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Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes GORDANA DUKOVIC, FENG WANG, DAOHUA SONG, MATTHEW SFEIR, TONY HEINZ, LOUIS BRUS, Columbia University — The optical transitions in semiconducting carbon nanotubes have recently been ascribed to excitons. We have used two-photon excitation spectroscopy to measure the energies of exciton states of different symmetries by taking advantage of the different selection rules for two-photon absorption and one-photon fluorescence in this quasi-one-dimensional molecule. The measured exciton binding energies are on the order of hundreds of meV. Here we report the investigation of structural dependence of the exciton energies for different nanotube species, ranging in diameter from 0.76 to 1.2 nm. The exciton binding energies vary inversely with nanotube diameter, ranging from 420 to 270 meV in this sample. This result is in agreement with theoretical predictions. In addition, we have found that the measured band-gap energies are significantly blue-shifted from those predicted by tight-binding calculations, which may have implications for the transport properties of semiconducting carbon nanotubes.

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