Quantitative insights in to the fluid interactions downstream of an atmospheric pressure dielectric barrier plasma jet.

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Low-temperature atmospheric pressure plasma jets are dielectric barrier discharges generated in thin dielectric tubes. The gas flowing through the capillary, typically Helium or Argon, is ionized, emerges into the quiescent ambient air creating a variety of reactive chemical species. The spatial separation between the region of plasma generation and species creation makes the plasma jet configuration unique, facilitating a stable source of short and long lived reactive oxygen and nitrogen species (RONS) under ambient conditions. Understanding the complex interaction between the discharge and the background gas is the key to understanding the RONS chemistry arriving at a downstream sample.

Recently, considerable progress has been made in understanding the complex fluid interaction at play in a plasma jet configuration. Many studies have demonstrated dramatic changes to the structure of the flowing gas, which initiate turbulent fluctuations, both gas heating and electrohydrodynamic forces have been cited as possible mechanisms behind these observations [1, 2, 3].

In this investigation, a particle imaging velocimetry (PIV) was used to provide quantitative insights in to the complex fluid interactions at the orifice of a helium plasma jet. By capturing the velocity profile of both the flowing and background gas the impact of plasma generation parameters on the flow structure were identified. It was observed that key plasma parameters, such as the applied voltage, have little impact on the velocity of the flowing gas. This finding implies that the early onset of turbulence in the plasma jet is not attributed to an increased velocity, but is more likely a consequence of a periodic perturbation to the jet shear layer introduced by the discharge.

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