

FIELD EMISSION PROPERTIES OF SHARP TUNGSTEN CATHODES COATED WITH A THIN OXIDE BARRIER CREATED BY ANODIZATION

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This research is aimed towards tests and more in-depth understanding of field emission properties of tungsten single tip field emitters coated with hundreds of nanometers thin barrier of tungsten trioxide. This dielectric barrier between metal-vacuum interface of the emitter can be beneficial for its performance, as increasing lifetime and increasing currents (in comparison to bare tungsten emitters)[1][2]. Tungsten emitters were prepared using a two-step electrochemical drop-off etching technique. Thin oxide barriers were prepared by anodization at 5 V, for 7 min (5 min linear increase from 0.02 to 5 V, then 2 min of 5 V at 0.3 M H₃PO₄ at 1,2 pH). The emitter had been connected as the cathode in triode configuration of FEM. The extraction electrode with a hole diameter of 1 mm was mounted approximately a few millimeters above the tip. The anode was an Al-coated Ce:YAG scintillator. In Fig. 1, the current characteristic dependent on the applied voltage is depicted. At a voltage of approximately 5950 V (with 1000 V applied to the extractor), the slope of the current characteristic changes. From this voltage onwards, it conforms to orthodox behavior, as verified by the Fowler-Nordheim plot and Murphy Good plot (Fig. 1b). It is unexpected, that it meets this for higher voltages on the extractor, as usually the opposite is true for sharp tungsten tips [2]. Unlike a pure tungsten emitter, the one with oxide coating did not tend to burn out with increasing voltage, thus allowing for relatively high voltages to be applied before damage occurred. Consequently, it was also capable of achieving higher currents and could be one of the ways to modify tungsten tips for better cold field emitters.

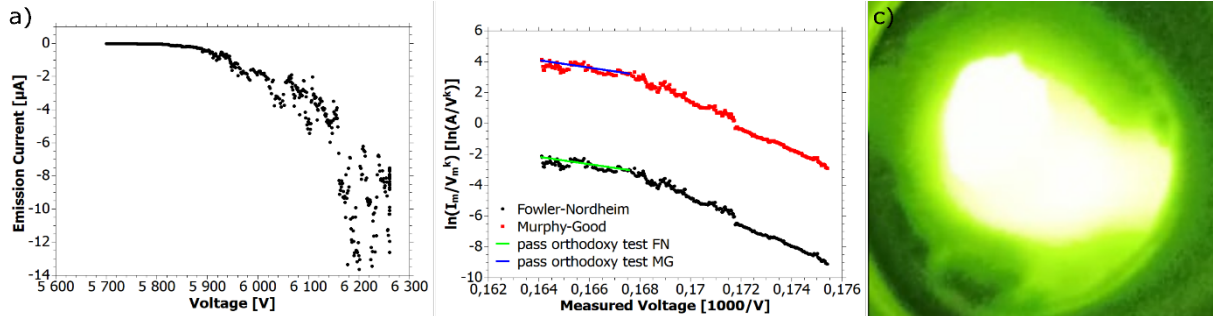


Fig. 1: (a) The example of current-voltage characteristics, (b) the corresponding FN and MG plots and (c) photo of emission of tungsten tip with oxide layer after 6060 V.

Acknowledgment

This article was supported by the Czech Academy of Sciences (RVO:68081731) and The Technology Agency of the Czech Republic FW03010504. We acknowledge CzechNanoLab Research Infrastructure supported by The Ministry of Education, Youth and Sports of the Czech Republic (LM2018110), and the project FEKT-S-23-8162 and CEITEC VUT/FEKT-J-24-8567.

References

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