EXPERIMENTAL AND MODELING STUDIES OF THE PLASMA BULLET LIFETIME*

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Several experimental results have shown that atmospheric pressure low temperature plasma jet (APLTPJ) is not a continuous medium; it consists of a train of bullet-like-structures called plasma bullets, propagating in the surrounding air with supersonic velocities in order of 10^4-10^5 m/s without any external electric field [1]. Therefore, the visible appearance of the plasma jet is actually the footprint of the plasma bullet. . In this work, the plasma bullet lifetime will be investigated.

It is found that the plasma bullet lifetime depends on three factors: the helium flow rate, the width of the applied voltage pulse, and its magnitude. The plasma bullet follows the trajectory of the helium gas channel, indicating that helium mole fraction value along the ionization channel should be more than a critical limit to sustain the plasma bullet propagation. This critical value will be determined for the different helium flow rates. The width of the applied high voltage pulse is also important. For pulse widths less than 700 ns, the plasma bullet stops propagating after the secondary discharge ignition, which occurs at the end of the voltage pulse. For longer pulses it is the diffusion of oxygen into the helium channel that extinguishes the bullet. In addition, how much energy is transferred into ionization is an important parameter because the plasma bullet dissipates its energy as it propagates forward. The effect of the magnitude of the applied high voltage on the plasma bullet lifetime will be also discussed.

[1] N. Mericam-Bourdet, M. Laroussi, A. Begum, and E. Karakas: 'Experimental investigations of plasma bullets', J. Phys. D: Appl. Phys., 2009, 42, pp. 055207.

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