Electrohydrodynamic Effects in the Leveling of Coatings

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Electrostatic charges are known to accumulate on substrates and at liquid interfaces in various coating processes. These charges can be present in various configurations and drive liquid flows that lead to defects. To better understand this phenomenon, we study the leveling of thin liquid films subject to electrohydrodynamic forces. The liquid is assumed to be Newtonian, both perfect dielectric and leaky dielectric materials are considered, and lubrication theory is employed. Linear stability analysis and asymptotic methods provide insight into the behavior of small-amplitude perturbations to the film thickness and nonlinear simulations shed light on the behavior of large-amplitude perturbations. The results of our detailed calculations enable us to propose simple heuristics for determining the conditions under which coatings subject to electrohydrodynamic forces will level.

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