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Poole-Frenkel emission by carbon nanotube defect sites DENG PAN, ELLIOT J. FULLER, BRAD L. CORSO, OSMAN GUL, PHILIP G. COLLINS, University of California Irvine — Single walled carbon nanotubes (SWCNTs) have a conductance that is particularly sensitive to the presence of defects and disorder. Here, we combine three-terminal transport measurements with Kelvin Probe Force Microscopy (KPFM) to investigate the electronic transmission of individual SWCNT defects. A unique strength of the work is the ability to fully characterize each SWCNT before and after the chemical addition of a particular defect. In transport, the additional resistance caused by a defect is studied as a function of bias, backgate and temperature. KPFM, on the other hand, directly images the spatial, bias-dependent voltage drop in the vicinity of the defect. The two types of measurement agree remarkably well and are consistent with a Poole-Frenkel emission model, in which a shallow trap state has a gate-dependent depth and width. The effective width of a defect trap is determined to be remarkably large and gate dependent, ranging from 400 to 1400 nm. The value might seem unphysical, if not for the fact that KPFM spatially resolves this potential drop and its gradient. Evidently, the SWCNT's very small carrier density and screening lengths lead to anomalously wide effective barriers, helping to explain the extreme sensitivity of SWCNTs to point defects.

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