S2-P-019601

SOME FEATURES OF CURRENT SHEET FUNCTIONING IN GAS-PLASMA SYSTEMS*

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The paper analyzes the results of experiments with argon/deuterium gas-puffs with an outer plasma shell. The dynamics and characteristics of the current sheet (CS) were studied using magnetic probes (*B-dot*) and optical diagnostics [1]. Measurements of the currents in the CS using *B-dot*, installed at different radii from the axis of the system, but at the same level relative to the cathode surface, show that there is a decrease in the amplitude of the current *B-dot* relative to the generator current *Ig* as the CS moves towards the center. The width of the current sheet decreases as one moves toward the axis with an increase in the average current density from units of kA/cm^2 to tens of kA/cm^2. Such high current densities cannot be explained by thermal, auto- or photoemissions. Obviously, a dense explosive emission plasma is formed on the cathode, which provides emission with a current density of tens of kA/cm^2. This high concentration plasma will expand into the interelectrode gap, and its front becomes the emitting cathode. A double layer is formed at the boundary between the dense cathode plasma and the injected anode plasma, as is the case in plasma opening switch.

When the cathode plasma expands into the interelectrode gap with a simultaneous increase in the magnetic field, it is possible to shift the emission boundary from the electrode into the plasma with shielding of part of the current in *B-dot*. This may be one of the reasons for the decrease in the current amplitude obtained by integrating the signal from magnetic probes near the pinch axis. An experiment with magnetic probes installed at different levels relative to the cathode plane confirms the possibility of such a scenario. On Fig. 1 shows a graph of the fraction of the probe current *IK*2 at a radius of 6 cm relative to the generator current *Ig* depending on the location of *B-dot* relative to the cathode grid.

The dynamics of the CS during the implosion of gas-puffs is the essence of the evolution of the near-cathode double layer and the current sheath formed by electrons injected from the cathode plasma. The acceleration of ions in a CS can only occur in an electric field. In our case, a self-consistent electric field arises in the CS due to the Hall effect and directed to the axis of the system: $E_r \sim j_z B_\varphi / en$. On the basis of optical diagnostics, the appearance of a glow on the axis of the system was registered at the moments when the front of the CS did not reach the center. Obviously, this is the registration of a shock wave front with a jump in density and temperature.

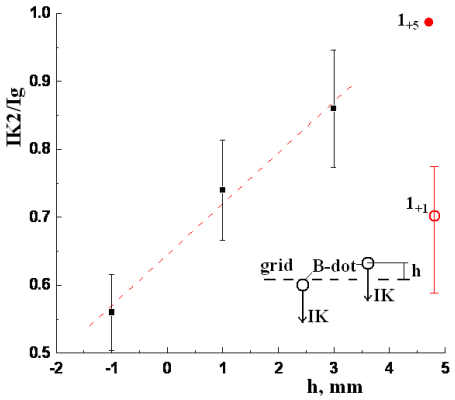

Fig.1. Graph of the dependence of the current fraction in the CS *IK*/*Ig* on the position of *B-dot* relative to the cathode plane h at a radius of 6 cm. Points 1_{+1} and 1_{+5} were obtained for *B-dot* at a radius of 3 cm in an experiment with an argon gas-puff with an outer plasma shell, 1_{+1} - standard position of the sensor (completely above the grid), 1_{+5} - the sensor is raised by 5 mm into the interelectrode gap (h = 5 mm).

REFERENCES

[1] V. Kokshenev, A. Rousskikh, A. Shishlov et al., "Formation and dynamics of the current sheath in the plasma shell of a Z-pinch in the microsecond implosion regime", 7th International Congress on Energy Fluxes and Radiation Effects (EFRE), Tomsk, Russia, pp. 217-221, 2020, doi: 10.1109/EFRE47760.2020.9241970.

* The work was supported by the Russian Science Foundation under grant No. 22-29-01554.