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Luminescence characterization and the energy level scheme for lanthanide doped CaYAl_3O_7

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Abstract

Spectroscopic studies of CaYAl_3O_7 doped with Ce^{3+} , Tb^{3+} , Eu^{3+} and Sm^{3+} were performed from visible to vacuum ultraviolet (VUV) at room temperature and showed the characteristic emission of the dopants. From the excitation curves, $4f-5d$ transitions were identified for Ce^{3+} and Tb^{3+} and charge transfer processes were observed for Eu^{3+} and Sm^{3+} . The experimental data were used to predict the energy levels of all divalent (Ln^{2+}) and trivalent lanthanides (Ln^{3+}) and to construct the host referred binding energy (HRBE) and vacuum referred binding energy (VRBE) schemes. The predicted values are in good agreement with experimental results which provide a better understanding of the CaYAl_3O_7 luminescent processes.

Keywords: CaYAl_3O_7 , Lanthanide, Electronic structure, Energy level scheme

1. Introduction

Lanthanide(Ln)-doped CaYAl_3O_7 are interesting materials due to their luminescence properties including mechanoluminescence (Ce^{3+} and Eu^{2+} doped) [1, 2], persistent luminescence (Ce^{3+} doped) [3] and up-conversion fluorescence (Yb^{3+} doped) [4]. These properties make this compound a potential candidate for several photonic applications as solid-state light source for white LED's [5], structural damage sensors [1, 2], volumetric displays and

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