Electron density and electric field behavior of a plasma jet with pulse width closing to pulse duration

X. Li[1*], Z. Li[1], L. Nie[1], and X. Lu[1]

[1] *State key laboratory of advanced electromagnetic engineering and technology, School of Electrical and Electronic Engineering, Huazhong University of Science and Technology, Wuhan, Hubei 430074, P.R. China*

Previously, the plasma plume appears with three regimes (dark area next to the nozzle, bright area in the middle, and dim area on the right) is observed when the pulse width of the applied voltage is close to the pulse duration [1]. Based on Thomson scattering and electric field-induced second harmonic (E-FISH) method, the spatial and temporal resolved electron density and electric field in the three regimes are measured to understand such observation [2-4]. It is found that, in the dark regime next to the nozzle, the electric field is relatively low, it has a peak value of about 10 kV/cm, but the electron density is high, it has a peak value of about 4.2×10^{20} m^{-3}. This indicates that the dark regime is like a conductive channel. On the other hand, for the bright regime, the electric field is much higher, which has a peak value of about 17 kV/cm. However, its electron density is significantly lower than that in the dark regime, its peak value is only about 10^{20} m^{-3}. Even in the dim regime, the electric field is higher than that in the dark regime, it has a peak value of about 13 kV/cm. The electron temperature is directly related to electric field, the results indicate that the brightness of the plasma plume at different regime is mainly decided by the electron temperature rather than the electron density.

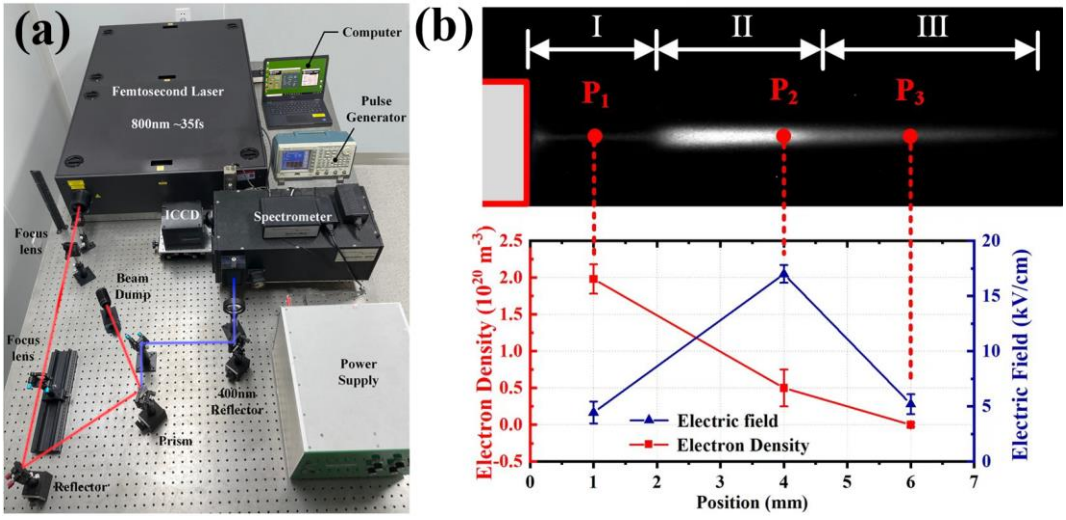

Figure 1. (a) Schematic of electric field induced second harmonic (E-FISH) system. (b)The electron density and electric field at different positions.

[1] Y. Xian, *et al*., Sci. Rep. **3** (2013) 1599.

[2] B. M. Goldberg, *et al*., Appl. Phys. Lett. **112** (2018) 064102.

[3] B. Huang, *et al*., High Volt. **6** (2021) 665.

[4] T. Chng, *et al*., Plasma Sources Sci. Technol. **31** (2022) 015010.

*Presenting author: leexvhust1997@163.com