Abstract Submitted
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Chaotic electroconvection near ion-selective membranes: investigation of transport dynamics from a 3D DNS CLARA DRUZGALSKI, ALI MANI, Stanford University — We have investigated the transport dynamics of an electrokinetic instability that occurs when ions are driven from bulk fluids to ion-selective membranes due to externally applied electric fields. This phenomenon is relevant to a wide range of electrochemical applications including electrodialysis for fresh water production. Using data from our 3D DNS, we show how electroconvective instability, arising from concentration polarization, results in a chaotic flow that significantly alters the net ion transport rate across the membrane surface. The 3D DNS results, which fully resolve the spatiotemporal scales including the electric double layers, enable visualization of instantaneous snapshots of current density directly on the membrane surface, as well as analysis of transport statistics such as concentration variance and fluctuating advective fluxes. Furthermore, we present a full spectral analysis revealing broadband spectra in both concentration and flow fields and deduce the key parameter controlling the range of contributing scales.

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