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Band Gap Modification in Metallic Nanotubes Due to Nanotube-Substrate Interaction MOH AMER, University of Southern California, ADAM BUSHMAKER, The Aerospace Corporation, STEVE CRONIN, University of Southern California — Previous work shows that a small band gap exists in metallic nanotubes. Here we give a detailed comparison between ultra-clean suspended and on-substrate carbon nanotubes (CNTs) in order to quantify the effect of the substrate on the effective band gap of quasi-metallic nanotubes [1]. Individual CNTs are grown across two sets of electrodes, resulting in one segment of the nanotube that is suspended across a trench and the other segment supported on the substrate. A significant change in the conductance of the suspended segment is observed ($\Delta G/G$ =0.84) with applied gate voltage. This change is attributed to the existence of the small band gap. The on-substrate segment, however, only shows a change in the measured conductance of $\Delta G/G$ =0.11.We used a Landauer model to extract the band gap of these devices. From these fits, the band gaps in the suspended region range from 75 to 100 meV, but are only 5-14.3 meV when the nanotube is in contact with the substrate. The decreased band gap is attributed to localized doping caused by trapped charges in the substrate that result in inhomogeneous broadening of the Fermi energy, which in turn limits our ability to modulate the conductance.

[1] Moh. R. Amer, A.B., and Stephen B. Cronin, The Influence of Substrate in Determining the Band Gap of Metallic Carbon Nanotubes. Nano Letters, 2012. 12: p. DOI:10.1021/nl302321k.

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