Phys. Rev. B 63, 115423 (2001) [*5 pages*]

[Issue 11 – 15 March 2001]

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Self-trapped exciton recombination in silicon nanocrystals

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Received 30 June 2000; revised 6 November 2000; published 2 March 2001

In this paper we investigate the time-resolved and stationary photoluminescence (PL) of silicon nanocrystals fabricated in a silicon oxide matrix. The PL intensity reveals a nonexponential decay for all temperatures which can be fitted by a “stretch”-exponential function. From 60 down to 5 K an increase of decay time is observed going along with a decrease of the PL intensity. In addition the PL spectra show a shape change during the decay. The experimental data are interpreted in the model of self-trapped excitons (STE) which are localized in a Si-Si dimer. A numerical simulation of this model provides the radiative and nonradiative recombination times of the STE transition, the energy of the STE singlet-triplet splitting and the height of the self-trapped barrier.

URL: http://link.aps.org/abstract/PRB/v63/e115423
DOI: 10.1103/PhysRevB.63.115423
PACS: 61.46.+w, 78.20.-e, 78.47.+p, 71.35.Aa