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Interfacial instabilities in electrified liquid films[1] MOHAMMADHOSSEIN FIROUZNIA, DAVID SAINTILLAN, University of California, San Diego — The electrohydrodynamic instabilities of fluid-fluid interfaces can be exploited in various microfluidic applications in order to enhance mixing, replicate well-controlled patterns or generate drops of particular size. In this work, we study the dynamics and stability of a system of three superimposed layers of two immiscible fluids subject to a normal electric field. Following the Taylor-Melcher leaky dielectric model, the bulk remains electroneutral while a net charge accumulates on the interfaces. The interfacial charge dynamics is captured by a conservation equation accounting for Ohmic conduction, advection by the flow and finite charge relaxation. Using this model, we perform a linear stability analysis and uncover different modes of instability in terms of the relevant dimensionless groups of the problem. Further, we perform numerical simulations using the boundary element method in order to study the full nonlinear problem. We demonstrate how the coupling of flow and interfacial charge dynamics in different modes of instability gives rise to non-linear phenomena such as tip streaming or pinching into droplets.

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