# Numerical Simulation of a colloidal thruster in the mixed ion-droplet regime.

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Experiments with colloid thrusters have shown their ability to operate in various flow regimes extending from the pure droplet to the mixed ion-droplet regime, and in some cases to pure ion emission. Experimental research of this issue has been done using time of flight techniques which have characterized the energies of the extracted species. The results from these experiments suggest that ions are emitted with various energies possibly implying the existence of various emission areas. The experiments have also shown that various fluid properties, such as viscosity, have important effects on the ion emission characteristics of colloidal thrusters.

We address this issue from the numerical perspective by incorporating an ion evaporation model to our single emitter colloid simulation. In previous papers we have presented results from our numerical model for an axisymmetric colloidal jet. The numerical simulation models the cone-jet transition region of the colloid jet; starting from the needle to the extractor grid, thus reproducing the typical electrospray experimental configuration. The liquid is modeled as an incompressible viscous fluid with a constant conductivity ($K \sim 1 \times 10^{-2}$ Si/m). A Surface charge relaxation equation is included in the model, and the potential and electric fields in the fluid are solved for. The equations have been simplified by employing a slenderness approximation except for the free surface boundary conditions where the terms have been kept exact. Simulation results have been shown to compare well to experimental data for a variety of liquids, for flows $1<\rho KQ/(\gamma\varepsilon\varepsilon_0)<36$. To study the ion emission issue we will add an ion evaporation model to our current simulation. We will present numerical results on the prediction of ion extraction onset and will address the effects of charge loss (due to emitted ions) on the jet dynamics and it's possible connection to the jet's collapse and the onset of a pure ion emission regime.