

Influence of Polystyrene layer on the Field Electron Emission Performance of Nano-Apex Carbon Fiber Emitters

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Abstract:

This research deals with the process of field electron emission from the surface of carbon fibers (CF) before [1-5] and after coating with polystyrene (Ps) insulating layer [6] under high vacuum conditions. Polyacrylonitrile carbon fibers of type VPR-19, thermally treated at 2800°C were used in this work. This investigation includes the current-voltage characteristics, Fowler-Nordheim and Murphy-Good plots [7,8]. Scanning electron micrographs have been obtained in addition to the field electron emission patterns has been recorded. Comparison between the emission process obtained from clean and composite emitters is reported. Significant improvement on the characteristics recorded from the emitters after being coated is observed.

Keywords: field electron emission, Fowler-Nordheim plots, Murphy-Good plots, carbon fiber field emission cathode, polystyrene insulating layer, composite cathodes.

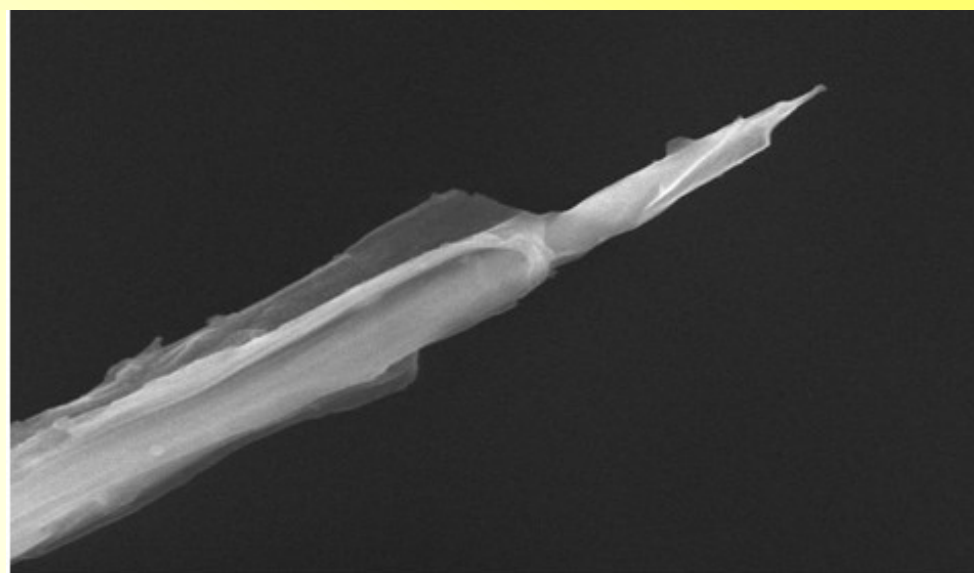
Methodology:

1. Preparation of insulating Polystyrene resins.

The solution was prepared in different concentrations. For the purpose of this study, the solution was prepared using: 4g of Polystyrene dissolved with 50 ml of Toluene.

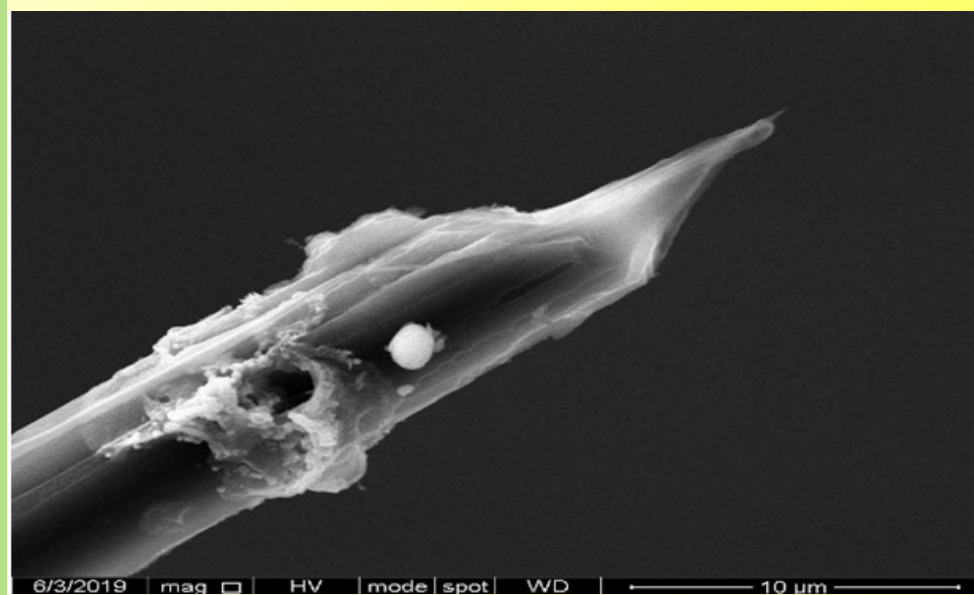
2. Clean W Samples

Base CF Samples are prepared using the Electrochemical Etching Process.



