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Electroconvective Instability in Flow-shear-induced Transport Barrier: Threshold for Stable Vortices and Chaotic Eddies[1] RHOKYUN KWAK, KIST / Massachusetts Institute of Technology, VAN SANG PHAM, JONGYOON HAN, Massachusetts Institute of Technology — Suppression of turbulence and transport by shear flow is a common process in plasma fluid dynamics, while it has been rarely observed in nonionized fluids. Here, we visualize this effect in microfluidic nonionized system with electroconvective instability (EC) initiated by ion concentration polarization on ion selective membrane. The membranes act as the source of both instability and flow shear (wall shear of Hagen-Poiseuille (HP) flow) simultaneously, fitting the requisite for this shear suppression effect; turbulence in the domain of flow shear. To the best of our knowledge, this is the first characterization of flow-shear-induced transport barrier in microfluidics, captured by scaling analysis, experiment, and numerical modeling. Selected by balancing flow shear and velocity fluctuation, which generated by HP flow and vortical EC, the threshold for shear suppression scales by EC thickness d_{ec}/w <0.618. Stable unidirectional EC occurs under the threshold, while chaotic EC occurs over the threshold by overcoming flow shear. It also has significant implications on the energy saving of electrochemical systems (*e.g.* electrodialysis) to prevent chaotic turbulences and corresponding energy dissipations.

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