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MODEL OF ELECTRON EMISSION FROM EXPANDING EXPLOSIVE EMISSION PLASMA FRONT*

YU.I. MAMONTOV[1], *I.V. UIMANOV*[1]

[1]*Institute of Electrophysics UB RAS, Yekaterinburg, Russia*

The 1D-3V PIC-MCC (1 dimension – 3 velocities Particle-in-Cell with Monte-Carlo collisions) self-consistent spherical-symmetric model was developed to investigate numerically dynamics of electrons emitted from an expanding explosive plasma front. The model describes a process of the virtual cathode formation within the nearest vicinity of the plasma front for fixed values of a plasma density and a voltage U between the front and an outer boundary of a calculation grid. This boundary was considered as an anode of the model; respectively, the plasma was assumed to be a cathode. U was varied from 0 V up to 1000 V. A radius r of the plasma front was in the range of 10 μm – 1 cm. An initial plasma density N_{pl0} was 10^{21} cm^{-3} [1,2]. The plasma density N_{pl} near the emitting front was assumed to decrease as r^{-2}. An emission current density J_{em} was determined as $J_{em} = eN_{pl} < V_t >$, where e is an elementary charge, $< V_t >$ is an average thermal velocity of electrons in plasma. For plasma emitted electrons, the Maxwellian energy distribution function was assumed to be valid [1,2]. The near-front plasma temperature T_{pl} was in the range of 1 eV – 3 eV. As a result of simulations, the dependencies of the current density J_{an} of plasma emission electrons near the anode on U, T_{pl}, and N_{pl} were obtained. In addition, the virtual cathode height U_{vc} was calculated for various simulation conditions. The effect of the electron beam self-closing was demonstrated. The limitations of the model caused by the electric field penetration in plasma were determined.

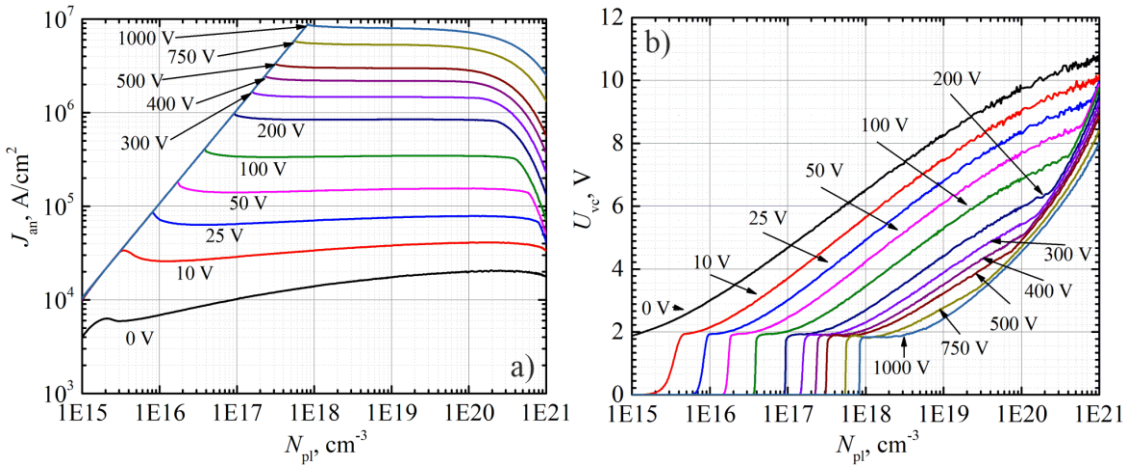

Fig.1. a) – anode current density J_{an} for various plasma density and voltage applied, b) – virtual cathode height U_{vc} for various plasma density and voltage applied. For a) and b), plasma temperature is 1 eV.

REFERENCES

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