3. Composite W-PS Samples

The coating procedure involves very slowly dipping for the clean CF tip into the PS and then accurately removing it to ensure that only a thin film



Conclusions:

- By comparing the results obtained from the I - V characteristics for the clean and composite samples, it is clear that a composite emitter has a slightly rise in the emission efficiency than a clean one.

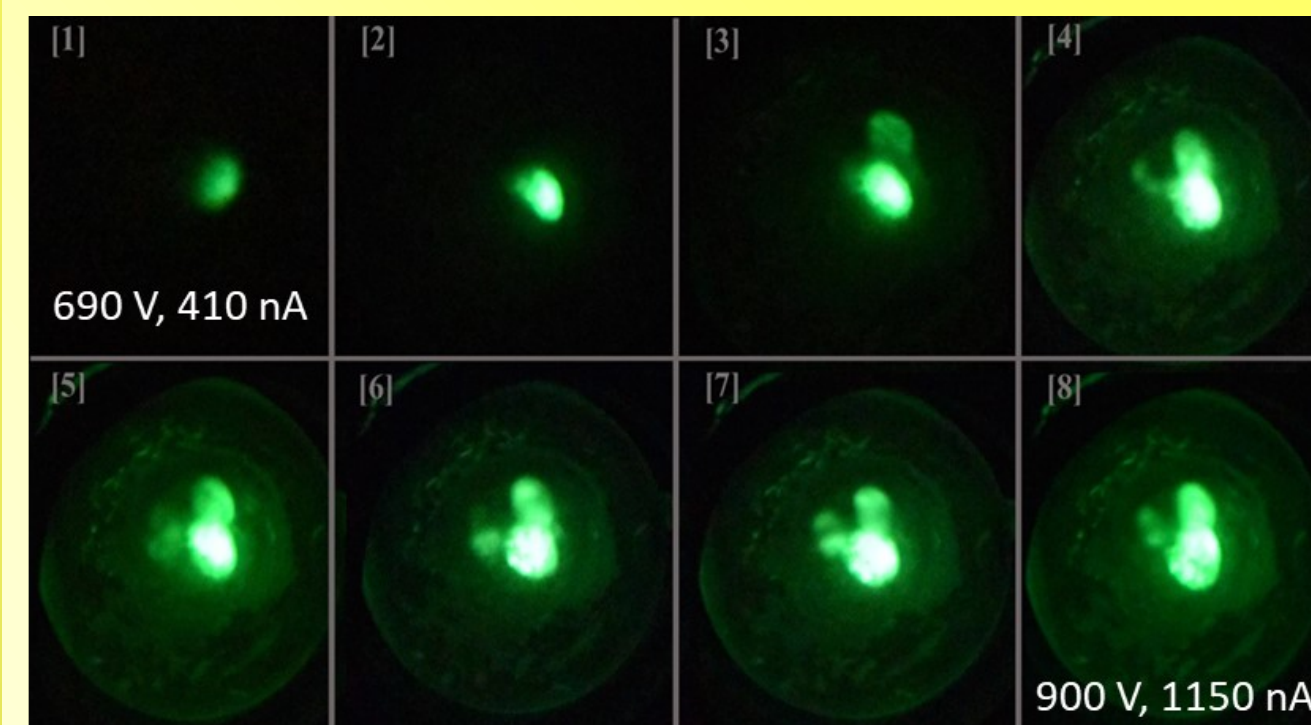
- The I - V characteristics, the FN and MG plots for the clean and composite CF tips along with FEM pattern images shows a slightly improved in the performance of the tip as an electron source. The same results were obtained for the other clean and composite CF tips.

