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TEMPORALLY RESOLVED EMISSION SPECTROSCOPY OF TRANSIENT SPARK DISCHARGES

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ABSTRACT

Transient spark - novel type of streamer-to-spark transition discharge generating non-thermal plasma of high chemical activity was successfully tested for flue gas cleaning, bio-decontamination or methane conversion to oxygenates and syngas. Here we present fundamental investigations of transient spark in air at atmospheric pressure by temporally resolved ICCD camera imaging and emission spectroscopy, coupled with oscilloscopic measurements. Despite DC applied voltage, the discharge has a pulsed character with short (<100 ns) high current (>1 A) pulses, with repetitive frequencies of a few kHz. The emission of N_2 2^{nd} and 1^{st} positive, N_2^+ 1^{st} negative systems, and atomic N and O lines was detected. Temporal evolution of the emission shows that N_2 2^{nd} and 1^{st} positive decay within the first 20 ns of the pulse. Further emission is due to various atomic lines and decays exponentially within 200 ns. The non-equilibrium character was confirmed by calculated vibrational (3000-4000 K) and rotational (400-1000 K) temperatures. Two typical modes of the transient spark were observed – low and high frequency pulses. The low frequency mode with stronger and shorter current pulses generates higher concentrations of radicals per pulse. However, the high frequency (~10 kHz) mode with the strongest N_2^* emission seems the best for plasma-chemical effects.