

About the mechanism of field emission of carbon nanostructures

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The mechanism of field emission from nanodimensional cathodes doesn't understand [1]. The carbon nanotubes were most studied among carbon cathodes. The majority of researchers treat the field emission characteristics of carbon nanotubes cathodes by Fauler-Nordgeim model accepting it as the pointed cathode with metal conductivity and very big strengthening factor of electric field intensity [2]. It is known that the carbon nanotube and graphite is not metal. They are semimetal with energy gap width $E_g = 0$ and two type of charge carrier, which together take part in field emission. The articles where authors observed the deviations of I-V characteristics from Fauler-Nordgeim law for carbon nanodimensional cathodes are

known. For example, data of emission current CNT cathode appreciably above their value which have been calculated by Fauler-Nordgeim equation [3].

In this work the field emission mechanism from various carbon nanostructures was studied. Graphite nanoplates (Fig. 1a), carbon multi walled nanotube (Fig. 1b) and normal aligned nanotube film were deposited on a nickel wire. The aspect ratio approximately was 80 and 600 for graphite nanoplates and carbon nanotube cathodes respectively. The I-U characteristics of all carbon cathodes have been measured in cell of electron microscope Carl Zeiss NEON-40. It is

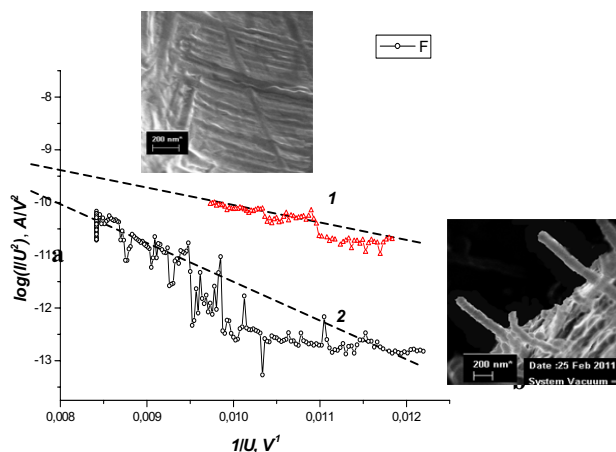


Fig.1. The I-V characteristic in the Fauler-Nordgeim coordinates for the graphite nanoplates and CNT cathodes . On inserts SEM image of their structures

noted, the I-V characteristic in the Fauler-Nordgeim coordinates isn't linear for all cathodes. (Fig.1). The strengthening factor of electric field intensity near at the cathode top was calculated for both types cathodes. It finds the wide disagreement of strengthening factors with their aspect ratio. Consequently the Fauler-Nordgeim model for carbon nanostructure is not valid.

- [1] Stetsenko B.V., *JPT* **81**(4), 152 (2011).
- [2] Eletsii A., *UFN* **172**(4), 402 (2002).
- [3] Stetsenko B.V., Shchurenko A.I., *Plasma Physics* 136 (2009).
- [4] Sveningsson M., Morjan R.-E. et. al., *Appl. Phys.A* **73**, 409 (2001).