Abstract Submitted
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Characterization of chaotic electroconvection near flat electrodes under oscillatory voltages[1] JEONGLAE KIM, SCOTT DAVIDSON, ALI MANI, Stanford Univ — Onset of hydrodynamic instability and chaotic electroconvection in aqueous systems are studied by directly solving the two-dimensional coupled Poisson–Nernst–Planck and Navier–Stokes equations. An aqueous binary electrolyte is bounded by two planar electrodes where time-harmonic voltage is applied at a constant oscillation frequency. The governing equations are solved using a fully-conservative second-order-accurate finite volume discretization and a second-order implicit Euler time advancement. At a sufficiently high amplitude of applied voltage, the system exhibits chaotic behaviors involving strong hydrodynamic mixing and enhanced electroconvection. The system responses are characterized as a function of oscillation frequency, voltage magnitude, and the ratio of diffusivities of two ion species. Our results indicate that electroconvection is most enhanced for frequencies on the order of inverse system RC time scale. We will discuss the dependence of this optimal frequency on the asymmetry of the diffusion coefficients of ionic species.

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