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Chemically-Driven Two Level Fluctuations in Single-Walled Carbon Nanotubes (SWCNTs) with Defects DANNY WAN, STEVEN R. HUNT, BRAD L. CORSO, ISSA S. MOODY, GREGORY A. WEISS, PHILIP G. COLLINS, Departments of Physics and Astronomy, Chemistry, Molecular Biology and Biochemistry, University of California, Irvine, CA 92697 — When a SWCNT conductor contains a defect, its electronic fluctuations are sensitive indicators of the surrounding chemical environment and of the chemical state of the defect itself. We demonstrate this effect by fabricating single SWCNT devices and then engineering their defect condition through the method of electrochemical point-functionalization. By characterizing the same SWCNT before and after the introduction of a point defect, we clearly establish the defect's contribution to the overall device noise. Carboxylate defects are particularly interesting because they have a deprotonated state that is sensitive to pH, electrolyte, and electrochemical potential. Large amplitude, two level fluctuations are observed from carboxylate sites when probed under conditions near the dissociation constant pKa, and the occupation statistics can be reversibly tuned by either pH or potential. We interpret the fluctuation in terms of the controlled protonation and deprotonation of the defect site, and describe a simple electrostatic gating model that supports this conclusion.

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