Characterization of Electron Yield Suppression with Carbon Nanotube Forest Grown on Silicon Substrates

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Abstract

Total, secondary and backscatter electron yield, along with emission energy spectra data, were taken of 3 carbon nanotube forests (CNTFs) with beam energies between 15-30,000 eV. Forests morphology, which vary in relative density, and height between 20-40 μm, were controlled by varying growth parameters. Due to their inherent microstructure and low-Z composition, CNTF’s can be used to reduce the electron yield of a base material by acting as a convoluted layer recapturing the substrate’s emitted electrons. Data analysis of a bare annealed substrate, with and without the deposited aluminum, allowed use of a multi-layered yield model to dissect the constituent contributions to the sample’s yield as a whole. Measured energy spectra of emitted electrons help determine the forest’s effectiveness at attenuating the yield, and over what energy range density and height are more influential. It is shown the forest reduces the overall yield of the substrate, substantially in the lower energy regime. At higher energies, the substrate’s yield dominates over the CNTF suppression due to their sparse packing density, and height. Treating the forest simply as a layered modification of a substrate predicts lower yield in the lower energy range, but under predicts suppression at higher energies.