Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Bifurcation in the equililbrium height of colloidal particles over an electrode in low frequency electric fields TAYLOR WOEHL, Dept. Chemical Engineering & Materials Science, University of California, Davis, CARI DUTCHER, Dept. Mechanical Engineering, University of Minnesota, NICHOLAS TALKEN, BING JIE CHEN, WILLIAM RISTENPART, Dept. Chemical Engineering & Materials Science, University of California, Davis — Colloidal particles are known to change their equilibrium height above an electrode in response to an applied AC electric field, partially due to a lift force caused by electrohydrodynamic (EHD) flow generated around each particle. Here we report the existence of an unexpected bifurcation in the equilibrium particle height in response to low frequency ($\sim$100 Hz) fields. Optical and confocal microscopy observations reveal that upon application of the field 40% of the particles rapidly move several particle diameters up from the electrode, while the remaining 60% move slightly down. Statistics compiled from repeated trials demonstrate that the probability of any particle moving up follows a binomial distribution, indicating that particle lift up is random and does not result from membership in a distinct subpopulation of particles. The observations provide strong evidence for the existence of a tertiary minimum in the interaction potential at a surprisingly large distance from the electrode. We present scaling arguments for the interaction potential in terms a balance between colloidal forces, EHD flow, dipole image attraction, and gravity, yielding a predicted interaction potential with a tertiary minimum that is qualitatively consistent with the observed bifurcation.

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Date submitted: 02 Aug 2013 Electronic form version 1.4