References:

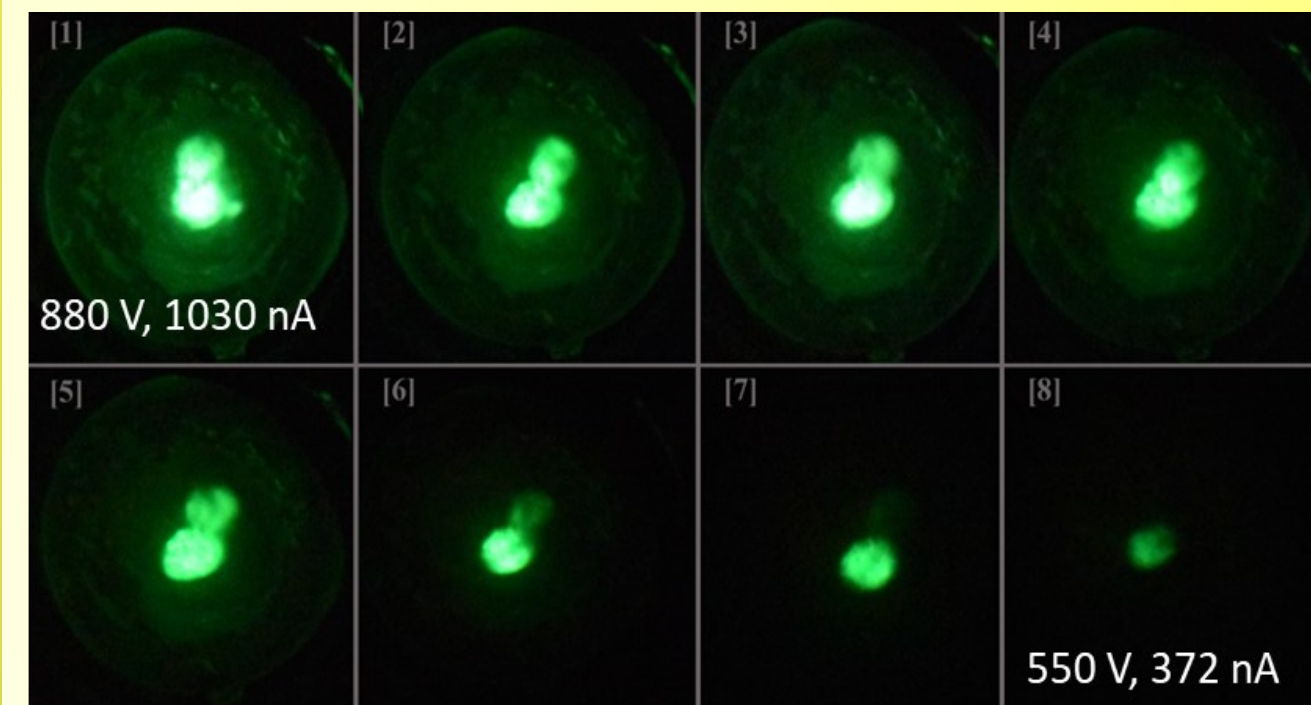
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Experimental Results:

