

EXPERIMENTAL STUDY OF ELECTRON GUNS WITH FIELD EMISSION AND LARGE EMITTER TIPS

S. P. Morev, A. N. Darmaev, E. K. Muraviev, V. M. Sablin
JSC «RPE «Toriy», Moscow, Russia,
E-mail: *npp@toriy.ru*

ABSTRACT

The report presents experimental study materials of the electron gun prototype, which contains up to four large field emitter tips from different materials. The voltage applying between the cathodes and the grid was continuous. The grid and the anode were under the same potential U_g , as a result, the electron beam propagated in equipotential space (fig. 1). The measurements were carried out with continuous pumping at a residual gas pressure of $5.0 \cdot 10^{-7} - 6.0 \cdot 10^{-8}$ Torr. Figure 2 shows the trace from the beam on the collector covered with luminophore, material of the field emitter is SU-2000 glassy carbon, tip height – 1.3 mm, tip diameter – $3.88 \mu\text{m}$, and a photo of the emitter before and after testing for five hours of continuous operation at a pressure of $10^{-7} - 5 \cdot 10^{-7}$ Torr. The maximum cathode current from this emitter was 0.535 mA, the current to the grid was 6% of the total current at grid voltage $U_g = 2015$ V. After work tip height decreased to $70 \mu\text{m}$. Tests of a similar emitter with a tip diameter of $6.0 \mu\text{m}$ at $U_g = 3600$ V lasted 30 hours, then were stopped (Fig. 3).

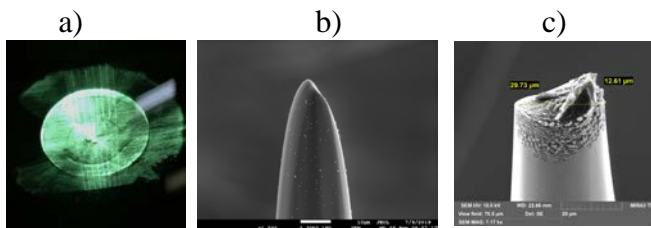
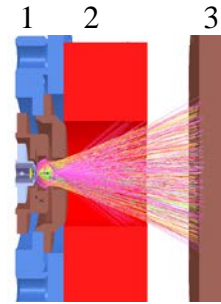


Fig. 2. The trace from the beam on the collector (a), the tip of the emitter of SU-2000 glassy carbon before (b) and after experiments (c)

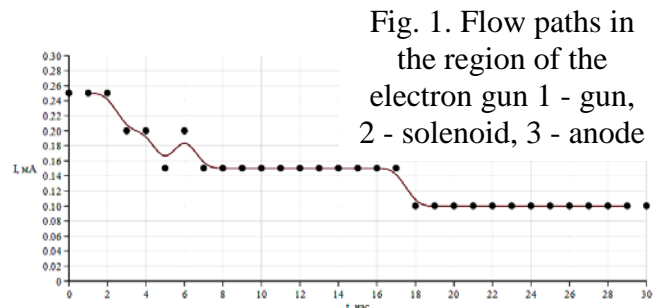


Fig. 3. The time dependence of cathode current, time represents in hours

Figure 4 shows photos of the field emitter made of tungsten after 12 hours of continuous operation. The tip height was 1.08 mm and the tip diameter was $6.62 \mu\text{m}$. The maximum current from this emitter at a pressure of $4 \cdot 10^{-8}$ Torr was 1.22 mA, the current to the grid was 2% of the total current at $U_g = 4640$ V.

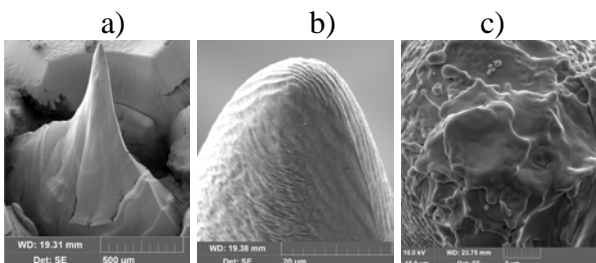


Fig. 4. Field emitter made of tungsten before (a - b) and after experiments (c)

The measurements showed that the emitter curvature does not change its value. The experiment with electron gun prototype immersed in the magnetic field of the solenoid was carried out. Measurements showed that at a voltage of $U_g = 5200$ V and a beam current of 0.44 mA, a change in the magnetic field from 0 to 0.028 T led to a decrease in the beam diameter from 40 mm to 1.0 mm.