CALCULATION OF THE CURRENT FLOWING THROUGH THICK-WALLED TUBE USING THE ELECTRIC FIELD INTENSITY MEASURED ON THE INNER SURFACE OF THE TUBE

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Using the time dependence of the electric field intensity measured on the inner surface of the tube the current flowing through is restored. Thus, using the data on the full current flowing through the electrode gap, can be individually determined the fraction of the current flowing through the plasma formed on the outer surface of the tube and flowing through the tube itself, being in condensed state.

The proposed method can be also used in the case of a thick-walled tube (the thickness of the skin layer, determined at the room temperature, significantly less than the wall thickness of the tube). While restoring of the current the inverse problem is solved, the incorrect decision of which is connected with the rapid attenuation of higher harmonics with electromagnetic field diffusion through the electrode material. The incorrectness of the problem was solved in the following way: for the restoration of the current profile the smoothed experimental voltage profile was used, and the number of terms in the expansion for calculation of the numerical solutions was limited; so, only the smooth components were taken into account.

Applying the offered method, the current profile was restored for the experimental data obtained in the Angara-5-1. The evolution of the current density and temperature distributions over thickness of the tube were also obtained. Numerical results for the electric field in the inner surface of the tube are in a good agreement with experimental data.

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References

1. EV Grabowski, PR Levashov, GM Oleinik, SL Olson, PV Sasorov, VP Smirnov, S. Tkachenko KV Khishchenko. The formation and dynamics of plasma on the surface of the foil layer during the flow of current high-power pulse // Plasma Physics, 2006. t. 32, No 9, p. 782-793.
2. JL Bakshaev, AV Bartov, PI Blinov, AS Chernenko, SA Danko, YG Kalinin, AS Kingsep, VD Korolev, VI Mizhiritsky, VP Smirnov, AY Shashkoff, PV Sasorov, SI Tkachenko. Investigation of the dynamics of plasma in the electrode High magnetically conveying line // Plasma Physics, 2007. Vol. 33, No 4, p. 291-303.
3. SS Ananiev, JL Bakshaev, AV Bartov, PI Blinov, SA Danko, A.I.Zhuzhunashvili, ED Kazakov, Yu Kalinin, AS Kingsep, VD Korolev, VI Mizhiritsky, VP Smirnov, S. Tkachenko, AS Chernenko. The transport properties of magnetically High transmission line and dynamics of near-electrode plasma // Plasma Physics, 2008, Vol. 34, No 7, pp. 627-640.