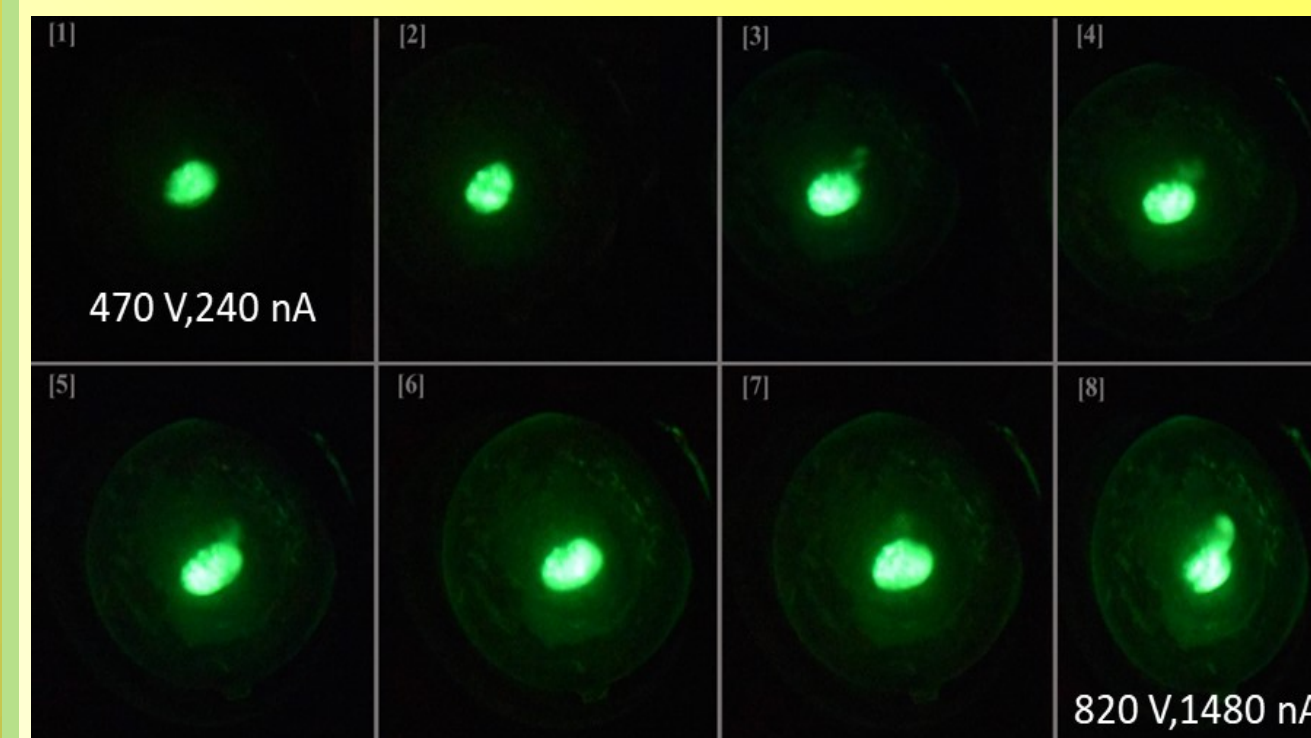
1. FEM pattern Images for Increase period of clean CF:



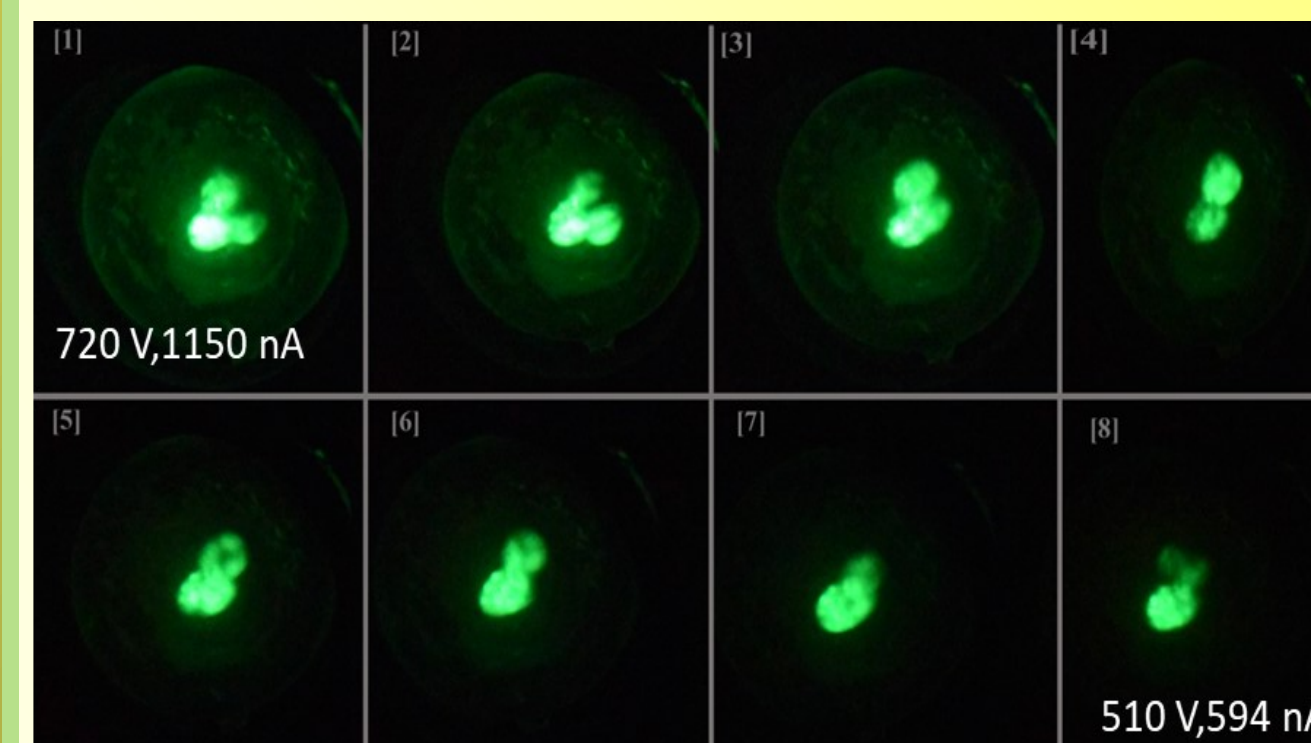
2. FEM pattern Images for Increase Decrease period of clean CF:



