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Kinetic energy budget for electroconvective flows near ion selective membranes[1] KAREN WANG, ALI MANI, Stanford University — Electroconvection occurs when ions are driven from a bulk fluid through an ion-selective surface. When the driving voltage is beyond a threshold, this process undergoes a hydrodynamic instability called electroconvection, which can become chaotic due to nonlinear coupling between ion-transport, fluid flow, and electrostatic forces. Electroconvection significantly enhances ion transport and plays an important role in a wide range of electrochemical applications. We investigate this phenomenon by considering a canonical geometry consisting of a symmetric binary electrolyte between an ion-selective membrane and a reservoir using 2D direct numerical simulation (DNS). Our simulations reveal that for most practical regimes, DNS of electroconvection is expensive. Thus, a plan towards development of reduced-order models is necessary to facilitate the adoption of analysis of this phenomenon in industry. Here we use DNS to analyze the kinetic energy budget to shed light into the mechanisms sustaining flow and mixing in electroconvective flows. Our analysis reveals the relative dominance of kinetic energy sources, dissipation, and transport mechanisms sustaining electroconvection at different distances from the interface and over a wide range of input parameters.

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