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Scaffolding Carbon Nanotubes into Single-Molecule Circuitry

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As electronic devices shrink to the nanometer scale, the relative importance of individual chemical bonds becomes larger and larger. Single-walled carbon nanotubes (SWNTs) represent an extreme limit of this rule, as the modification of a single lattice site can dramatically change chemical activity and electronic properties. This presentation will focus on single-site experimentation in which we find, create, and alter point defects in SWNTs. Due to the correspondence between chemical and electronic properties, changes in SWNT device conductance reveal these chemical processes happening in real-time and allow the SWNT sidewall to be deterministically broken, reformed, and conjugated to target species. We routinely functionalize pristine, defect-free SWNTs at one, two, or more sites, and have demonstrated three-terminal devices in which a single-molecule attachment controls the electronic response.