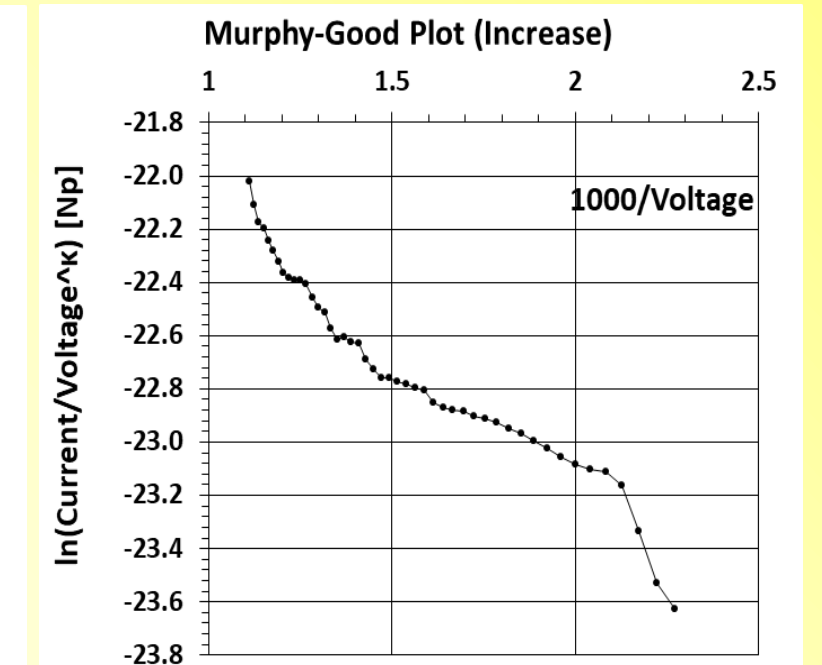
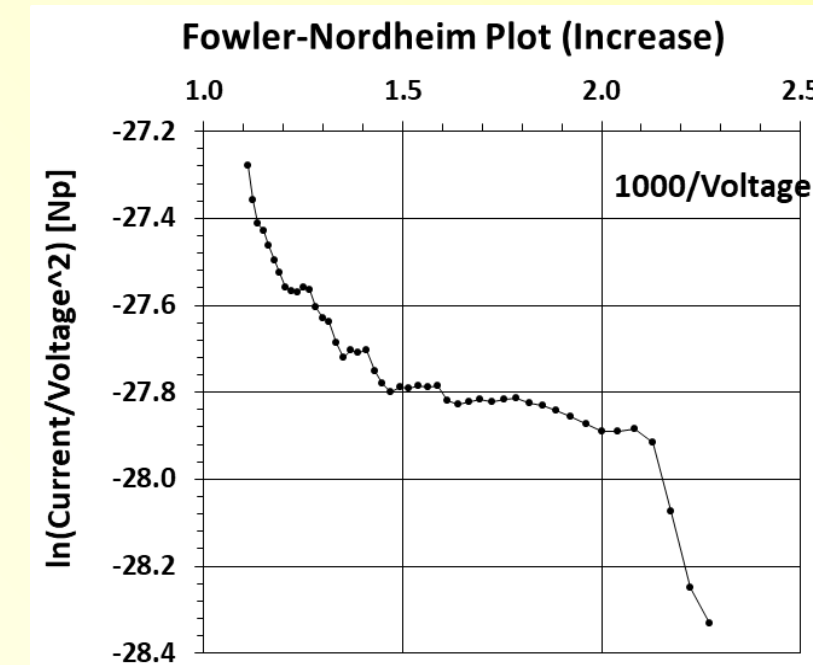
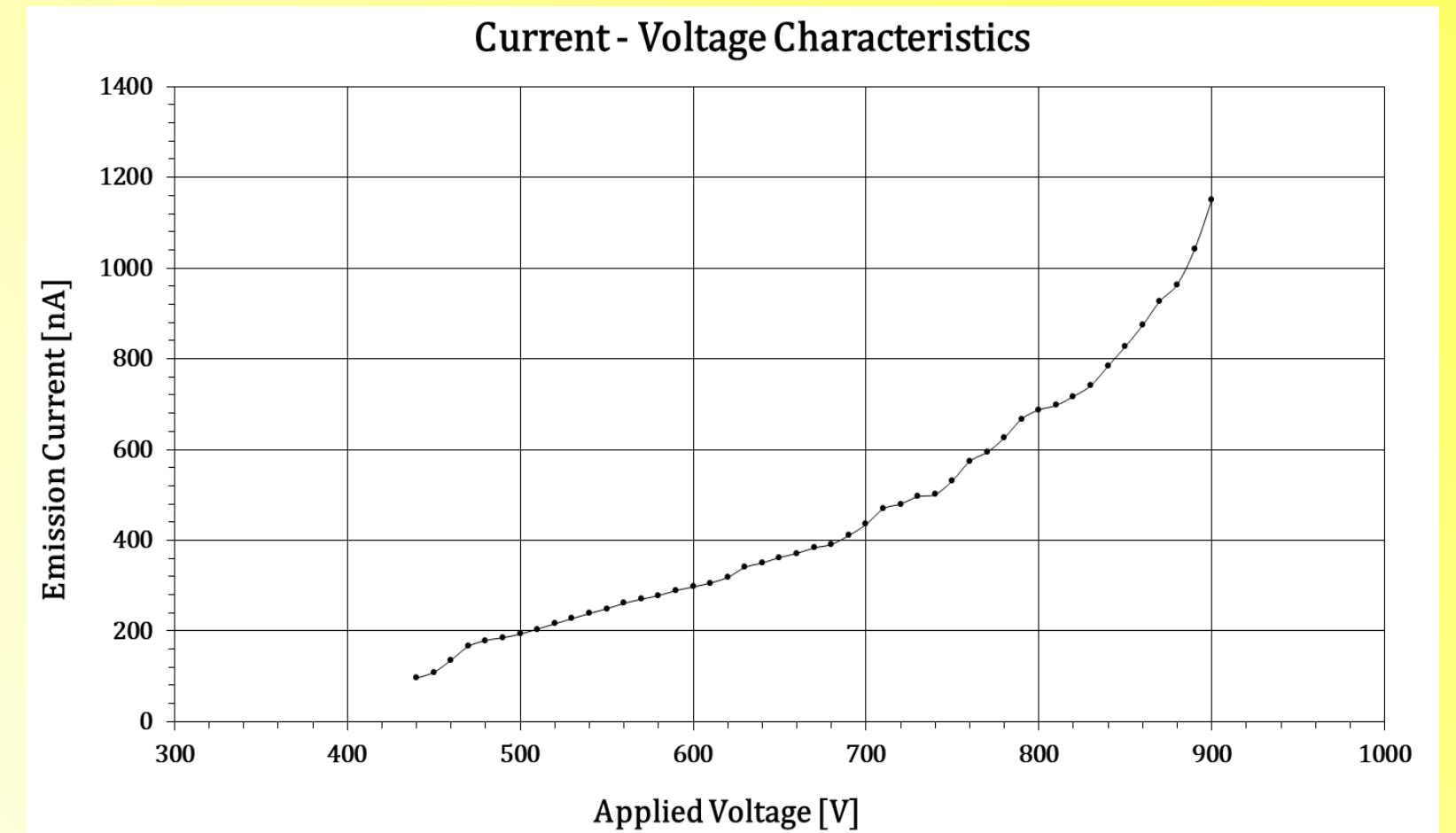
3. FEM pattern Images for Increase period of composite CF-Ps:



4. FEM pattern Images for Decrease period of composite CF-Ps:



5. Current-Voltage Characteristics, FN plot and MG plot for Increase period of clean CF:



6. Current-Voltage Characteristics, FN plot and MG plot for increase period of composite CF-Ps:

