5th Asia-Pacific Conference on Plasma Physics, 26 Sept-1Oct, 2021, Remote e-conference

Discharge characteristics and mechanism of plasma plume generated by atmospheric plused discharge

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Atmospheric pressure plasma plume generated by pulsed discharge was studied by experimental diagnostics and numerical simulations. It was found that the plasma plume was generated in the rising phase of pulse voltage, in which, a plasma bullet propagated toward the ground electrode with the speed in the range of 10^4 m·s^{-1}. It was also found that the electric field in the vicinity of the plasma bullet reached the magnitude of 10^6 V·m^{-1}, indicating that the formation of plasma bullet can be attributed to the localized enhanced electric field, which will be enhanced close to the ground electrode. The spatio-temporal evolution of electron density in the discharge reveals that the residual electron density remains after the plasma bullet passes through, which explains the tailing phenomenon of plasma bullet. The enhanced electron generation rate at the head of plasma bullet is corresponds to the localized enhanced electric field, which explains the generation mechanism of plasma bullet. This study on the characteristics and mechanism of plasma bullet provides a theoretical basis for the development of the atmospheric plasma plume generated by pulsed discharge.

Figure 1(a) shows a schematic diagram of the discharge structure of the numerical model, which is also a schematic diagram of the corresponding experimental device. As shown in the figure, the plasma jet is generated and propagated in the dielectric tube. Figure 1(b) shows a photo of a typical plasma bullet produced in a quartz tube taken by ICCD (Andor iStar) in the experiment. The exposure time taken was 20 ns. Figure 1(c) shows the He^+ density in the numerical simulation of the discharge corresponding to Figure 1(b), which can be used to correspond to the luminous intensity of the plasma. It can also show the plasma bullet formation and transport process consistent with the corresponding experimental measurements.

References

1 L, Iza F, Janson N B, Law V J, Kong M G 2010 J. Phys. D: Appl. Phys. 43 075201

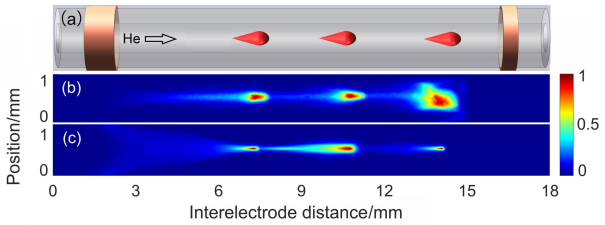

Fig. 1. (a) Schematic setup of discharge; typical appearance of plasma bullet (b) taken in experiments and (c) numerically simulated.