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Understanding the physics of atmospheric pressure low temperature plasma jets[1] ERDINC KARAKAS, MOUNIR LAROUSSI, Laser and Plasma Eng. Inst., Old Dominion University — In this paper, we present the current state of the art of our APLTPJs sources, namely the "Plasma Pencil" and the "Tube Reactor." Recent experimental results show that an ionization wave exists and propagates along the plasma jet. The plasma jet created by this ionization wave is not a continuous medium but rather consists of a bullet-like-structures known as "Plasma Bullets." More interestingly, these plasma bullets actually have a donut-shaped makeup. Our latest plasma jet experiments reveal that the propagation characteristics of the ionization wave can be explained using a streamer theory model. This is especially important for adequate explanations of the plasma bullet propagation. It is also found that the secondary discharge, ignited by the charge accumulation on the dielectric electrode surfaces at the end of the applied voltage, interrupts the plasma bullet propagation due to an opposing current along the ionization channel. In addition, the plasma bullet also comes to an end when the helium mole fraction along the ionization channel, or applied voltage, or both, are less than some critical values. The APLTPJs' chemical composition includes short-lived and long-lived reactive species. Especially, helium metastables play an important role promoting an enhanced chemistry along the plasma jet.

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