ELECTRON BEAM GENERATION IN ABNORMAL GLOW DISCHARGE UNDER PURE CONDITIONS*

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Earlier in [1] investigations of current-voltage characteristics (IVC) of abnormal glow discharge (AGD) of direct current in pure conditions (achievable vacuum ~10^{-5} Torr) with Ti cathode were conducted resulting in an unusual S-shaped IVCs (in coordinates $U(I)$). The purpose of this work is to continue the study of the peculiarities of electron beam generation and the behavior of the IVC in the AGD with silicon carbide cathode in the system with the achievable vacuum in the discharge cell better than 10^{-6} Torr.

The experimentally obtained IVCs is well approximated by the expression $j = A \cdot U^x \cdot p^y$ [2,3], where j – discharge current density (A/cm^2), U – applied voltage (V), p – gas pressure (Torr), A – constant, x and y – degree indices. In [4] the approximation agrees well with the experimental results with the coefficients $A = 2.5 \cdot 10^{-12}$, $x = 3$, $y = 2$. Fig. 1a shows a series of dependences of applied voltage U on reduced discharge current density j/p^2 for discharge in helium under conditions of molecular gas impurity in the working gas not more than 10^{-5}%. Fig. 1a demonstrates: 1 – no coincidence of dependencies for pressure in the range 1.4 – 10 Torr; 2 – the depth of current drop increases with increasing gas pressure; 3 – change in the y value in the range from 2.5 to 1.4 with increasing pressure.

The energy characteristics of the electron beam in the AGD cell were investigated using the calorimetric method, Fig. 1b (curves 1-4). In comparison with the results obtained in [5] with LaB_6 (Fig. 1b (curves 5-7)) and Mo–Al_2O_3 (Fig. 1b (curves 8,9)) cathodes, electron beam generation efficiency ~65% (curves 1,2, $U = 2750$ V) is achieved at lower voltages, shorter discharge gap lengths, and higher pressures.

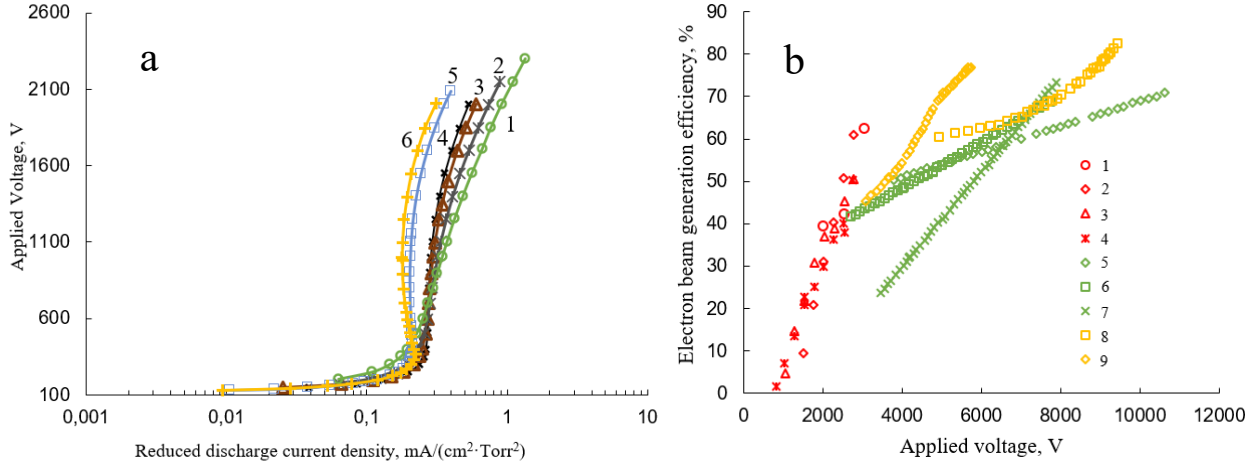

Fig.1. (a) Dependence of reduced discharge current density on applied voltage for different helium pressure p_{He} = 1.4 (1), 2.17 (2), 3.3 (3), 4.3 (4), 6.9 (5), 10 (6) Torr; (b) dependence of electron beam generation efficiency on applied voltage (present work (l (discharge length) = 30 mm, d (cathode area) = 2 cm^2): $p_{He} \cdot l$ = 78 (1), 140 (2), 228 (3), 300 (4) Torr·mm; [5] (l = 130 mm, d = 7.41 cm^2): LaB_6 cathode, $p_{He} \cdot l$ = 130 (5), 260 (6), 390 (7) Torr·mm; Mo-Al_2O_3 cathode, $p_{He} \cdot l$ = 130 (8), 260 (9) Torr·mm

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