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Enhancement of Overlimiting Current through an Ion-Selective Membrane via Surface Conductivity Patterning SCOTT DAVIDSON, Stanford University, MATTHIAS WESSLING, RWTH Aachen University, ALI MANI, Stanford University — Electroconvection's ability to enhance transport through ion-selective surfaces provides promising opportunities for improving many diffusion-limited electrochemical and microfluidic systems. We have investigated two sources of electroconvection at ion-selective surfaces, electrokinetic instability and surface-patterning with impermeable stripes and their interactions using direct numerical simulation of the governing equations. We show that despite the reduced surface area available for transport, patterned surfaces can lead to an up to 80% increase in current density relative to homogeneous surfaces. At applied voltages below the nominal threshold of instability, patterning enhances transport by inducing flow, while at higher voltages they do so by regularizing the chaotic electroconvective flows. Additionally, we show the formation of novel electroconvective patterns with multiple coexisting length scales due to electrokinetic instability at the homogeneous surface.

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