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Exciton radiative lifetime in carbon nanotubes VASILI PEREBEINOS, JERRY TERSOFF, PHAEDON AVOURIS, IBM - Watson Research Center — The optical properties of carbon nanotubes are dominated by excitons, and the exciton radiative lifetime determines the optical efficiency. We calculate the exciton radiative lifetime as a function of tube diameter and chirality, finding an unusual nonmonotonic temperature dependence [1]. This reflects the crucial role of exciton bands that are optically inactive, due to spin or parity, below the optically active exciton. We determine the scaling with diameter of the singlet-triplet and parity forbidden exciton splittings. We also calculate the exciton dispersion, finding a non-parabolic behavior of the optically active band. Excitons that thermalize into low-energy optically inactive bands cannot contribute to light emission, unless they are thermally excited into the active band, resulting in reduced emission yield at low temperature. However, in real systems there is typically some symmetry breaking, which mixes optically allowed and forbidden bands; and as a result, some emission is still possible from the nominally forbidden bands. This may account for the multiple emission peaks and complex temperature dependence seen in some experiments. [1] NanoLett. 5 DOI: nl051828s (2005).

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