Carbon Nanotubes and Semiconductor Nanowires as Electron Field Emitters

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The advantages of the carbon nanotube and semiconductor nanowire as electron field emitter tips include their small radii of curvature, high aspect ratios, high chemical resistance, and strong mechanical strength. Field emission from carbon nanotubes and semiconductor nanowires at low applied electric fields has been demonstrated by several groups. However, the emission behavior reported for nanotubes and nanowires varies widely. Most of this variation is attributed to differences in the nanotube and nanowire content of measured samples. Typical reported samples include nanotube and nanowire film emitters where nanotubes and nanowires were randomly deposited in the form of a thin film, or nanotube or nanowire powder emitters where a trace amount of nanotube or nanowire powder was attached to a tungsten filament with carbon or metal paint. All of these studies not only suggest the promises of carbon nanotubes and nanowires as electron field emitters but also indicate the challenges for making applicable carbon nanotube and nanowire emitters. To further advance this development, we demonstrate a systematic study on carbon nanotube and nanowire emitters, including single-nanotube emitters, multi-nanotube emitters, and nanowire emitters made by the procedures developed in our group. We used a field emission microscope equipped with a Faraday cup to carry out the field emission measurements. The characteristic of the emission current versus applied voltage, and the angular distribution of the emission current were investigated. The challenges and progress for this study are reviewed and the technological promises of these emitters are discussed.