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Determination of the exciton binding energy in single-walled carbon nanotubes TODD KRAUSS, ZHENJIA WANG, HERMENEGILDO PEDROSA, LEWIS ROTHBERG, University of Rochester — The optical properties of single-walled carbon nanotubes (SWNTs) are intrinsically important for potential applications in photonics and also provide insight into their structural and electrical properties. Absorption and emission of semiconducting SWNTs are dominated by excitonic effects, but a determination of central features such as exciton binding energies remains elusive. We will present measurements of the exciton binding energy in SWNTs using resonance Raman scattering of isolated SWNTs under an electrochemical bias. The Raman intensity under an applied voltage is sensitive to state filling and enables a determination of the (electronic) gap between the second Van Hove singularities in densities of states for electrons and holes in specific semiconducting SWNTs. On the other hand, Raman scattering preferentially selects sets of SWNTs whose excitonic transitions (optical gap) are resonant with the incident and scattered photon energies. Simultaneous measurement of the electronic gap and exciton resonance allows us to infer binding energies for the exciton of 0.49 and 0.62 eV for tubes with structural (n,m) indices (10, 3) and (7, 5), respectively. Analogous Raman and electrochemical studies in metallic SWNTs imply the absence of a sharp excitonic feature.

Todd Krauss
University of Rochester

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