

DESIGN AND OPERATING CHARACTERISTICS OF HOLLOW CATHODE PLASMA ELECTRON GUN WITH NON-SELF-SUSTAINING HIGH-VOLTAGE GLOW DISCHARGE.*

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In this report, the design and performance of pulsed electron sources (electron guns) are described. The discharge mechanism of the source is based on non-self-sustaining high-voltage glow discharge. The electron guns can be divided into two main types: secondary electron emission type (Fig. 1a) with flat cathode and plasma electron generation (hollow cathode plasma source) type (Fig. 1b). In the last electron gun type, the plasma that generates inside the hollow cathode acts as an electron beam source. Electrons emitted by the cathodes (being bombarded by ions) are accelerated by a voltage drop (U_{acc}) of several tens of thousands of volts.

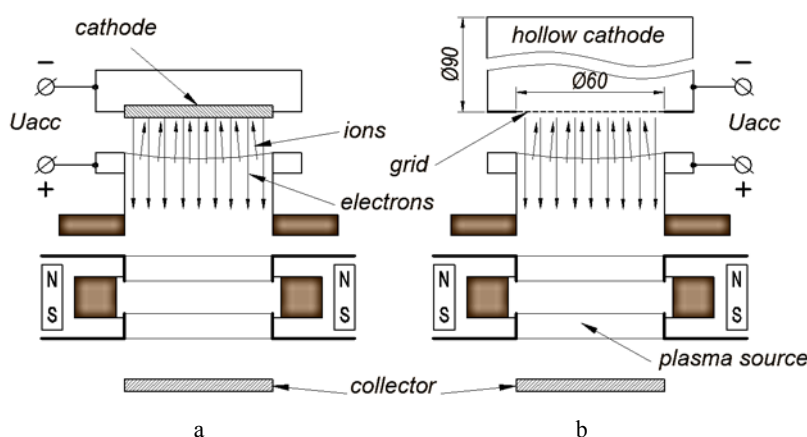


Fig.1. Schematic diagrams of the electron sources

The anode plasma acts as an ions ranging in beam current up to 1.5 A in pulse mode accelerated towards the cathode. The plasma is created by a toroidal plasma generator built according to the scheme of a plasma thruster with closed electron drift and a short acceleration zone (an anode layer). The working gas pressure has a strong effect on the anode plasma generator operation - determining the generator discharge current (and hence the ion beam current) and the duration of the discharge current pulse. Argon, nitrogen, and air were used as a operational gas. The pulse mode of the electron gun operation is implemented due to the pulse mode of the plasma anode generator.

It was shown in experimental studies the electron beam current increases by more than one and a half times for the hollow cathode type of electron gun compared to the current for the flat cathode. Under certain experimental conditions, the formation of a pre-modulated electron beam with a frequency of up to 20 MHz was observed in the hollow cathode type gun. The maximum electron beam current for the hollow cathode type was 10 A with a pulse duration about 250 μ s and the high-voltage drop up to 35 kV.

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