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Bright and dark exciton energy and excitonic effect of single wall carbon nanotubes

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We calculate optically-active (bright) and optically-inactive (dark) exciton energy of single wall carbon nanotubes (SWNTs). The bright and dark exciton energy of SWNTs is calculated by solving the Bethe-Salpeter equation in which the one particle energies are given by the extended tight-binding scheme [1]. In previous paper we used the static dielectric constant k=2.22 in order to reproduce the resonance Raman experiment for bundle samples [2]. However, since the exciton energy depends on the surrounding materials of a SWNT [3], we need to consider a correction to this environmental effect for other samples. In this paper we discuss the environmental effect of SWNTs. We express the environmental effect by the dielectric constant as a function of a diameter of a SWNT to reproduce and evaluate the experimental results. We also compare our calculation with the resonance Raman experiments in the different environment. From our calculation we show the exciton energy Kataura plot for each sample.

References

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