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The Primary Break-up Instabilities in a gas-liquid coaxial atomizer combined with electro-spray RODRIGO OSUNA, NATHANAEL MACHICOANE, ALBERTO ALISEDA, University of Washington — We present an experimental study of a canonical coaxial gas-liquid atomizer, balancing the physics of gas-assisted atomization and electro-sprays. The laminar liquid stream is injected through a long straight metallic pipe at the center of the turbulent gas jet. The liquid needle is used as the anode, while the cathode is formed by a ring located on the streamwise face of the coaxial gas chamber. The gas Reynolds number ranges from 10^4-10^6, while keeping the liquid Reynolds number constant at 10^3. The electrospray voltage applied is varied from 100 to 5000 V and the resulting negative charge transferred to the liquid jet spans from O(10^{-3} – 10^{-1}) Coulomb per cubic meter. The relative influence of the high speed gas to the liquid electric charge on the primary instability and jet break-up is studied. The effect of the electric field on the atomization process is characterized by high speed visualization at the nozzle exit, complemented with the resulting droplet size distribution in the mid field after break-up has ended. The quantitative visualization captures the fast dynamics of the interface de-stabilization and clearly shows the changes in the liquid stream instabilities caused by the electric field. These instabilities control the liquid droplet sizes and their spatio-temporal distribution in the spray, as measured from light interferometry.

Alberto Aliseda
University of Washington

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