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Carbon nanotube excited states: the role of the environment

PHAEDON AVOURIS, IBM T.J. Watson Research Center

The nature of the excited states and the radiative and non-radiative decay of isolated CNTs will be briefly reviewed. I will then focus on the role of the environment, external fields and photon confinement on these properties. I will discuss the use of photovoltage microscopy as a means of imaging environment-induced potential fluctuations in CNTs, presence and size of Schottky barriers at contacts and the extent of band-bending. Scanning resonant micro-Raman scattering will be used to evaluate the CNT excited state shifts induced by the substrate, and, also the phonon frequency and linewidth changes due to the fields of trapped substrate charges, and charge-transfer effects. Variations in local charge density will be determined by making use of the dependence of electron-phonon coupling on the local charge density. The non-radiative decay of free and localized excitons will then be examined and it will be shown that a phonon-assisted electronic decay mechanism made possible by interaction with the environment can dominate the lifetime of excited CNTs. Finally, results on the modification of the radiative properties of CNTs by changing the photon field mode density for CNTs enclosed in micro-cavities will be presented.