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Analysis of Thin Leaky Dielectric Layers Subject to an Electric Field MATTHEW KEITH, ALEXANDER WRAY, STEPHEN WILSON, University of Strathclyde — We investigate a bilayer of liquid and gas contained between two planar electrodes subject to a normal electric field described by the Taylor–Melcher leaky dielectric model. We use both the full Stokes flow formulation and the long-wave approximation to explore the linear stability of the system. Nonlinear calculations reveal four qualitatively different behaviours, namely, the return of the liquid-gas interface to its flat state, asymptotic thinning, contact with the upper wall, and singular touchdown behaviour. The appropriate parameter planes are determined numerically. Of particular interest are the interfacial dynamics of these four behaviours, which we investigate both analytically and numerically. In particular, we investigate the long-time behaviour in the asymptotic thinning regime and the onset of sliding. Additionally, we explore the self-similar dynamics of the interface during touchdown and upper-wall contact. Finally, we explore the limiting cases of a perfectly conducting liquid and a highly conducting liquid and gas, both of which are commonly observed physically, which allow for additional analytical and numerical progress.

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