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Electro-hydrodynamic particle levitation on electrodes EHUD YARIV, Technion — When colloidal particles deposit electro-phoretically onto a planar electrode, they slowly aggregate, eventually forming planar 2D crystalline structures. The attractive particle-particle interaction is due to electrokinetic flows associated with the particle Debye layer as well as the induced Debye layer surrounding the electrode. A common feature in the experimental observations is the small thickness of the particle-electrode gap separation, which was indeed reflected in the numerical figures employed hitherto in the existing numerical analyses. Here, we exploit it using singular perturbation methods. Thus, the fluid domain is separated into an "inner" gap region, where the electric field and flow strain rate are intensive, and an "outer" domain, consisting of the remaining fluid domain, where they are moderate. The inner region is analyzed using standard lubrication approximation, and the outer region is investigated using tangent-spheres coordinates. This method provides an analytic approximation for the hydrodynamic force that keeps the particle levitating against the action of gravity, as well as far-field approximations for the velocity decay, which agree with existing numerical simulations.

Avshalom Manela
MIT

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