Abstract Submitted
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A Thick Double Layer Theory for Dielectrophoresis of Nano-Colloids[1] SAGNIK BASURAY, ZACHARY GAGNON, HSUEH-CHIA CHANG, University of Notre Dame, USA, FRANCK PLOURABOUE, GEMP, IMFT UMR 5502, France — An analytical theory is reported for the AC dielectrophoretic cross-over frequency of nano-colloids whose dimension is comparable to the double layer thickness. Unlike larger particles, the counter-ions are dispersed in a large ion cloud around the particle and can be shifted asymmetrically relative to the particle. A linear theory based at the Debye-Huckel limit produces a Poisson equation with complex coefficients, whose solution can be expressed in terms of complex spherical Bessel functions of fractional order with a nearly uniform far field. The key polarization mechanism is due to tangential migration and concentration of the charges to the far pole of the particle to form a concentrated cap whose dimension is frequency dependent. The characteristic time for this cross-particle migration is the geometric mean of the double layer relaxation time and the diffusion time across the particle, whose inverse is the cross-over frequency. This is favorably compared to literature data for latex particles, for which the classical dielectric polarization theory predicts no cross-over, and is consistent with our data for high-conducting drops which possess two.

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