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Electrohydrodynamics of falling drops in inertial regime
NALINIKANTA BEHERA, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, Kharagpur,West Bengal, India, SHUBHADEEP MANDAL, Max Planck Institute for Dynamics and Self-Organization, Am Fassberg 17, D-37077 Gttingen, Germany, SUMAN CHAKRABORTY, Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, Kharagpur,West Bengal, India — Buoyancy-driven motion of a Newtonian drop suspended in another Newtonian medium in the presence of uniform electric field is studied numerically. The inertial effects are considered to be strong enough to affect the drop dynamics, contrary to the case of Stokes flow. Irrespective of the flow regime, perfectly-dielectric drop always moves faster. However, in inertial regime the steady-state drop shape displays oblate to prolate shape transition and the transient deformation of drop is found to be non-monotonic, which is in sharp contrast to the similar case of Stokes flow. For certain electrical property ratios, the leaky-dielectric drop shows features similar to perfectly-dielectric drop. For leaky-dielectric drops, along with drop deformation, interfacial charge convection is found to be a vital controlling parameter. Charge convection can increase or decrease the net drag acting on the drop depending upon the electrical properties of fluids. For some fluids charge convection have significant effect on drop speed and its morphology. The present study finds its useful applications in oil-water separation process as well as in microfluidic devices.

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