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The temperature dependence of excitonic decay in single-wall carbon nanotubes[1] T. MCDONALD, W. METZGER, C. ENGTRAKUL, J. BLACKBURN, National Renewable Energy Lab, G. SCHOLES, Centre for Quantum Information and Quantum Control, and Institute for Optical Sciences University of Toronto, G. RUMBLES, M. HEBEN, National Renewable Energy Lab — Recent theoretical calculations indicate that the existence of a multiplet of excitonic states may affect recombination kinetics in single-walled carbon nanotubes. The possibility of a multiplet of coupled excitonic bands has strong implications for the temperature dependence of the effective radiative lifetime. We have performed steady-state photoluminescence, time-correlated single photon counting, and Raman spectroscopy measurements on single-wall carbon nanotubes from 4 to 293 K. We observe novel photoluminescence spectra that cannot be attributed to vibronic transitions and verify the existence and energy levels of weakly emissive excitonic states. We determine how nonradiative and radiative excitonic decay rates change as a function of temperature and contrast this with theoretical predictions. The results suggest that recombination kinetics are influenced by multiple excitonic bands, including a dark lower state. The long lifetimes of the low-energy peaks measured here suggests that other bands may have different excitonic decay and transport properties that may be potentially useful in photoconversion devices.

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