Interaction between Two, Stationary or Impacting, Electrically Charged Droplets

Osameh Ghazian, Kazimierz Adamiak, G. S. Peter Castle
Department of electrical and computer engineering
University of Western Ontario, Canada
e-mail: oghazian@uwo.ca

***Abstract*— Interaction between two identical charged droplets is investigated numerically by solving the incompressible Navier-Stokes equations coupled with the convective equation of the level set function. In the first model, the mechanism of Coulomb attraction between two conducting droplets is investigated. Numerical simulation shows that two conducting droplets carrying charges of the same polarity under some conditions may be electrically attracted. This apparent paradox can be unravelled by considering the surface charge redistribution and the deformation of the droplets. Time-domain evolution of droplet shape for different parameters is presented. The second part of the study concerns the collision dynamics of two identical charged droplets. Some interesting features of the charged droplet disintegration and satellite droplet formation are illustrated via various examples. At low Weber numbers, two droplets carrying the charges of the same polarity can repel each other only if the electrostatic repulsion is strong enough to overcome the kinetic energy of the droplets. As Weber number increases, the drop collision leads to their coalescence. As Weber number is further increased, satellite droplets are formed. It is also found that the number of the satellite droplets after collision appears to increase with an increase in the droplet charge.**