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Photoluminescence and Judd–Ofelt analysis of Eu^{3+} doped $LaAlO_3$ nanophosphors for WLEDs

T. Manohar [a], Ramachandra Naik [b, c], S.C. Prashantha [b, d, *], H. Nagabhushana [e, **], S.C. Sharma [f], H.P. Nagaswarupa [d], K.S. Anantharaju [d], C. Pratapkumar [d], H.B. Premkumar [g]

[a] Department of Physics, Jnanavikas Institute of Technology, Bidadi, Bangalore 562109, India
[b] Research and Development Center, Bharathiar University, Coimbatore 641046, India
[c] Department of Physics, New Horizon College of Engineering, Bangalore 560103, India
[d] Research Center, Department of Science, East West Institute of Technology, Bangalore 560091, India
[e] Prof. C.N.R. Rao Center for Advanced Materials, Tumkur University, Tumkur 572103, India
[f] Dayanand Sagar University, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560078, India
[g] Department of Physics, Acharya Institute of Technology, Bangalore 560090, India

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ABSTRACT

Europium doped lanthanum aluminate nanophosphors were synthesized by a combustion process using Oxalyl di-hydrazide as fuel. The nanophosphors calcined at 900 °C for 3 h were characterized by PXRD, FTIR spectroscopy, SEM and TEM. The average crystallite size determined by TEM and Scherrer's method was found to be in the range 20–50 nm. The characteristic emission peaks (λ_{exi} - 395 nm) recorded at ~ 591, 616, 646 and 696 nm ($^5D_0 \rightarrow {}^7F_{j=0,1,2,3}$) may be attributed to the 4f–4f intra shell transitions of Eu^{3+} ions. The estimated CIE chromaticity co-ordinates were calculated from emission spectra, were close to the national television standard committee value of red emission. Correlated color temperature was found to be 1929 K.

1. Introduction

The demand for developing efficient luminescent materials including suitable hosts for lanthanide ions remains highly desirable. It is known that Perovskite structured lanthanum aluminate ($LaAlO_3$) has attracted much interest for its wide range of applications owing to its fascinating physical and chemical properties. Recent photoluminescence studies indicated that $LaAlO_3$ was a good host material for lanthanide ions, due to its wide-band gap (~5.6 eV), significantly low phonon energy (146–159 cm^{-1}) and good transparency over the visible light range [1]. The luminescence of Eu^{3+} ions was especially useful for probing the local structure of luminescent centers in a host lattice. Lin et al. [2], investigated systematically the luminescence of Eu^{3+} in different lattice sites of $La_2CaB_{10}O_{19}$, and paved the way for the investigation on multiple-sites luminescence of Eu^{3+} [3]. Therefore, the spectroscopic properties of Eu^{3+} in different host lattices are important not only for possible industrial application but also for basic research.

Trivalent doped rare earth ions find a wide range of applications including in security ink, bar codes, anti-counterfeiting ink and display applications [1]. Further luminescent materials, doped with Eu^{3+} ions were widely studied for their high efficiency and proper Commission International de I' Eclairage (CIE) chromaticity coordinates. Eu^{3+} doped phosphors were effectively excited by near-UV and blue light, as a result these phosphors emit a strong red color which is attributed to 4f–5d transitions. It involves broad spectral line width as occurred for low valence rare-earth ions which crystal field related and can be tuned by the size and the crystal structure [4]. The $LaAlO_3$ host doped with rare earth ions exhibits some interesting applications such as long lasting phosphor, X-ray imaging, light emitting display (LED),

* Corresponding author. Research Center, Department of Science, East West Institute of Technology, Bangalore 560091. India. Tel.: +91 9886021344.
** Corresponding author. Tel.: +91 9945954010.
E-mail addresses: scphysics@gmail.com (S.C. Prashantha), bhushanvlc@gmail.com (H. Nagabhushana).

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