Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Scaling laws for electrospraying KRISHNARAJ SAMBATH, Purdue University, ROBERT COLLINS, Oak Ridge National Laboratory, MICHAEL HARRIS, OSMAN BASARAN, Purdue University — When stressed by strong electric fields, fluid menisci develop conical structures called Taylor cones which emit from their tips fine jets that in turn break up to form a mist of charged droplets. This phenomenon, known as electrohydrodynamic tip-streaming, cone-jetting, or electrospraying finds application in a number of industrially and scientifically important processes, including mass spectrometry, particle synthesis, and cloud physics. Here, this phenomenon is analyzed using the leaky-dielectric model developed by Taylor and Melcher for the situation in which an initially spherical free drop of an incompressible Newtonian fluid surrounded by a gas is subjected to an electric field. The resulting initial-boundary-value-problem is solved using the finite element method with elliptic mesh generation and adaptive, implicit time integration. The simulation results and simple scaling arguments are then used to infer the universal scaling laws governing the sizes and charges of the small electrospray drops.

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Date submitted: 05 Aug 2011 Electronic form version 1.4