresis' after Squires and Bazant (J. Fluid Mech. 509, 2004). In particular we show that the effects of the slip can be modeled by a linear distribution of point-force singularities along the particle axis, resulting in a stresslet flow. Based on this slender-body model we perform numerical simulations of multiparticle systems that include far-field and near-field hydrodynamic interactions as well as Brownian motion. Simulations at infinite Peclet number (i.e. negligible Brownian motion) show that particle pairing occurs in the suspension as a result of the disturbance flow. The finite Peclet number case is also considered, and results are reported on pair probabilities, orientation distributions and diffusivities.