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Spray Formation from a Charged Liquid Jet of a Dielectric Fluid[1]
WILLIAM DOAK, VICTOR DE BELLIS, PAUL CHIAROT, State University of New York at Binghamton, MICROFLUIDICS AND MULTIPHASE FLOW LABORATORY TEAM — Atomization of a dielectric micro-jet is achieved via an electrohydrodynamic charge injection process. The atomizer is comprised of a grounded nozzle housing (ground electrode) and an internal probe (high voltage electrode) that is concentric with the emitting orifice. The internal probe is held at electric potentials ranging from 1–10 kV. A pressurized reservoir drives a dielectric fluid at a desired flow rate through the 100-micrometer diameter orifice. The fluid fills the cavity between the electrodes as it passes through the atomizer, impeding the transport of electrons. This process injects charge into the flowing fluid. Upon exiting the orifice, the emitted jet is highly charged and it deforms via a bending instability that is qualitatively similar to the behavior observed in the electrospinning of fibers. We observed bulging regions, or nodes, of highly charged fluid forming along the bent, rotating jet. These nodes separate into highly charged droplets that emit satellite droplets. The remaining ligaments break up due to capillarity in a process that produces additional satellites. All of the droplets possess a normal (inertial) and radial (electrically-driven) momentum component. The radial component is responsible for the formation of a conical spray envelope. Our research focuses on the jet, its break up, and the droplet dynamics of this system.

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