

Carbon Nanotube Field Emission X-ray Generator

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Abstract

Carbon nanotube (CNT) field emission (FE) X-ray generators use CNTs to enhance electron emission. CNTs are deposited on the cathode which improves electron generation. These electrons travel to the anode which then frees the x-rays. Cathode design and optimization ultimately decides the performance of the x-ray generators. This project will include initial fabrication, characterization, and testing/optimization of the devices. Numerous modernized fabrication processes including photolithography, electron beam evaporation, chemical vapor deposition (CVD), and atomic layer deposition will be used. This device uses an uncommon x-ray generator material – CVD grown CNTs. CVD involves using a vapor at some temperature to react and deposit CNTs on the surface of the device as shown in the figure below.

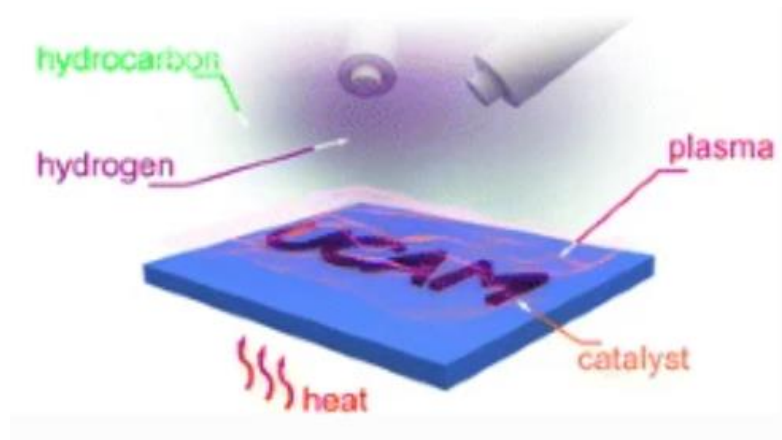


Figure 1 - CVD of CNTs

*(Parmee, R.J., Collins, C.M., Milne, W.I. et al. X-ray generation using carbon nanotubes. Nano Convergence 2, 1 (2015).
<https://doi.org/10.1186/s40580-014-0034-2>)*

CVD is the most optimal growth method of CNTs in terms of resolution. The CNTs will also be manipulated for optimal x-ray generation. This manipulation involves the “twisting” of the CNTs into a tip. It’s currently unclear whether this twisting will be done during the initial growing of the CNTs (during CVD) or after the growing, but this will be solved in the testing stages. Since device performance is dependent on cathode geometry, twisting the CNTs will further improve x-ray generation. This fabrication process with twisting of the CNTs is what makes this a novel x-ray generating device.