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ABSTRACTS

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Problems Related to Photoluminescence of Si Nanocrystals

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It is a widely accepted opinion that the intense photoluminescence (PL) of Si nanocrystals (Si-nc) is caused by radiative recombination. Our analyses of available theoretical and experimental data show that Si-nc has an indirect band structure and, therefore, it is doubtful that radiative recombination is the main mechanism of intense PL [1]. Due to quantum confinement effect the band gap of Si-nc widens and the second conduction sub-band moves away from the first one. We propose a model, according to which a fraction of electrons reaches the second conduction sub-band by e-e-h Auger recombination process (occurs at collisions of two electrons and one hole), the main part of the intense radiation being caused by direct electron transitions from the second conduction sub-band to the first one [1].

There are several problems, for which the radiative recombination model cannot give conclusive evidence. Main of them are:

- The emitted photon has a much smaller energy than the absorbed one (difference is some tenths of eV).
- PL has a wide spectral band (the full width at the half maximum reaches 0.7eV).
- PL decay curve is not exponential, but can be approximated by a stretched exponential function.
- PL rise time decreases as the excitation intensity increases.
- Only some percents of Si-nc are luminescent.
- The luminescent Si-nc has very high radiative quantum efficiency (60-90%).

In this presentation we show contradictions in the existing in literature explanations of these problems on the basis of the radiative recombination model. We also give evidences that the listed problems can be explained by our model.

[1] T.Puritis, J.Kaupuzs, Physica E **35**, 16-22, (2006)

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