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Electrohydrodynamic Instability of a Capacitive Elastic Incompressible Membrane[1] YUAN-NAN YOUNG, Department of Mathematical Sciences, New Jersey Institute of Technology, MICHAEL MIKSIS, ESAM, Northwestern University — The electrohydrodynamic instability of a leaky capacitive membrane in a direct current (DC) electric field, both perpendicular and parallel to the membrane in a micro-fluidic channel, is investigated theoretically. Under a parallel electric field, the membrane can be driven unstable with a vanishing membrane conductance. On the other hand a non-conducting capacitive membrane is always stable under a perpendicular electric field, and membrane conductance is essential for membrane instability due to a perpendicular electric field. The effects of membrane conductance, bending modulus, and charge relaxation time on the membrane instability are elucidated for several combinations of conductivity ratio and permittivity ratio in the bulk fluids. The tangential electric field acts similarly to the membrane tension in terms of its damping effects at small length scales (high wave number), while either bending or membrane tension is needed to damp out the small-scale perturbations under a perpendicular electric field.

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