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Effects of buoyant forces on chaotic electroconvection[1] ELIF KARATAY, Stanford Univ, MATTHIAS WESSLING, RWTH Aachen University, ALI MANI, Stanford Univ, STANFORD UNIVERSITY, DEPARTMENT OF MECHANICAL ENGINEERING COLLABORATION, RWTH AACHEN UNIVERSITY, DEPARTMENT OF CHEMICAL ENGINEERING COLLABORATION —
The transport of ionic species is enhanced by induced electroconvection that arise due to electrokinetic instabilities stemming from coupling of hydrodynamics with ion transport and electrostatic forces. Recent research have shown the contribution of chaotic multi-scale structures beyond a threshold value of applied electric potential. However the buoyant forces have been neglected in the existing studies of chaotic electrokinetic flows where the density gradients of salt depletion can become gravitationally stable or unstable depending on the geometric orientation of electrokinetic systems. In this study we thoroughly examine the interplay of gravitational convection and chaotic induced electroconvection in both gravitationally stable and unstable configurations via direct numerical simulations of a model system consisting of a salt solution confined in between two cation selective membranes. Our results reveal that buoyant forces are not negligible when the Rayleigh number of the system exceeds a critical value $Ra_{cr} \sim 1000$. When the density gradient of salt depletion is gravitationally stable, the growth of the electrokinetic flow structures are saturated by buoyant forces. Whereas gravitationally unstable density gradient leads to buoyant flow structures.

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