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Quantitative Characterization of Defect Densities in Single-Walled Carbon Nanotubes YUWEI FAN, BRETT GOLDSMITH, PHILIP COLLINS, Department of Physics and Astronomy, University of California Irvine, Irvine, CA 92697-4576 — The prevailing conception of carbon nanotubes and particularly single-walled carbon nanotubes (SWNTs) continues to be one of perfectly crystalline wires. We have demonstrated a selective electrochemical method which labels point defects and makes them easily visible for quantitative analysis. High-quality SWNTs are confirmed to contain one defect per 4 um on average, with a distribution weighted towards areas of SWNT curvature. While this defect density compares favorably to high quality, silicon single crystals, the presence of a single defect can have tremendous electronic effects in one-dimensional conductors like SWNTs. We demonstrate a one-to-one correspondence between chemically-active point defects and sites of local electronic sensitivity in SWNT circuits, confirming the expectation that individual defects may be critical to understanding and controlling variability, noise, and chemical sensitivity in SWNT electronic devices. By varying the SWNT synthesis technique, we further show that the defect spacing can be varied over orders of magnitude. The ability to detect and analyze point defects, especially at very low concentrations, indicates promise of this technique for quantitative process analysis, especially in nanoelectronics development. This work is partly supported by NSF grant DMR-0239842.

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