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Controlled Screening of Excitons in Single, Suspended Carbon Nanotubes. ANDREW WALSH, Physics Dept., BU, A. NICKOLAS VAMIVAKAS, ECE Dept., BU, YAN YIN, Physics Dept., BU, STEPHEN CRONIN, EE Dept., USC, BENNETT GOLDBERG, Physics Dept., BU, M. SELIM UNLU, ANNA SWAN, ECE Dept., BU — Recent measurements in carbon nanotubes (CNTs) have demonstrated that the optical transition energies are excitonic (e-h) in nature, with binding energies that are large fractions of an eV. The exciton energies in CNTs should be sensitive to screening by the environment, yet only small variations of the optical transition energies have been reported for widely varying dielectric environments. Here, we use resonant Raman spectroscopy to follow the change in the optical transition energy of single carbon nanotubes suspended across trenches in dry nitrogen, in high humidity, and after immersion in water. The transition energies are shown to red shift monotonically with increased screening, up to 33 meV. We develop a scaling relationship between the exciton binding energy and the external ε to quantify the effect of screening on the e-e and e-h interaction energies. These energies are shown to change by hundreds of meV with screening but almost cancel, leading to the small observed shifts reported both here and in the literature. For the nanotubes measured here, the e-e energy is found to be about 25% greater than the exciton binding energy in an unscreened environment.

Andrew Walsh
Physics Dept., BU

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