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Electrostatic control of the coffee stain effect[1] ALEX WRAY, DEMETRIOS PAPAGEORGIOU, Imperial College London, KHELLIL SEFIANE, University of Edinburgh, OMAR MATAR, Imperial College London — The "coffee stain effect," as first explained by Deegan et al. 1997, has received a great deal of attention amongst modellers and experimentalists in recent years, perhaps due in part to its obvious casual familiarity. However, it maintains interest because of its intriguing reliance on an interplay of a trio of effects: contact line pinning, inhomogeneous mass flux, and resulting capillarity-driven flow. What is more, the effect, and especially its suppression or reversal, find applications in fields as diverse as sample recovery, mass spectroscopy and the printing of Organic LEDs. We examine the motion a nanoparticle-laden droplet deposited on a precursor film, incorporating the effects of capillarity, concentration-dependent rheology, together with a heated substrate and resultant mass flux and Marangoni effects. We allow the substrate to act as an electrode and incorporate a second electrode above the droplet. The potential difference together with a disparity in electrical properties between the two regions results in electrical (Maxwell) stresses at the interface. We show via lubrication theory and via direct numerical simulations that the ring effect typically observed may be suppressed or augmented via appropriate use of electric fields.

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