Intensified Optical Emission and Afterglow in Atmospheric Pressure Argon Plasma driven by Pulsed Microwave

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Dynamical properties of atmospheric pressure argon plasma driven by microwave pulses with high repetition rate and fast rise time are investigated. Time-resolved spectroscopic measurements reveal an emission burst at the pulse rise including electron continuum emission, hydroxyl molecular (OH) lines, and a large overshoot of argon atomic lines. The latter suggests an increase in the density of excited argon (Ar*), and which can be interpreted as a transient increase in electron temperature supported by a global model simulation. At the pulse off, an afterglow burst of argon lines is observed with a time scale much faster than the conventional afterglow in low pressure discharges and its rise time scales hardly change for different pulse periods. The afterglow burst indicates dissociative recombination of argon dimer ions and generation of excited argon species, implying that the afterglow burst can be used to maximize the density of reactive species. Compared to continuous wave operation, the time-averaged emissions of Ar* and OH molecules are enhanced by about 60%and 30% respectively, in the pulsed microwave operation. Study of the emission burst and afterglow may help optimize the pulse parameter to maximize the generation of reactive species.

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