S6-P-021102

# NUMERICAL MODEL OF HIGH CURRENT PLASMA SOURCE

*D.L. SHMELEV[1], S.A CHAIKOVSKY[1], I.V. UIMANOV[1], V.I. ORESHKIN[2], A.G. ROUSSKIKH[2]*

*[1]Institute of Electrophysics, UB, RAS, Ekaterinburg, Russia*
*[2]Institute of High Current Electronics, SB, RAS, Tomsk, Russia*

Recently, in experiments on the implosion of plasma Z-pinches, a plasma source with an annular anode similar to the source shown in Fig.1 [1, 2] was used to create a plasma liner. The current passed through such a source can reach hundreds of kiloamperes. Radiographic measurements of the mass of the plasma liner (Fig. 2) show that the mass flow from the source corresponds to a specific erosion in the source on the order of milligrams per Coulomb. This is about a hundred times greater than the cathodic erosion typical of a conventional vacuum arc. Obviously, the discharge burning in the considered source cannot be a classical vacuum arc.

To investigate possible erosion mechanisms, a simplified 2D CFD source model with aluminum electrodes and a sinusoidal current pulse with an amplitude of 325 kA was created. It was found that after 0.2 μs intense evaporation followed by ionization occurs from the entire cathode and anode surfaces into the gap. Moreover, the anode makes the main contribution to the erosion. Plasma radiation makes a significant contribution to the heating of electrodes. Comparison of the calculated mass of the liner with the experiment is shown in Fig. 2. It can be seen that the calculation qualitatively coincides with the experimental results.

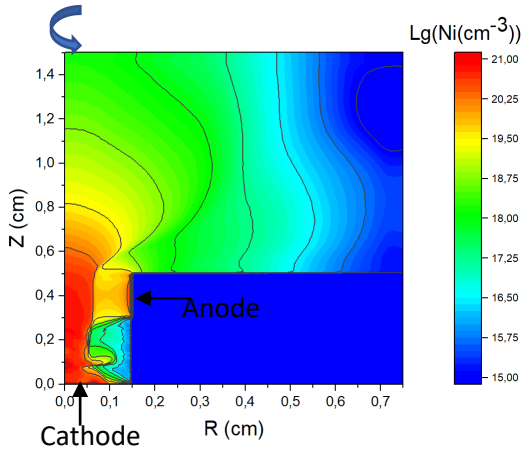


Fig.1. Plasma density distribution at 0.6 ms.

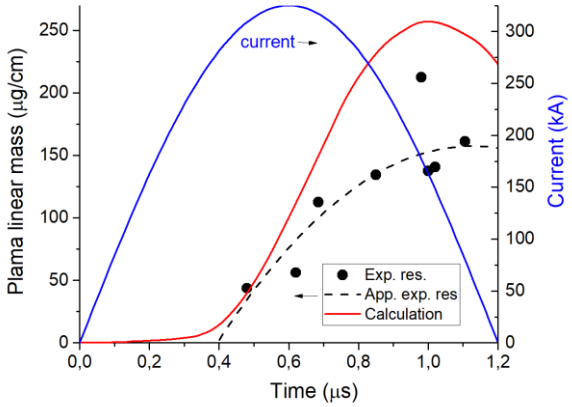


Fig.2. Arc current and plasma mass. Points – experimental results, dushed curve – approximation of experimental results, red solid curve – calculation results.

## REFERENCES

[1] D.L. Shmelev, A.S. Zhigalin, S.A. Chaikovsky, V.I. Oreshkin, A.G. Rousskikh, "Formation of double shell during implosion of plasma metal puff Z-pinches. Physics of Plasmas", 27(9), 092708, 2020.

[2] R. K. Cherdizov, R. B. Baksht, V. A. Kokshenev, V. I. Oreshkin, A. G. Rousskikh, A. V. Shishlov, D. L. Shmelev, A. S. Zhigalin, "Effect of tailored density profiles on the stability of imploding Z-pinches at microsecond rise time megaampere currents", Plasma Physics and Controlled Fusion, 64(1), 015011, 2022