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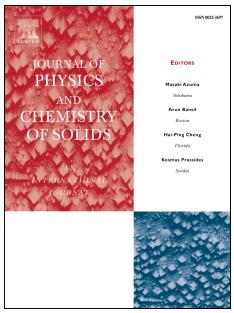

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Deepshikha Painuly, Navin Kumar Mogha, Dhanraj T. Masram, R. Singhal, R.S. Gedam, I.M. Nagpure

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Phase stability and transformation of the α to ε-phase of Alq_3 phosphor after thermal treatment and their photo-physical properties

Deepshikha Painuly[1], Navin Kumar Mogha[2], Dhanraj T. Masram[2#], R. Singhal[3], R. S. Gedam[4], I. M. Nagpure[1*]

[1]*Physics, Department of Sciences and Humanities, National Institute of Technology, Uttarakhand–246174, India*

[2]*Department of Chemistry, North Campus, University of Delhi, India–110007*

[3]*Dept. of Physics and Materials Research Centre, Malaviya National Institute of Technology Jaipur–302017, India*

[4]*Dept.of Applied Physics, Visvesvaraya National Institute of Technology, Nagpur–440010, India*

Abstract

In this study, we analyzed changes in the phases of aluminum tris 8–hydroxyquinoline (Alq_3) after thermal treatment at different temperatures and their photo–physical properties. We prepared α–Alq_3 phosphor via the co–precipitation method. Improvements in the phase purity due to stagnation of the α–phase and the transformation from α to ε–Alq_3 were achieved by thermal treatment in an Ar atmosphere. The initial formation, stagnation, improvement in the phase purity, and conversion to ε–Alq_3 were confirmed by X–ray diffraction (XRD) analysis. The XRD results were also validated by Fourier–transform infrared spectroscopy and nuclear magnetic resonance spectroscopy. Ultraviolet–visible (UV–Vis) absorption spectroscopy was conducted in the presence of acidic and basic media at concentrations of 10^{-6} M to 10^{-3} M, respectively. The modifications in the UV–Vis absorption spectra indicated changes in the band gap energy (E_g) after thermal treatment. The variations in E_g for α and ε–Alq_3 supported the stagnation and transformation of the phase. Photoluminescence (PL) analysis of the as–prepared α–Alq_3 determined a λ_{emi} maximum at 516 nm. A minor blue shift of $\Delta\lambda$ = 2 nm was observed as the PL intensity increased for the annealed α–Alq_3. A large blue shift of $\Delta\lambda$ = 18 nm as the PL intensity decreased was due to the change in phase from α to ε–Alq_3. PL study of the α and ε–Alq_3 phases in acidic solvent detected blue shifts, whereas red shifts occurred in the basic solvents due to variations in their dielectric constants. The mechanism related to the solvatochromatic effect on the shifts in PL emission was also determined in this study. Thermogravimetric analysis/differential thermal analysis was employed to determine the thermal stability of the as–prepared phosphors.

Keywords: Acetic acid (AC), Dichloromethane (DCM), Dimethyl sulfoxide (DMSO), Formic acid (FC), Meridional aluminum tris 8–hydroxyquinoline, Photoluminescence (PL).

***Corresponding Author:** indrajitnagpure@gmail.com (I. M. Nagpure)

[#]Co–corresponding Author: dhanrajtm@gmail.com (Dhanraj T. Masram)