Implementation and Characterization of an Iodine Field Emission Ion Source for FIB Applications

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Emission of positive and negative ions is possible when a molten salt is exposed to a sufficiently high electric field. Particularly interesting is the emission of ions from ionic liquids, which are molten salts at, or near, room temperature. Ionic liquid ion sources (ILIS) have shown potential to be used in various focused ion beam (FIB) applications, since their operation and characteristics are similar to those of liquid metal ion sources, with the advantage that ILIS work at low temperatures in comparison and a large number of ionic liquids with many different compositions are available. In this paper we present results on the emission characteristics of negative ions extracted from two iodine-based ionic liquids using a time-of-flight mass spectrometer and a retarding potential analyzer. The ionic liquids BMI-I and EMI-I are both used as source media, producing droplet free beams with multiple solvated ion species. Attention is given to BMI-I and EMI-I in particular due to the potential of creating a beam of pure and clustered I- ions, which are expected to improve the performance in secondary ion emission applications. Properties important to the focusing of the ion beam such as mass and energy distributions are obtained. Effects on the ion emission are studied through a comparison of the two sources using temperature as a parameter to modify the liquid viscosity and electrical conductivity. The iodine-based ion beam characteristics are used to predict the source's performance in FIB columns.

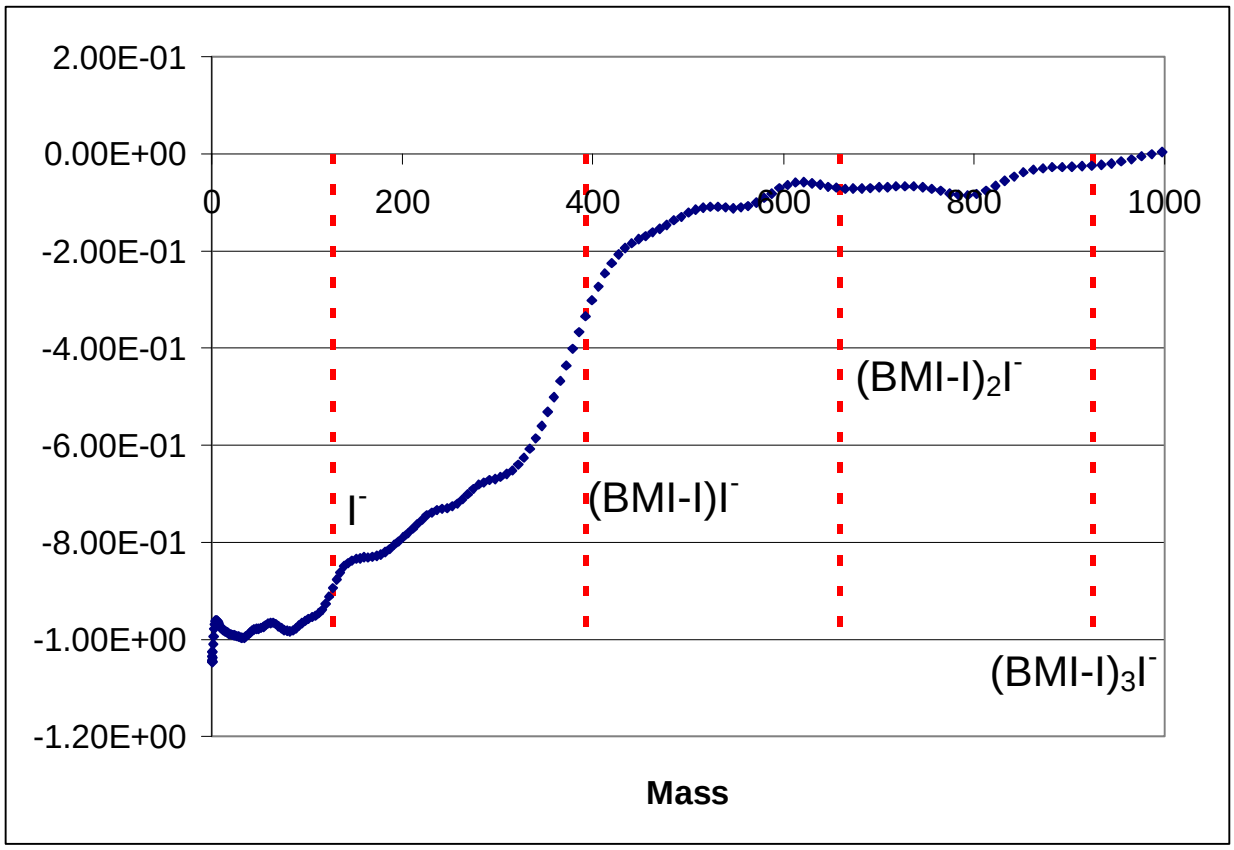

Figure 1. Preliminary time-of-flight mass spectrometer results for ion emission from BMI-I in the negative mode.