Electrohydrodynamic deformation and breakup of an uncharged droplet suspended in an ambient fluid of higher conductivity

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***Abstract*— The 3-D deformation and breakup of an initially uncharged spherical droplet suspended in another immiscible fluid under uniform dc electric field are numerically investigated. Both the droplet and the ambient fluids are considered as incompressible Newtonian fluids. In all the cases both fluids are slightly conductive ("leaky" dielectrics) with the ambient phase more conductive than the droplet. Three regimes were observed: 1) oblate deformation (which can be predicted from the small perturbation theory), 2) oscillatory oblate-prolate deformation and 3) breakup of the droplet. It was found that an increased electric field causes the prolate deformation to be damped in the oscillation regime. Further increase of the electric field leads to complete damping of the prolate deformation and breakup, which creates a toroidal shape. It was shown that the threshold electric field strength depends on the viscosity r! atio of both fluids. The critical electric capillary number beyond which the droplet eventually breaks up in a symmetric manner has been determined**