Field emission of carbon cathodes with hard limited nanostructured emitting surface

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Experimental studies of field emission with nanostructure carbon materials have the fundamental interest First of all it is caused efficiency low voltage emission of carbon fibers.

The field emission properties have been examined in the vacuum diode system by applying voltage between the emitter (cathode) and a flat anode. The cathode was make from carbon fiber by diameter d = 7μm and height h= 2 mm and have emitting end surface. The emitting surface consists of nanosized fibrils. The pressure of residual gas P= 10^{-5}–10^{-7} Torr.

Current-voltage characteristics were investigated under various anode-cathode distance D_{ak} = 1–10 mm. The cathode had an aspect ratio h/d ≈ $3 \cdot 10^2$. Aspect ratio macrogeometry cathode and nanostructure of the emitting surface determine the gain factor of the electric field β ≈ $(3–7) \cdot 10^4$.

Experiments have shown that fibril fiber cathodes begin to emit at voltages U= 0.5–0.7 kV (initial field emission current I ~ 10^{-6}A). Experimental current-voltage characteristics have good reproducibility and are consistent with the theory of Fowler-Nordheim for field-emission current. Obtained by limiting current density j = $5 \cdot 10^2$ A, by the voltage U= 1.8 kV, the distance $D_{ак}$= 1mm, the cathode height h= 2mm. Current density values are much higher than for the best examples of thermo cathodes.

In accordance with the results febrile fiber cathodes can be used effectively in a technical vacuum and low operating voltages.