EXCITONS IN SINGLE-WALLED CARBON NANOTUBES: ENVIRONMENTAL EFFECT

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S u m m a r y

The properties of excitons in semiconducting single-walled carbon nanotubes (SWCNTs) isolated in vacuum or a medium and their contributions to the optical spectra of nanotubes are studied within the elementary potential model, in which an exciton is represented as a bound state of two oppositely charged quasiparticles confined to the nanotube surface. The emphasis is given on the influence of the dielectric environment surrounding a nanotube on the exciton spectra. For nanotubes in the environment with a permittivity less than $\sim$ 1.8, the ground-state exciton binding energies exceed the respective energy gaps, whereas the obtained binding energies of excitons in nanotubes in a medium with permittivity greater than $\sim$ 4 are in good accordance with the corresponding experimental data and consistent with the known scaling relation for the environmental effect. The stabilization of a single-electron spectrum in SWCNTs in media with rather low permittivities is discussed.