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Electrophoretic mobility of a particle attached to a fluid interface in the thin Debye layer limit. STEFFEN HARDT, MICHAEL EIGENBROD, Institute for Nano- and Microfluidics, TU Darmstadt — We consider the electrophoretic mobility of a particle attached to an interface between an electrolyte and a dielectric fluid, assuming a large viscosity and dielectric permittivity ratio. We further assume a constant zeta potential at the particle surface and that the Debye layer around the particle is much thinner than the particle diameter. Based on that, the electrostatic and the hydrodynamic stresses at the particle surface locally balance. As a result, no torque is exerted on the particle. In the absence of gravity, the electrodipping force is the only potential cause for the deformation of the fluid interface. We show that at lowest order, the interface deformation is proportional to the equilibrium electrocapillary number. Further, the solution of the Young-Laplace equation indicates that the interface only gets deformed in the close vicinity of the particle surface. As a result, to a good approximation, during the electrophoretic transport of a particle along a fluid interface, the interface deformation is negligible. This allows relating its electrophoretic mobility to the mobility in the bulk electrolyte, indicating that the two are identical. Finally, we discuss potential applications in electrophoretic separation processes.

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