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Non-coalescence of oppositely charged drops W.D. RISTENPART, Univ. Calif. at Davis, J.C. BIRD, Harvard Univ., A. BELMONTE, Penn. State Univ., F. DOLLAR, H.A. STONE, Harvard Univ. — Electrically induced droplet motion manifests itself in processes as diverse as storm cloud formation, commercial ink-jet printing, petroleum and vegetable oil dehydration, electrospray ionization in mass spectrometry, electrowetting and lab-on-a-chip manipulations. An important issue in practical applications is the tendency for adjacent drops to coalesce, and oppositely charged drops have long been assumed to experience an attractive force that favors their coalescence. Here we report the existence of a critical field strength above which oppositely charged drops do not coalesce. We observe that appropriately positioned and oppositely charged drops migrate towards one another in an applied electric field; but whereas the drops coalesce as expected at low field strengths, they are repelled from one another after contact at higher field strengths. Qualitatively, the drops appear to "bounce" off one another. We directly image the transient formation of a meniscus bridge between the bouncing drops, and propose that this temporary bridge is unstable with respect to capillary pressure when it forms in an electric field exceeding a critical strength. The observation of oppositely charged drops bouncing in strong electric fields should affect our understanding of any process involving charged liquid drops, including de-emulsification, electrospray ionization and atmospheric conduction.

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