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Electrical Effects in Liquid Droplets

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It is desired in the production of sprays to find the ways to control the size and distribution of liquid droplets. It is also of interest to provide means for directing the spray towards the target of interest. Both these goals can be addressed using electric fields, e.g. electrostatic spraying/painting. The proper design and efficiency of these techniques rely on the understanding of the fundamental aspects of droplet dynamics when exposed to external electric fields, and especially on the understanding of the processes associated with droplet break up. This study is focused on the dynamics of liquid droplets driven by induced polarization effect and involves both experiments and theory. During experiments droplets were isolated from all other effects using microgravity environment. The evolution of droplets was captured using a high-speed movie camera. Theoretical analysis, which involved numerical simulation of the deforming droplet, was able to reproduce various stages of the deformation process in time up to the formation of Taylor cones. The droplet evolution process can be divided into rapid distortion followed by a combination of capillary instability and formation of Taylor cones and mass removal from the zone of the cones. Rapid distortion theory was proposed to described droplet evolution in the Taylor-cone regime. Good agreement between the experiment and theoretical modeling has been observed.