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EXPERIMENTAL INVESTIGATION OF INFLUENCE OF IONIZATION WAVE VELOCITY ON VOLTAGE DROP DURING PULSED GAS BREAKDOWN*

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Previously experiments [1] have shown that the formation of both positive and negative streamers in a point-to-plane gap causes a voltage drop. The report presents the first experimental verification of our theoretical data [2-3] on the relation between the ionization wave velocity and the voltage dynamics during pulsed breakdowns in a highly inhomogeneous electric field.

The experimental setup consisted of nanosecond high-voltage generators, a high-voltage cable, a discharge chamber with a transmission line and a built-in capacitive voltage divider. The cathode was an Al foil twisted into a tube. A 4.5 cm long tube made of a twisted fluoroplastic film was put on the cathode to prevent the development of the ionization wave toward the side wall of the chamber. The grounded electrode was plane. The interelectrode distance was varied from 1 to 4 cm. The chamber was pumped out with a fore vacuum pump and then filled with air. The pressure was varied in the range of 4–100 Torr.

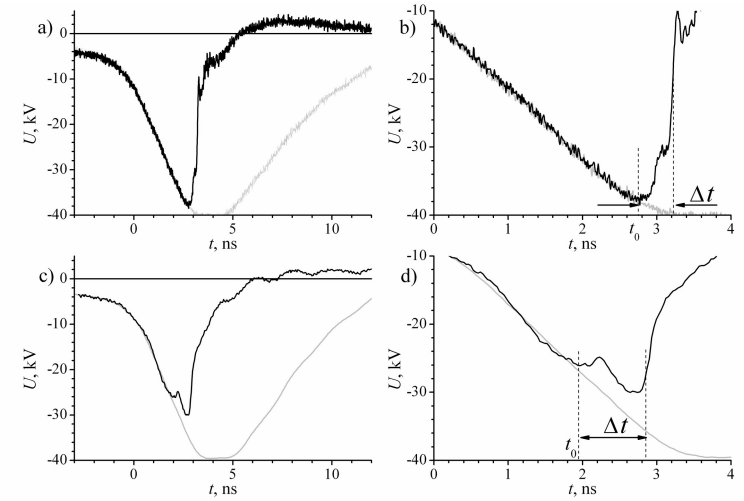

Fig. 1. Waveforms of voltage from capacitive voltage divider during discharge in air at a pressure of 10 Torr. Grey curve – idle mode, black curve – breakdown mode. Interelectrode distance is (a, b) 2 cm and (c, d) 4 cm.

Figure 1 shows typical waveforms of voltage from voltage divider recorded in the experiments. It is seen from Fig. 1b, d that at t_0 the voltage goes slightly below the voltage in idle mode. There is a short interval Δt of ionization wave propagation from cathode to anode. The voltage decreasing in the interval Δt can be explained by the displacement current comparable with the transmission line charging current arises. As the wave reaches the anode (grounded electrode), the voltage decreases sharply and a breakdown occurs. To estimate the ionization wave velocity, we can measure the time interval Δt.

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