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COLLISION OF PLASMA DIFFUSE JETS AND STREAMERS DURING A PULSED DISCHARGE IN AIR AND NITROGEN *)

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In recent years, interest has increased in the study of collisions of leaders and streamers during pulsed discharges in air and other gases of various pressures. Streamers were studied in the tip-to-tip [1] and blade-to-blade gaps [2]. The collision of the leaders was observed during the propagation of negative lightning towards the Earth [3], as well as in the air at atmospheric pressure at meter gaps [4]. In [5, 6], the interaction of diffuse jets in long dielectric tubes filled with low-pressure gases was studied.

The purpose of this work is to study the collision of plasma diffuse jets and streamers with different and identical front polarities and to determine the emission spectra, discharge parameters, color and shape of plasma formations in the interaction region.

During the experiments, two installations were used. In the first, streamers were formed in the mode of single pulses between two parallel electrodes in the form of blades 30 cm long [2]. The length of the gap that was filled with nitrogen at a pressure from 10 to 2280 Torr was 1.2 or 2 cm. Voltage pulses with an amplitude of ~200 kV and a duration at half maximum with a matched load of 3 ns were supplied to the electrodes from a RADAN-220 generator. In the second installation, plasma diffuse jets (PDJ), which consisted of streamers [6], were initiated in a quartz tube 215 cm long from capacitive discharge plasma, which was created in a pulse-periodic mode from two generators. The amplitude of the voltage pulses was 7 kV, and their frequency was 21 kHz. Generators of both the same polarity and the opposite were used. The tube was filled with atmospheric air to pressures of 0.4, 1, 1.5 and 2 Torr.

Experiments at the first installation showed that at high pressures at the meeting point of streamers with different front polarities, the discharge luminosity in the visible region of the spectrum decreases, and the reduced electric field (E/p) increases. An increase in E/p made it possible to reach the lasing threshold in nitrogen at a wavelength of 337.1 nm at high nitrogen pressure. At the second installation, data were obtained on the radiation and shape of the PDS during their collision. With different polarities of the streamer front in the PDS, the luminosity of the discharge at the place of their meeting increased, and with the same polarity it decreased. The PDS that were formed in the tube had a color, emission spectra, and the speed of propagation of the luminescence front similar to those observed for streamers in “columnar” sprites [7].

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