USE OF CERAMIC CATHODE BASED ON LANTHANUM AND TITANIUM BORIDES FOR GENERATION OF ELECTRON BEAMS OF LARGE CROSS-SECTION

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Recently, among the various applications of high-power electron beams, applications related to electron irradiation of large surfaces and large gas volumes have taken an important place. This irradiation with electron beams is used for the heat treatment of materials, applying coatings, and realization of plasma-chemical processes, curing of polymer coatings, sterilization of food products, etc. Common to all these applications – the use of electron beams of large cross section.

The production of such electron beams is associated with the creation of a previously unused set of conditions in electrophysical installations, namely, a combination of electrodes of large sizes, high voltage of long duration and compliance with the requirements for the uniformity of the current density distribution over the flow section. Typically, the instability properties of radiation during the generation of beams of large cross-section associated with the heterogeneity of forms microstrip and irregularity of their location on the surface of the cathode. To realize the cathode operation in the mode of explosive emission, the same micro-tip shape with high surface density and uniform distribution over the cathode surface is required.

This paper presents the results of experiments on the creation of a multisection cathode for the generation of large-section beams by sections based on lanthanum and titanium borides treated by self-propagating high-temperature synthesis. The cathode is assembled on a brass matrix with 52 holes evenly distributed over its surface, into which sections are attached, which are tablets based on the LaB6-TiB2 compound. Microscopy of the surface of the section of the cathode showed that the height microstrip is from 9 to 13 microns, the base diameter 8-13 μm, the surface density of microstrip > $2 \cdot 10^6$ cm^{-2}. The manufactured multi-section cathode was tested at the omega-350 accelerator, which has the following parameters: the pulse amplitude of the accelerating voltage up to 350 kV, pulse duration up to 1.5 μs, the maximum beam current density up to 10 kA/cm^2.

For comparison of emission characteristics of the accelerator was also tested multi-sectional cathode is made of steel cylindrical sections repeating cermet on the surface of which had a flange height of 1 mm and a thickness of 0.5 mm. In the experiments we compared the amplitude and temporal parameters of the pulses of voltage and current at the cathodes. When using a metal-ceramic cathode, the impedance matching of the voltage pulse is better, and consequently, the pulse front increases steeper. Also, a multi-section cathode based on metal ceramics allows to obtain a large amplitude of the current pulse (up to 2.5 kA) at its longer duration (up to 3 μs).