# Contrasting the characteristics of atmospheric pressure plasma jets operated with shielded and unshielded high voltage electrodes

**Bhagirath Ghimire[1,2*] and Kunning G. Xu[1]**

[1]Center for Space Plasma and Aeronomic Research, University of Alabama in Huntsville, Huntsville 35899 (USA)
[2]Department of Mechanical and Aerospace Engineering, University of Alabama in Huntsville, Huntsville 35899 (USA)
Email: bhagirath.ghimire@uah.edu

Atmospheric pressure plasma jets (APPJs) are known to generate a cocktail of reactive oxygen and nitrogen species (RONS. In the last two decades, research groups around the world have utilized different configurations of the device for several biological and medical applications. One commonly utilized version of the APPJ includes a shielded and unshielded high voltage (HV) electrode. Although these versions have been utilized in several studies, a comparative study between the two are missing.

In this study, the influence of shielding a HV electrode is investigated by constructing two identical plasma sources. Both plasma jets contain a tungsten electrode enclosed inside an internal quartz tube, which is further enclosed in a secondary quartz tube and fitted in a T-tube. The end of the internal quartz tube in the first plasma jet is closed to shield the high voltage electrode (named as shielded jet) while the end of the internal quartz tube in the second plasma jet is open (named as unshielded jet). We investigate the characteristics of the plasma jet by using electrical, optical and fast imaging diagnostics tools. Significant difference in the characteristics of the two plasma jets are observed. Results from time-resolved imaging shows that the plasma bullets in the unshielded jet travels an order of magnitude faster and propagate twice as far as the shielded jet. The higher propagation speed and longer plume length for the unshielded configuration are attributed to higher electric fields caused by greater accumulation of wall charges. These physical characteristics of the unshielded plasma jet also result in the production of more than double the concentration of hydrogen peroxide in plasma activated water. Spectroscopic measurement of the rotational temperature show that both jets operate at room temperature, facilitating their use in real-world applications, with unshielded configuration of the plasma jet offering a better choice.

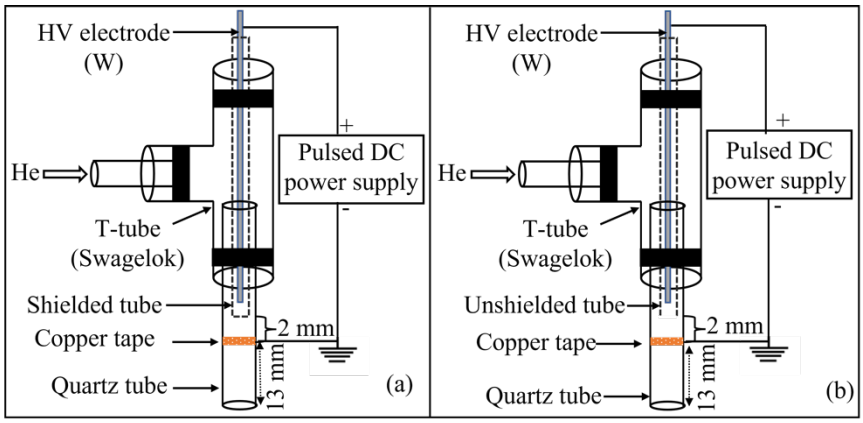


Figure 1: Schematics of the atmospheric pressure plasma jets with (a) shielded and (b) unshielded high voltage electrodes.

This work was supported by NSF OIA 1655280 and DOE DE-SC0021391.