EFFECT OF IONIZATION WAVE VELOCITY ON VOLTAGE*

THEORY, SIMULATION, EXPERIMENT.

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Investigations of pulsed breakdown of a gas-filled gap with a highly inhomogeneous electric field have shown that a runaway electron beam (REB) is formed during the breakdown [1–3]. It was also shown that REB is formed at the initial stages of breakdown (stage of a sharp increase in the voltage pulse). The formation of REB leads to the multielectron breakdown initiation and the appearance of an ionization wave (IW). The velocity of IW movement varies widely depending on various parameters (geometry, amplitude and temporal characteristics of the voltage pulse, type and pressure of the gas) and can reach values comparable to the speed of light, which has been repeatedly shown in numerical simulations [4-7]. The so fast ionization wave rapidly changes the gap geometry such that displacement current comparable with the transmission line charging current arises [6] and the voltage across the gap and the line drops. The faster the ionization wave, the higher the displacement current. The voltage U_d in the transmission line depends on IW velocity v:

$$U_d = \frac{2U_0}{1+\frac{v}{c}}, \tag{1}$$

where U_0 is the voltage in the traveling wave, and c is the speed of light [6].

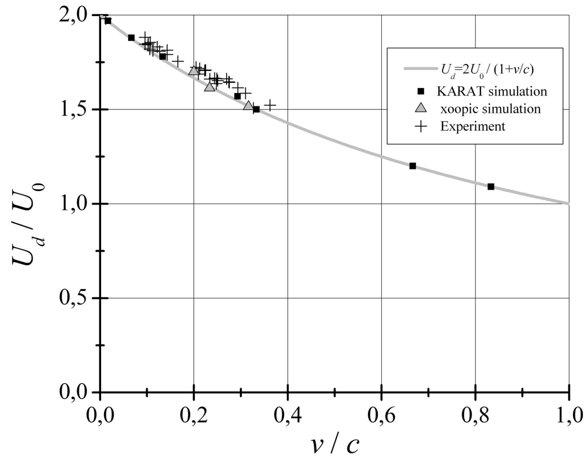

Fig.1. Transmission line voltage vs IW velocity according to theoretical (gray curve), simulation and experimental data (symbols).

Figure 1 demonstrates the behavior of voltage according to expression (1), results of numerical simulation [6] and experiments under different conditions.

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