

Capillary Ionic liquid Electrospray: Beam Compositional Analysis

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Abstract

Orthogonal time-of-flight mass spectrometry has been used to characterize the kinetic energy and charged species distributions from an *in vacuo* electrospray ion source for four different ionic liquids at volumetric flow rates between 0.3 and 3.3 nanolitres per second. In all cases, the mass spectra revealed charged species consisting of both singly-charged and multiply-charged ions. Additionally, two broad and unresolved droplet distributions occur in the 10^4 to 10^6 atomic mass unit per charge ranges. The mean jet velocity and mean jet breakup potential were established from analysis of the energy profile of the high mass-to-charge droplets. At the jet breakup point, we find the energy loss and the jet diameter flow rate dependence of the electrospray beam to be similar to that estimated previously by Gamero-Castaño (*Phys. Fluids*, 2008, **20**, 032103) for 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide at similar volumetric flow rates. Similar trends are observed for all four liquids at the measured flow rates. The primary droplets determined from the application of the jet velocity to the continuity equation results in a mean charge that is initially super-Rayleigh. The experimental evidence for the low mass-to-charge unresolved distribution suggests that these species are the result of shattering of the super-Rayleigh primary droplet and is supported by the associated Weber numbers for the primary droplets. Satellite droplets, with kinetic energy profiles similar to the sub-Rayleigh primary droplets are also directly detected by the time-of-flight instrument. Variance in the jet velocity and breakup potential along with a modelling of the composite mass spectrum into variously sized droplets is discussed.