Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Stark effect, polarizability and electroabsorption in silicon nanocrystals[1] CEYHUN BULUTAY, Bilkent University, MUSTAFA KULAKCI, RASIT TURAN, Middle East Technical University — The experimental quantum-confined Stark effect data in embedded Si nanocrystals (NCs) is unambiguously explained with an atomistic pseudopotential theory. The majority of the Stark shift comes from the valence states which undergo a level crossing with respect to the applied field. The nonmonotonic behavior of the experimental data as well as the peak intensity appearing around 0.5 MV/cm and the subsequent fall off are well reproduced by the theory. However, for small Stark fields, the 300 K emission comes out to be stronger in the theoretical estimation due to thermally-activated nonradiative processes not accounted in the theory that possibly degrade the emission rate at higher temperatures. The polarizability of embedded Si NCs is obtained over a diameter range of 2.5–6.5 nm which unveils the importance of Coulombic effects for larger NCs. The intraband electroabsorption analysis asserts that p-doped Si NCs will benefit from a wider voltage tunability. Finally, the spin-orbit interaction is considered as a function of NC size which begins to have an impact on the results for large Stark fields.

[1]Supported by TUBITAK with the Project No. 106T048 and 106M549.

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Date submitted: 05 Nov 2009

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