

Direct Current and Alternating Current Electrospays: The Application of Electrostatics to Chemical Analysis

Dr. David B. Go
Assistant Professor
Aerospace and Mechanical Engineering
University of Notre Dame

Abstract

Electrospray droplet generation is an elegant electrostatics phenomenon where the electrostatic field balance perfectly with surface tension to form unique liquid cones. In addition to applications ranging from particle deposition and electrospinning to microthrusters, electrospays have become a workhorse in mass spectrometry – the gold standard of chemical analysis. As a method that can generate charged molecules from liquid solutions with little internal energy and fragmentation, electrospray ionization has become one of the *de facto* ionization methods for mass spectrometry and widely available commercially. A new regime of electrospays operated at very high frequencies, called alternating current electrospray ionization (AC ESI), has recently been shown to be a powerful addition to the ionization family. The electrical forces that govern AC electrospays are fundamentally different than DC electrospays resulting in the formation of a different cone structure and different droplet formation mechanics. Additionally, recent mass spectrometry analyses have shown that frequency variation in AC ESI can be used to modulate the nature of the charging of target analyte molecules and impact the ensuing mass spectra. This work will outline the fundamental theory of AC electrospays in comparison to DC electrospays and its application to chemical analysis.