

Modeling of the quadratic non-Condon effect in the 4f 135d-4f 14 luminescence spectrum of a LiYF₄:Lu³⁺ crystal

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Abstract

Based on a microscopic model of the electron-phonon interaction, we have calculated the shape of the 4f 135d-4f 14 electronic-vibrational luminescence spectrum of a LiYF₄:Lu³⁺ crystal at zero temperature taking into account the quadratic non-Condon effect. We have found that the magnitude of the quadratic non-Condon effect of this spectrum is several times greater than the magnitude of the linear non-Condon effect. We have formulated conditions under which the zero-phonon line can be observed in absorption and luminescence spectra of this transition, which is forbidden at zero temperature. It has been proven that, if the point symmetry group of the environment of an impurity center does not have mathematically irreducible representations with a dimension higher than unity, no zero-phonon line will be observed in these spectra. We have given an explanation for the absence of the zero-phonon line in 4f 14-4f 135d absorption and luminescence spectra of the LiYF₄:Lu³⁺ crystal at low temperatures. © 2014 Pleiades Publishing, Ltd.

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