

## Carbon Nanotube Fiber Array Field Emission Cathodes

Steven B. Fairchild, Mathew A. Lange,  
*Materials and Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson Air Force Base,  
OH 45433*

Nathan P. Lockwood  
*Directed Energy Directorate, Air Force Research Laboratory, Kirtland Air Force Base, NM 87117*

Daniel Marincel  
*Department of Chemical and Biomolecular Engineering and Department of Chemistry, Rice University,  
Houston, TX 77005*

Field emission (FE) cathodes made from carbon nanotube (CNT) fibers have demonstrated high emission currents, low turn-on voltages, long lifetimes and offer considerable potential for use as electron sources for vacuum electronic devices. CNT fibers were fabricated by wet-spinning of pre-made CNTs<sup>1</sup> and consist of CNT fibrils held together by van der Waals forces. The fibers were 50 $\mu$ m in diameter and their morphology was controlled by fabrication method, processing conditions, as well as purity, size, and type of the CNT starting material. These fibers have demonstrated stable field emission currents exceeding 1 mA for 10 hours<sup>2</sup>. Cathode arrays were made by weaving the CNT fiber into carbon cloth which is then mounted to a graphite block. All fibers were cut to uniform height by holding the fibers between 2 glass slides and cutting with a razor blade across the top. A 5x5 array consisting of 5mm long fibers spaced 5mm apart was fabricated. The array was tested in a diode configuration test stand with DC emission current reaching 17mA for an applied field strength of 0.39V/ $\mu$ m. The cathode array demonstrated stable emission at ~9mA for 1 hour of operation. A 10x10 array consisting of 1mm length fibers spaced 1mm apart has been fabricated and the results will be presented.

1. N. Behabtu et al., "Strong, Light, Multifunctional Fibers of Carbon Nanotubes with Ultrahigh Conductivity", *Science* 2013, 339, 182.
2. S. Fairchild et al., "Morphology dependent field emission of acid-spun carbon nanotube fibers", *Nanotechnology* 2015, 26, 105706

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