INFLUENCE OF THE PRESSURE AND KIND OF WORKING GAS ON THE HIGH-CURRENT ELECTRON GUN CHARACTERISTICS*

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The use of low-energy (up to 30 keV), high current (up to 25 kA) electron beams (LHEBs) is rather effective for the surface treatment and modification of metal products [1, 2] and has good prospects for further development. Usually, LHEB formation is carried out in a high-current gun with an explosive emission cathode and plasma anode based on a high-current reflective (Penning) discharge. Recently, we have proposed a new method for initiating explosive emission with resistively uncoupled arc plasma sources built in a disk cathode [3]. The new cathode unit, providing the initiation of explosive emission irrespectively from the acceleration gap length and fill medium, is a controlled device and can be used in an electron gun with a vacuum or a gas-filled diode without any plasma anode. The present work is devoted to the investigations of the influence of the pressure and kind of the working gas on the characteristics of high-current electron gun.

In the Fig. 1, the dependences of the beam pulse energy for the cases of argon, air and helium on gas pressure as well as for the case of vacuum diode at residual gas pressure (air) at 0.008 Pa are given. It is clear, that higher energy of the beam is achieved in the case of argon at pressure of 0.08–0.093 Pa. The decrease of the beam pulse energy at higher pressure is caused by a plasma-beam discharge in the gun which leads to a sharp decrease of the gun impedance and therefore the average kinetic energy of the beam electrons.

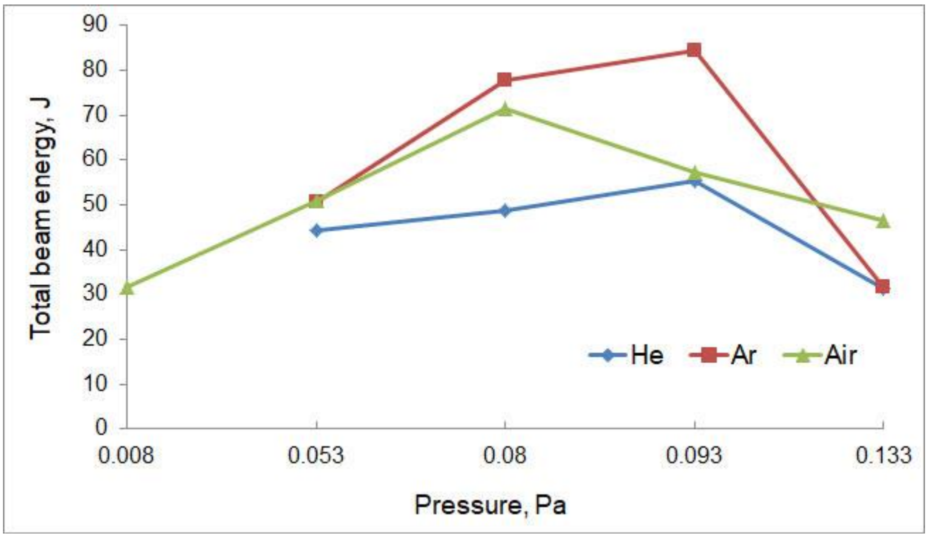

Fig.1. Beam current amplitude and total pulse energy in dependence on working gas pressure: argon (curve 1), air (2), and helium (3). Guide magnetic field – 0.1 T, acceleration voltage amplitude – 15 kV. The pressure values are given in an air equivalent.

Besides, the energy density distributions via the beam cross section obtained by a thermal imager have been studied.

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