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A study of non-coalescence of aqueous droplets suspended in castor oil under electric field SUBHANKAR ROY, ROCHISH THAOKAR, Indian Institute of Technology Bombay — Experimental and numerical investigations are carried out to study the effect of electric field on coalescence and non-coalescence behaviour of two water droplets suspended in an insulating oil (castor oil). Unlike immediate breakup of the bridge, as reported in earlier studies like Ristenpart et al. (2009) [Non-coalescence of oppositely charged drops. Nature 461 (7262), 377–380], the non-coalescence behaviour observed in our experiments show that at higher than critical electric fields the droplets form a bridge which starts thickening thereby exhibiting a tendency to coalesce. However, soon this phenomenon slows and comes to a stop, and the thickened bridge starts thinning dramatically, initiating the phenomenon of eventual non-coalescence. Numerical simulations using boundary integral method are able to explain the physics behind the thickening of this bridge, followed by thinning and non-coalescence. The fundamental reason is the competing meridional and azimuthal curvatures of the bridge under the effect of electric field induced Maxwell stresses which determine the Laplace pressure inside the bridge to become either positive or negative thereby determining the direction of fluid flow towards or away from the centre of the bridge. Velocity and pressure profiles confirm this postulation, thus enabling us to predict this behaviour of transitory coalescence followed by non-coalescence.

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