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Sensitizing Carbon Nanotube Transistors for Single Molecule Sensor Applications[1] PHILIP G. COLLINS, MAXIM AKHTEROV, PATRICK C. SIMS, ELLIOT J. FULLER, O. TOLGA GUL, DENG PAN, Department of Physics and Astronomy, University of California Irvine, Irvine, California 92697, USA — Recent work has demonstrated single-charge sensitivity in two types of carbon nanotube transistors. In one case, a two-level system near the nanotube or noncovalently attached to the nanotube perturbs the current electrostatically. In a second case, a sidewall defect or other covalent modification sensitizes one site along the conductor. Comparative research has helped reveal differences in the transduction mechanisms of the two cases and provides design rules for maximizing reliable signals for sensing applications. The covalent modifications are not mere perturbations and they are far more sensitive than noncovalent attachments, for example. However, the new degrees of freedom that accompany covalent disorder often have similar energy scales, leading to multiple independent fluctuations that degrade the overall signal-to-noise. Noncovalent sensitization generally produces a smaller signal amplitude in a background of other low-energy fluctuators, but a well-designed noncovalent linker can result in a highly predictable signal amplitudes. Furthermore, noncovalent fabrication methods are scalable, so that wafer-scale arrays of molecular sensors are most likely to follow this path.

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