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Measurement of resistance induced by a single potassium atom on chiral-angle known nanotubes: understanding the impact of a model scatterer for nanoscale sensors MASA ISHIGAMI, RYUICHI TSUCHIKAWA, DANIEL HELIGMAN, BRANDON BLUE, University of Central Florida, ZHENGHI ZHANG, Columbia University, AMIN AHMADI, EDUARDO MUCCIOLO, University of Central Florida, JAMES HONE, Columbia University — Rational design for nanotube-based sensors requires precise understanding of how impurities impact transport properties of nanotubes. Such impurity-induced carrier scattering is expected to be dependent on the chirality of nanotubes and the nature of scattering potentials imposed by impurities. Yet until our recent measurements, it has been impossible to measure the impact of impurities on resistance of carbon nanotubes with known chirality. We have developed arrays of experimental techniques to control experiments down to atomic scale to measure the scattering strength of charged impurities on semiconducting single-walled carbon nanotubes with known chirality. The resistivity of nanotubes is measured as a function of the density of adsorbed potassium atoms, enabling the determination of the resistance added by an individual potassium atom. Holes are scattered 37 times more efficiently than electrons by an adsorbed potassium atom. The determined scattering strength is used to reveal the spatial extent and depth of the scattering potential for potassium, a model Coulomb adsorbate, paving way for rational design of nanotube-based sensors. This work was supported by the National Science Foundation under the Grants No. 1006230 and 1006533.

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