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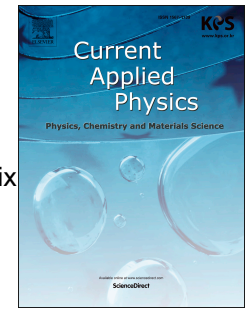

Site spectroscopy probing of Eu^{3+} incorporated into novel $LiY_xSr_yZrO_{3+\alpha}$ host matrix

I. Ahemen, F.B. Dejene

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Site spectroscopy probing of Eu^{3+} incorporated into novel $LiY_xSr_yZrO_{3+\alpha}$ host matrix

Ahemen I.[*1,2], Dejene F. B.[1]

[1]Department of Physics, University of the Free State, Qwa Qwa, South Africa

[2]Department of Physics, University of Agriculture Makurdi, Nigeria

*Email: Ahemen.iorkyaa@gmail.com

Abstract

In this work, we investigated the spectroscopic properties of $LiY_xSr_yZrO_{3+\alpha}$: Eu^{3+}, a red emitting nanophosphor based on $SrZrO_3$ perovskite. The synthesis process was an auto-combustion process. X-ray diffractograms show the orthorhombic structure of $SrZrO_3$. Photoluminescence (PL) excitation spectra display a split charge transfer band revealing the presence of two possible sites for the Eu^{3+} ions. The emission spectra at 231 nm excitation illustrate the dominance of the $^5D_0$ - $^7F_1$ transition, which is an indication that the smaller sized Eu^{3+} ions are mostly situated at the more ordered (symmetric) Sr^{2+} sites. The emission spectra at 292 nm & 397 nm excitations show the dominance of $^5D_0$ - $^7F_2$ transition which suggests some of the Eu^{3+} ions are also situated at the distorted Zr^{4+} sites. Both the intensity parameters, asymmetry ratio and the decay lifetimes of the nanophosphors show dependence on Y^{3+} concentration, signifying a modification in the host structure. Maximum quantum efficiency value of ≈ 46% was obtained for the nanophosphors which indicate the need for improvement for practical applications. CIE coordinates show the suitability of this phosphor for both red emission in LED and as a complementary colour for white LED applications.

Key words: spectroscopy, perovskite, photoluminescence, quantum efficiency, nanophosphors

Introduction

Compounds with perovskite structure are of great interest to researchers primarily because of their important physical characteristics, chemical stability, and superior mechanical properties [1,2]. A lot of attention is now focused on studying the photoluminescence (PL) properties of perovskites with disordered structure [3]. The principal reason is the distinct potential of these materials for electro-optic applications. The optical properties of disordered semiconductors are characterized by the presence of a broad PL band. This phenomenon is attributed to the electronic states inside the band gap, which are the main defects for an intense PL response. According to Longo et al.[4], the displacement of Zr or Sr atoms in disordered perovskite, $SrZrO_3$ may induce some vacancy defects at the axial and planar oxygen sites of the [ZrO_6] octahedral. It is well known that the