Field Electron Emission from Carbon Black Nanotips: Characterization and Analysis

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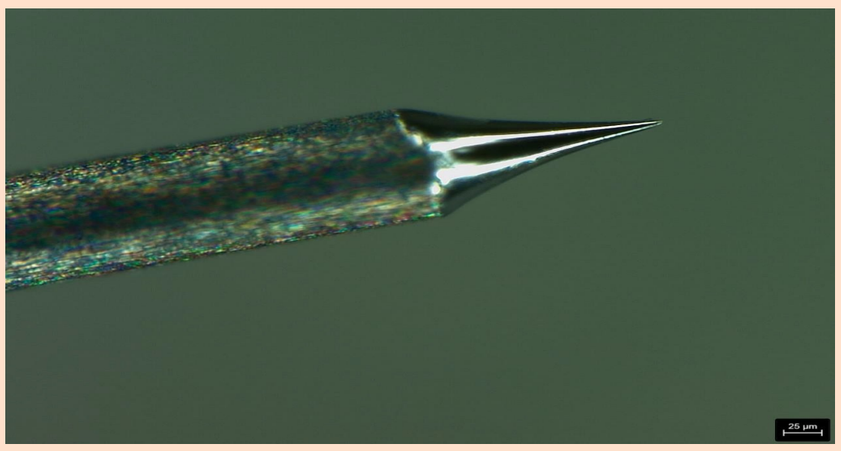
Abstract:

As a cold field electron emitters, Carbon Black (CB) nanoparticles [1] will be investigated in this study under several conditions. To fabricate the emitter, tungsten blunt tips are prepared by electrochemical etching process [2]. Coating the blunt tip with a thin layer of epoxy (URP-4 resin) and Mounting the CB nanoparticles on the tungsten tip surface. The current – voltage characteristics of the samples were studied. Fowler – Nordheim and Murphy – Good plots were used to analyze the results [5, 6]. The relaxation and baking methods for samples were considered in this experiment under pressure of (10^{-7} mbar). Field emission microscope used to study the shape and intensity of emitted current on a fluorescent screen. A more sophisticated processes may enhance the adhesion of particles and exploit the low size and high surface area of them to reach a highest emitted current subjected to the lowest applied voltage.

Methodology:

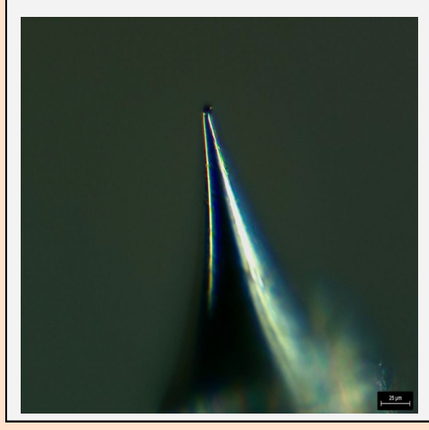
1. Preparation of clean blunt Tungsten tip.

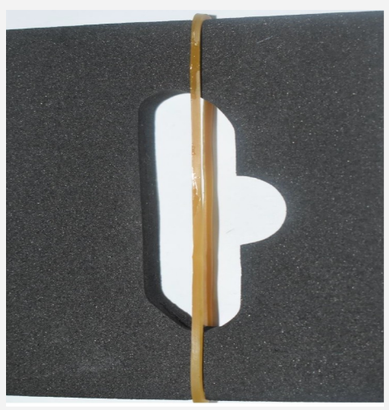
Electrochemical etching process by NaOH solution, the wire is immersed into the solution for ~ 3mm. The etching circuit consists of power supply (8- 10 *V*), 2M of NaOH solution and two electrode; the anode which is the Tungsten wire immersed in the solution and the cathode as a metal ring surrounding the solution.



2. Mounting CB Particles on Tungsten Tip

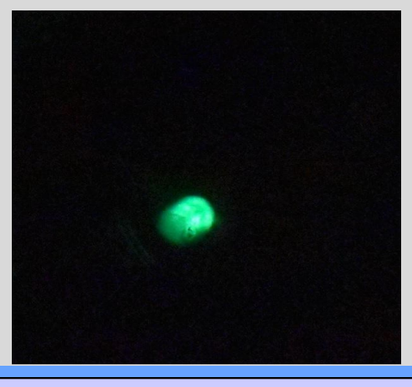
Mounting the CB nanoparticles on the Tungsten tip needs another material to fix the particles on its surface. In this work, a thin layer of epoxy is used. Firstly, the very thin layer of epoxy applied to a rubber ribbon surface and expanded well over the rubber surface before touching it slowly by the blunt

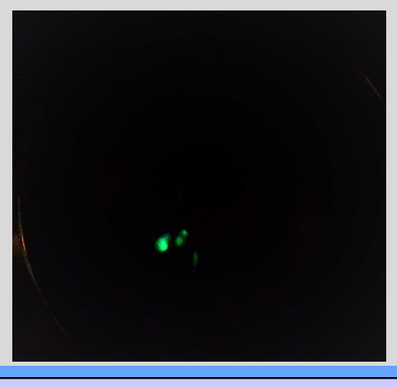




Results:

1. FEM pattern Images before and after relaxation:





Conclusions:

- The relaxation process reduced the switch on voltage.

- More sophisticated processes may enhance the adhesion of particles and exploit the low size and high surface area of them to reach a highest emitted current subjected to the lowest applied voltage.

