**Experimental study of sub-atmospheric streamers in pure N2  with implications for nitrogen kinetic models**

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Fast ionization waves (streamers) initiate most of the discharges in different gases. A study of streamers can be performed at various pressures and the increase of the gas pressure causes the reduction of the streamer's lifetime. Therefore, the investigations of streamers at close to atmospheric pressures are highly challenging for diagnostics due to their sub-nanosecond time evolution.

We investigate the streamers in pure N2 at the pressure of 200 Torr. The investigated monofilament streamer develops in a dielectric barrier discharge configuration with point-to-plane electrode geometry. Our experimental investigations include electrical characteristics, time-resolved images obtained using four 4-Picos ICCD cameras and N2/N2+ emission spectra, all acquired with sub-nanosecond temporal resolution.

Time-resolved images and emission characteristics provide clear evidence of the formation of a cathode-directed streamer and allow the determination of the streamer propagation velocity. Using the intensity ratio of the first negative and second positive system of molecular nitrogen [1], we determine the reduced electric field at the first nanoseconds after the streamer onset. Subsequently, the electric field profile serves as an input parameter for 0D state-to-state kinetic model. Using the model, we aim to explain the evolution of experimentally observed N(4S) and N2(A3Σ+u) species [2-3] as well as the vibrational distribution functions of excited states of N2/N2+. The conclusions of our work are significant for plasma-chemistry models of highly non-equilibrium nitrogen plasmas.

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