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STABILIZATION OF THE BEAM CURRENT PULSE IN ELECTRON SOURCES WITH GRID PLASMA CATHODES*

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In electron sources with grid plasma emitters (GPE) and a plasma anode, the current in the accelerating gap I_0 is determined by several components [1–5] and can be written as:

$$I_0=\alpha\cdot I_d + I_{i2}\cdot[1+(1-\Gamma)\cdot\gamma_2 + \Gamma\cdot\gamma_1]$$

where $\alpha=I_{em}/I_d$ is the coefficient of electron extraction from the plasma emitter, equal to the ratio of the emission current I_{em} to the discharge current I_d; I_{i2} is the current of accelerated ions from the anode plasma; γ_2 is the coefficient of ion-electron emission from the metal during bombardment with accelerated ions of the emission electrode; γ_1 is the coefficient of ion-electron emission from the emission plasma due to ion-electronic processes in the plasma emitter; Γ is the effective geometric transparency of the emission electrode, which makes it possible to take into account the flow of ions that have passed through the grid of the emission electrode into the plasma emitter. In this case, the contribution of each term can be different depending on the specific type of electron source, the parameters of the generated electron beam, the geometry of the electrodes, their material, operating pressure, etc.

This work is devoted to methods for increasing the electrical strength of a high-voltage accelerating gap in electron sources with a GPE. First of all, the paper highlights the issues of stable generation of an electron beam under conditions of an uncontrolled increase in the current in the accelerating gap due to the ion component I_{i2}. Several methods have been proposed to reduce such instability, both by eliminating the positive feedback associated with an uncontrolled increase in the arc discharge current during its pulse, and by implementing several methods for introducing negative feedback (NFB) into the total current in the accelerating gap, which make it possible to level the factors, destabilizing the operation of electron sources on the example of a source with a GPE based on a low pressure arc. The use of any of the proposed methods for introducing beam current stabilization made it possible not only to increase the stability of the operation of several electron sources with GPE, but also to ensure greater repeatability and controllability of pulses, as well as to increase the integrated energy of the generated electron beams.

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