ENERGY SPECTRUM OF ELECTRONS IN A NEAR-CATHODE LAYER

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When studying the physical processes in a near-cathode layer, the determination of spectrum of electrons emitrd by cathode is of particular importance, as both the spectrum structure in itself and, specially, position of its maximum are of decisive importance for optimum mode of cathode operation, increase of its service-life, rise of work stability. Usually, the energy electron spectrum can be determined, knowing, in the first place, electron distribution in a cathode (metal) (it is, as rule, Fermi-Dirac distribution R(n)), and, in the second place, the structure of potential barrier U(x). Usually, U(x) is assumed in the form:

$$U_{1(x)} = \varphi_0 - e/4x - E_0\, x, \qquad (1)$$

where x - the distance to cathode; φ_0 - work function; e - electron charge; E_0 - electric field intensity.

As there are always microbuges (roughness) on a cathode surface, the electric field intensity increases and the field gain is introduced; then, the potential barrier is written in the form:

$$U_{2(x)} = \varphi_0 - e/4x - mE_0\, x \qquad (2)$$

However, this expression for potential barrier is doubted in many cases, and in [1, 2,] it has been suggested that the potential barrier is to be written in the form:

$$U_{3(x)} = \varphi_0 - e/4x - T(x),$$

where $T(x)$ - is nonlinear function as from the complicated nature of potential variation adjacent to the microbulges on a cathode surface (s. Fig.). Generally, the function $T(x)$ is of variable kind for the microbulges of different form. So, for microbulges in the hemisphere form:

$$T_{hs} = E_0\, R_o\, (1 + x) \left[1 - \frac{1}{(1 + x)^2}\right],$$

for microbulges in the semi-cylider form:

$$T_{sc} = E_0\, a\, (1 + x) \left[1 - \frac{\ln f_1 (x)}{\ln f_2 (x)}\right],$$

where $f_1(x)$ and $f_2(x)$ - functions depending on an axis ellipsoid and its eccentricity;

for microbulges in the form of acute-angled cone (at $E_0 = \infty$),

$$T_c = \frac{C_1}{X^{\alpha}},$$

where $C_1 = \text{const}$, α - coefficient, depending on an opening of a cone.

Howeverr, it has been obtained that densities of electron current and energy spectrum depend substantially on the nondimension parameter $M = \varphi_0 / E_0 a$.

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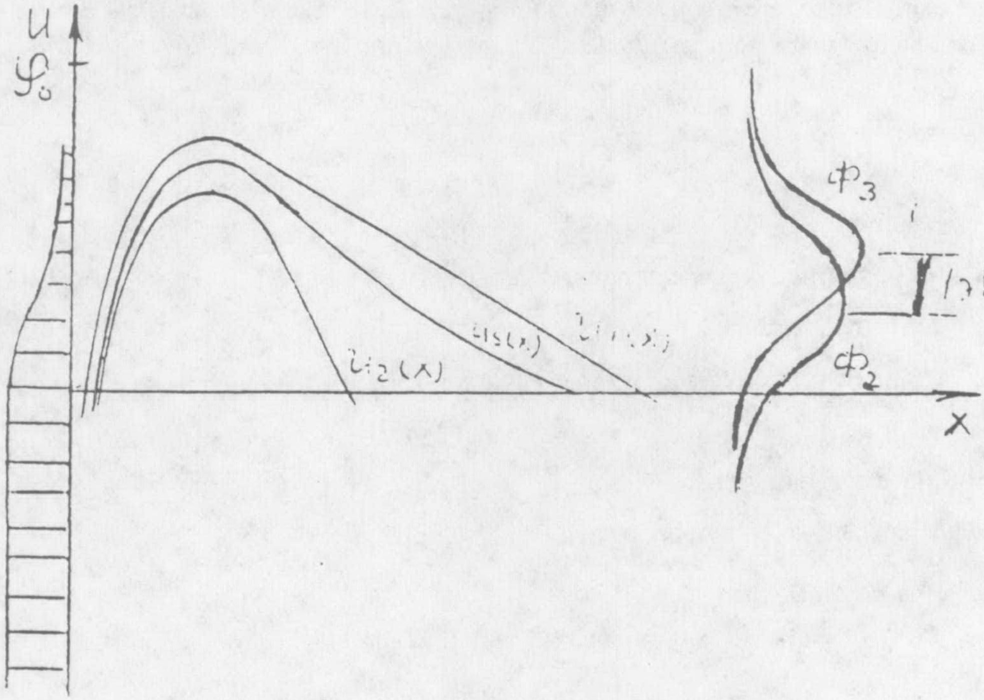
At $M < 3 \cdot 10^{-2}$ the energy spectrum for the barrier $U_3(x)$ is close to that for barrier $U_1(x)$; at $M>30$ the spectrum of the barrier $U_3(x)$ is close to the spectrum for $U_2(x)$; and only for $3 \cdot 10^{-2} < M < 30$, the concrete form of barrier for each microbulge should be considered.

Analysis of energy spectra of electrons passed through barriers $U_2(x)$ and $U_3(x)$ showed the position of maximum of spectrum $\Phi_3(x)$, appropriate to the barrier, can be dispaced by approximately 1 eV relative to the maximum of spectrum, appropriate to barrier $U_2(x)$, and the structure in itself becomes more asymmetric as compared with the structure of spectrum $\Phi_3(x)$, what gives the subsantial changes of thermal mode on a cathode surface.



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