

LaF₃ doped with Ce/Gd/Eu: energy transfer and excitation dependence of photoluminescence rise-and-decay kinetics

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Streszczenie

In this paper, we analyze time-domain luminescence measurements using multiexponential rise-and-decay functions. The relationships between these functions and the physics behind the analyzed photoemission kinetics are shown using several basic arbitrary photoluminescence systems. The advantages and disadvantages of the different types of functions mentioned are discussed. The paper is focused on peculiarities of the fitting process, such as the role of initial guess, under- and overfitting problems, and estimating fit quality (using patterns in the fit residual). Systems of differential equations are used to analyze selected cases by adjusting certain parameters. Hydrothermally treated LaF₃:Ln³⁺ nanoparticles (where Ln³⁺ = Gd³⁺; Gd³⁺,Ce³⁺; Eu³⁺; Ce³⁺,Eu³⁺; Gd³⁺,Eu³⁺; or Ce³⁺,Gd³⁺,Eu³⁺) were used as a test case in which the role of interionic charge transfer was investigated by direct experimental measurements only, without the underlying theory. The methodological tips contained in this paper, although applied to the lanthanide (III) luminescence, should be interesting and useful for a much broader audience, for everyone working with smooth rise-and-decay curves.

Słowa kluczowe

multiexponential decay, energy transfer, photoluminescence rise, rise-and-decay kinetics, decay fitting lanthanides, luminescence, curve fitting, exponential decay

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