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Current-Induced Cleaning of Adsorbates from Suspended Semiconducting Carbon Nanotube Diodes ARGYRIOS MALAPANIS, EVERETT COMFORT, JI UNG LEE, College of Nanoscale Science and Engineering, SUNY, Albany, NY — Single-walled carbon nanotubes (SWNT) are prime candidates for future applications, including nanoelectronic and nanophotonic devices. Because of their large surface-to-volume ratio compared to that of a bulk seminconductor, however, SWNTs are very sensitive to their environment. Others have already established that their electronic properties can be dramatically changed by exposure to air, particularly oxygen or water. In this paper,[1] we show that the electronic and optical properties of $p-n$ diodes fabricated with suspended semiconducting SWNTs degrade over time with exposure to ambient conditions, mainly due to adsorption onto the tube's suspended part, which creates band-gap states. We provide the first correlation between adsorbate-generated electronic states and their impact on diode performance. Specifically, we show that the ideality factor, a fundamental parameter used to measure defect states in a $p-n$ diode, increases with the degree of adsorbate coverage. We also demonstrate a simple technique—current annealing—that can thermally reverse such degradation, returning device properties to their original characteristics.

[1]A. Malapanis, E. Comfort, and J. U. Lee, Appl. Phys. Lett., 98, 263108 (2011).

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