References:

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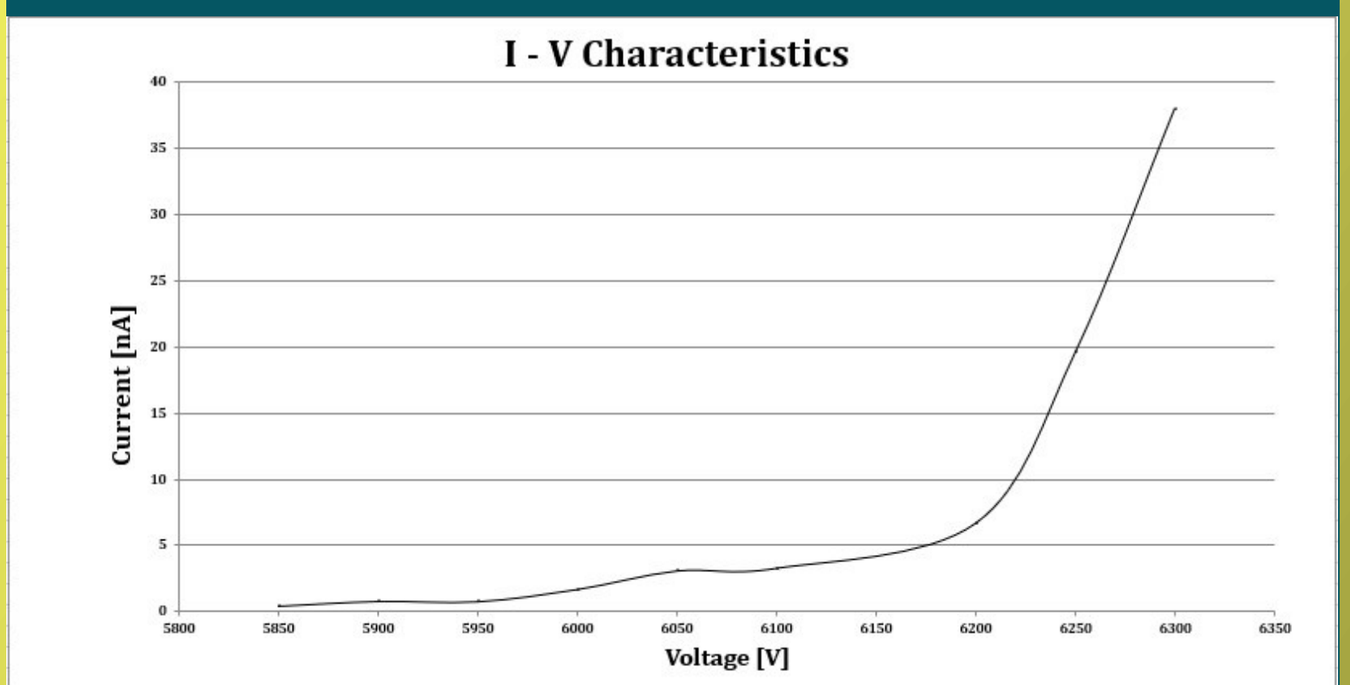
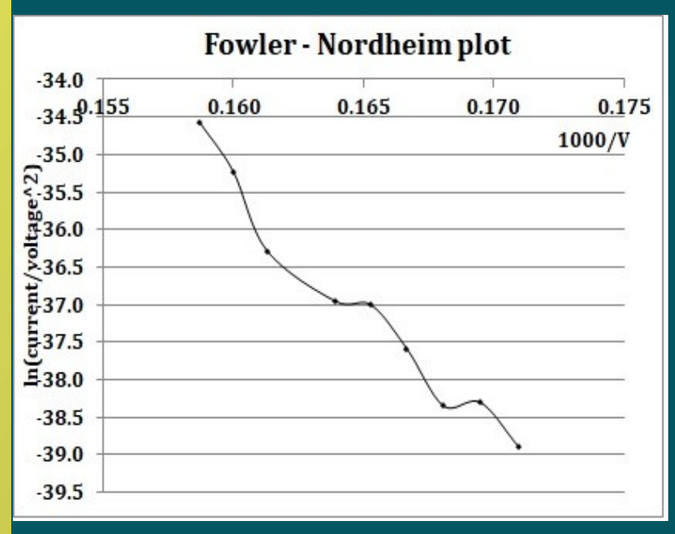
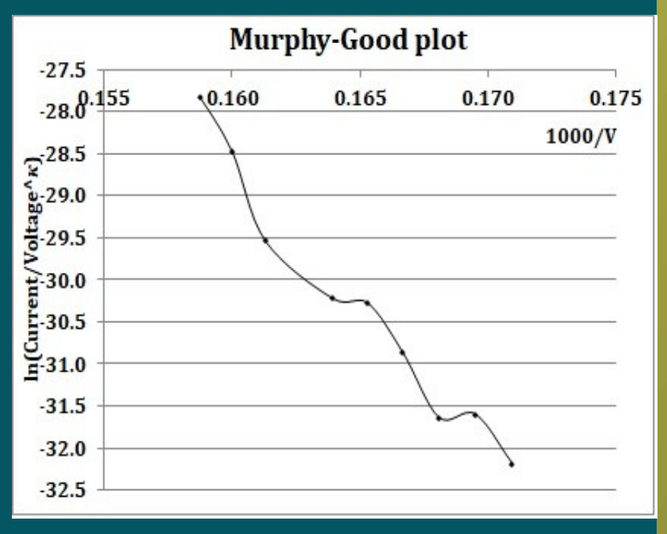
2. I-V, FN and MG plots before relaxation process







3. I-V, FN and MG plots after relaxation process