Electrohydrodynamic Effects on the Spreading of Liquid Films

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Extended Abstract (six page maximum):

The spreading of a liquid film down an inclined surface is a conceptually simple problem which has nevertheless been under investigation for decades. It has been demonstrated that under certain conditions, the liquid front can destabilize and split into "fingers", leading to incomplete coating of the surface. Additionally, electric fields can be used as a means of deforming liquid interfaces and droplets. However, it is not well understood how the presence of an electric field may affect the gravity-driven spreading of liquid films and droplets. Of principal interest is the effect of electrostatic forces on the evolution of the "capillary ridge" which destabilizes the film front and leads to coating defects. We work within lubrication theory and use a one-dimensional model to investigate the spreading of both perfect and leaky dielectric liquid films down an inclined plane in the presence of an electric field. Our results from nonlinear simulations show that an electric field increases the height of the capillary ridge through interactions with both dipoles and surface charges.