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**Sheared Electroconvective Instability** RHOKYUN KWAK, Massachusetts Institute of Technology, VAN SANG PHAM, KIANG MENG LIM, Singapore-MIT Alliance, National University of Singapore, Singapore, JONGYOON HAN, Massachusetts Institute of Technology — Recently, ion concentration polarization (ICP) and related phenomena draw attention from physicists, due to its importance in understanding electrochemical systems. Researchers have been actively studying, but the complexity of this multiscale, multiphysics phenomenon has been limitation for gaining a detailed picture. Here, we consider electroconvective(EC) instability initiated by ICP under pressure-driven flow, a scenario often found in electrochemical desalinations. Combining scaling analysis, experiment, and numerical modeling, we reveal unique behaviors of sheared EC: unidirectional vortex structures, its size selection and vortex propagation. Selected by balancing the external pressure gradient and the electric body force, which generates Hagen–Poiseuille(HP) flow and vortical EC, the dimensionless EC thickness scales as $(\phi^2/U_{\mathrm{HP}})^{1/3}$. The pressure-driven flow(or shear) suppresses unfavorably-directed vortices, and simultaneously pushes favorably-directed vortices with constant speed, which is linearly proportional to the total shear of HP flow. This is the first systematic characterization of sheared EC, which has significant implications on the optimization of electrodialysis and other electrochemical systems.

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