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Electrohydrodynamic free-surface motions: (I) Dielectric breakdown and (II) Onset of menisci ALEXANDRE PERSAT, Harvard University, THOMAS WARD, UCLA, HOWARD STONE, Harvard University — We report experiments on electrically driven transient motions of (poorly conducting) dielectric liquids in a cylindrical configuration. A wire in contact with the liquid bath is raised to a potential ϕ_0 with an outer grounded ring electrode. The liquid rises along the wire to establish a new equilibrium shape that is substantial higher than that provided by surface tension. Above a critical field an instability sets in: the fluid convects and the interface shape and motion are time dependent. We provide evidence that the instability is due to dielectric breakdown and the associated fluid motion then comes from electrical stresses due to free charge density. A model of the time-dependent electrical response is given and is in qualitative agreement with the experiments. In addition, for low fields we study the transient evolution of the interface as wetting occurs. We find distinct dynamical responses that depend on an electrical Reynolds number and provide physical arguments to explain the different power laws (height versus time) measured for low and high viscosity liquids.

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