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Concentration self-quenching of luminescence in crystal matrices activated by Nd³⁺ ions: theory and experiment

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Abstract

Resonance migration and cross-relaxation processes leading to concentration self-quenching of fluorescence have been studied theoretically and experimentally with Nd³⁺: LaF₃ bulk crystal as an example. The time range of theoretical description of self-quenching kinetics has been expanded by including into consideration the long-range fluctuation stage that determines the slow luminescence quenching of donor centers isolated due to fluctuations of donor surroundings. New experimental data on fluorescence kinetics concentration dependence in a Nd³⁺: LaF₃ bulk crystal are consistently described with single set of energy migration C_{DD} and cross-relaxation C_{DA} microparameters. The obtained results is the first step to solve the problem of quenching in RE doped nanocrystals where, along with self-quenching, the quenching by additional acceptors namely, various molecular groups, residing in the volume of the nanoparticles have to be accounted.

Keywords: self-quenching; energy transfer; fluctuation stage; Nd³⁺: LaF₃ crystal; nanocrystals

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