459b Measurement and Simulation of Ac Electric Field Induced Forces on a Colloidal Particle above One Kilohertz

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Application of an alternating electric field across a suspension of colloidal particles induces measurable, electrolyte dependent, forces on particles near the electrode even at frequencies above 1 kHz. An electrohydrodynamic body force in the fluid has been proposed as the mechanism generating the force on the particles; the suggested source of this force is the spatially inhomogeneous polarization of the electrode's double layer due to the presence of the particles. Experiments at kiloHertz frequencies and numerical calculations of the proposed time-dependent force were performed. In addition to the previously proposed mechanism, charged particles in electrolytes with unequal ionic mobilities were found to experience an additional force due to the interaction of a net electric field from the asymmetric polarization of the electrode under the particle with the charge of the particle. This force, which we call the Differential Polarization Electrokinetic (DPE) force, was found to increase with the magnitude of the electrode's equilibrium zeta potential, and was directed towards the electrode for KOH electrolyte. These are the first simulations to provide a basis for the experimentally observed electrolyte dependence.