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DISCHARGE PROPAGATION IN HONEYCOMB MONOLITH

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Generation of atmospheric plasmas in small cavities and narrow channels of various dielectric materials and heterogeneous catalysts has been interesting for various environmental applications. The interaction of the plasma with the catalytic material affects plasma properties and catalyst activity, lead to various synergetic effects that often result in enhanced efficiency of chemical processes. The paper follows our previous works [1-2] aimed at the generation of the stable discharge plasma inside a honeycomb catalytic monolith. A bundle of quartz capillary tubes was used instead of ceramics honeycomb substrate to be able to perform the optical emission spectroscopy of the discharge and analyze the discharge propagation inside the channels. The objective of the present paper was to study the streamer discharge propagation inside a single quartz capillary tube by means of electrical and temporarily resolved optical diagnostic methods and determine the conditions of its stable generation and propagation velocity with respect to the various parameters - capillary diameter and length, amplitude and frequency of the applied voltage, and gas mixture composition.

The experimental system consisted of a single quartz capillary tube (diameter 1, 2 and length 1-2.5 cm) with a needle electrode and a plane electrode set at its ends. The discharge was generated by the AC high voltage (50 Hz - 1 kHz) power supply in various gas mixtures containing N_2, O_2 and H_2O vapours at room temperature. The voltage and the current waveforms were recorded by an oscilloscope, the discharge spatially resolved emission along the capillary by a photomultiplier, and temporarily resolved images of the discharge by ICCD camera system.

The stable generation of streamer discharge was observed only for a certain combination and range of the applied voltage and gas composition. The streamers onset voltage increased with the water vapour contents. During one period of the applied voltage several streamers were observed in both positive and negative polarity, their amplitude and number increasing with the applied voltage and N_2/O_2 ratio in the mixture, however independent of the capillary diameter. Depending on the applied voltage and humidity, the streamers appeared at different times of the harmonic waveform of the applied voltage (not only in the maxima, but also beyond), that can be attributed to the effect of the dielectric material. At the voltage of 22 kV and capillary tube diameter of 1 mm, the streamer propagation velocity was found to be $\approx 4.2*10^7$ cm/s, and decreased with the increasing diameter and concentration of nitrogen. Equivalent streamer velocity measured in the same conditions but without a capillary tube was found to be $\approx 2.7*10^7$ cm/s. The effects of other parameters on the streamer propagation velocity will be reported.

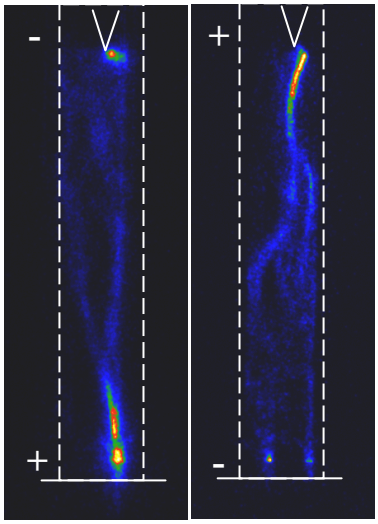

Fig. 1: *Streamer propagation in quartz capillary tubes (∅ 2 mm, 22 kV, gate 20 ns)*

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