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Hydrodynamic interactions in induced-charge electrophoresis of colloidal rod dispersions DAVID SAINTILLAN, Department of Mechanical Engineering, Stanford University, ERIC S. G. SHAQFEH, Departments of Chemical Engineering and of Mechanical Engineering, Stanford University, ERIC DARVE, Department of Mechanical Engineering, Stanford University — The behavior of a dilute dispersion of ideally polarizable slender rods in an applied electric field is studied theoretically and numerically. The polarization of a rod results in the formation of a dipolar charge cloud around its surface, leading to a non-linear fluid slip, which causes particle alignment and creates a disturbance flow in the surrounding fluid. We derive a simple slender-body formulation for this phenomenon based on the thin double layer approximation and valid for high aspect ratio particles, and use it to study the hydrodynamic interactions between a pair of aligned rods. In particular, the pair probability density function in a dilute dispersion is calculated, and indicates that particle pairing can be expected. We also present results from large-scale numerical simulations that include both far-field and near-field hydrodynamic interactions as well as Brownian motion. Particle pairing is indeed observed to occur at high values of the Peclet number (weak Brownian motion), and results are reported for pair probabilities, orientation distributions and hydrodynamic diffusivities.

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