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Three distinct electron characteristics in a pulsed rf atmospheric-pressure plasma jet

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Cold plasma jet has become one of the most attractive versatile plasmas, and active studies on plasma properties such as electron density (n_e) and temperature (T_e) have facilitated better development and implementation of plasma jets. Here we demonstrate the temporal evolution of n_e and T_e in a radio-frequency (rf)-driven argon plasma jet operating at atmospheric pressure. The plasma jet is driven by a 5-MHz sinusoidal rf power modulated by a 50 kHz square pulse with a 75% duty ratio. A 532 nm Nd:YAG laser is applied to the plasma, and laser Thomson scattering measurements are performed using a triple-grating spectrometer coupled to an intensified CCD camera. From this investigation, we find that n_e and T_e vary during the pulse repetition period of 20 μs in the ranges of (2–12) × 10^{18} m^{-3} and 0.3–6.0 eV, respectively. With respect to the 5 MHz period (200 ns), T_e varies with the rf oscillating field, while n_e remains constant. Special attention is given to three distinct electron characteristics depending on the pulse phase in the plasma jet—ionizing (on-pulse), stationary, and recombining (off-pulse) states. Our measurements will be valuable for related experimental and numerical plasma research and provide further insights into the effect of rf pulsing on the electron kinetics in atmospheric-pressure plasmas.

References
S. Park and S.-Y. Yoon, Plasma Sources Sci. Technol. **31**, 055011 (2022).

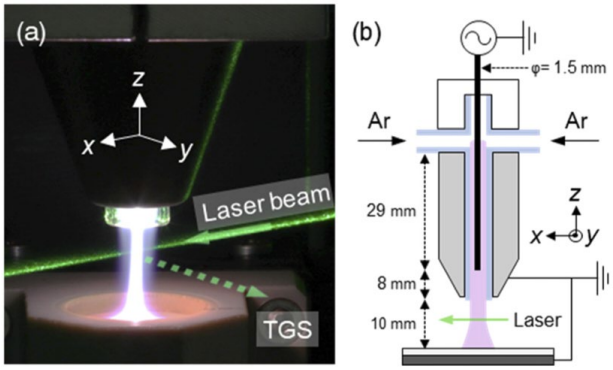

Figure 1. (a) Photograph of a pulsed rf plasma jet generated in argon with a 532 nm laser beam crossing the plume of plasma jet. (b) Schematic configuration of the rf plasma jet apparatus used in this work (not to scale).