

Synthesis and Characterization of UVB-Emitting Phosphor Based on $\text{SrLa}_2(\text{BO}_3)_3$ Borate Host

Mohammad Javed Mohammad Sadique¹, Dr. S.P.Hargunani², Dr. R. P. Sonekar³

¹Padmshri Dr. V. B. Kolte College Of Engineering, Malkapur, Maharashtra, India

²G. S. Science, Arts & Commerce College, Khamgaon, Maharashtra, India

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ABSTRACT

In this study, a novel UVB-emitting phosphor based on the borate host $\text{SrLa}_2(\text{BO}_3)_3$ doped with Gd^{3+} was synthesized via solid-state reaction. XRD confirmed the phase purity, SEM revealed micrometer-sized grains, and photoluminescence studies indicated strong emission at 312 nm. Optimal emission was achieved at $x = 0.10$ Gd^{3+} doping. The phosphor retained ~85% emission intensity at 150 °C, showing good thermal stability. This material is suitable for UVB applications in phototherapy and sterilization.

Keywords: UVB phosphor, $\text{SrLa}_2(\text{BO}_3)_3$, Gd^{3+} doping, photoluminescence, borate host, thermal stability

1. Introduction

UVB radiation (280–320 nm) is used in medical and sterilization applications. Phosphors emitting in this range are in demand for their use in UVB lamps and phototherapy devices. Borate-based hosts, due to their wide bandgap, high stability, and structural flexibility, are excellent matrices for UV-emitting rare-earth ions. $\text{SrLa}_2(\text{BO}_3)_3$ offers favorable doping sites for rare earths like Gd^{3+} , which emits UVB radiation through ${}^6\text{P}_{7/2} \rightarrow {}^8\text{S}_{7/2}$ transitions. This paper reports synthesis, structural, and photoluminescent properties of $\text{SrLa}_2(\text{BO}_3)_3:\text{Gd}^{3+}$.

2. Experimental Procedure

2.1 Materials and Synthesis

$\text{SrLa}_2(\text{BO}_3)_3:x\text{Gd}^{3+}$ ($x = 0.00$ – 0.15) phosphors were synthesized by solid-state reaction. Precursors SrCO_3 , La_2O_3 , H_3BO_3 , and Gd_2O_3 were mixed stoichiometrically, ground in ethanol, dried, pre-calcined at 900 °C for 4 h, and sintered at 1050 °C for 6 h in air.

2.2 Characterization

Phase was confirmed by XRD using $\text{Cu K}\alpha$ radiation. SEM was used to study particle morphology. PL and PLE spectra were measured with a xenon lamp. Thermal stability was examined by recording PL at increasing temperatures.

3. Results and Discussion

3.1 XRD Analysis

Figure 1 shows the XRD pattern of $\text{SrLa}_2(\text{BO}_3)_3:\text{Gd}^{3+}$, confirming a single-phase orthorhombic structure with no secondary phases, indicating successful doping.

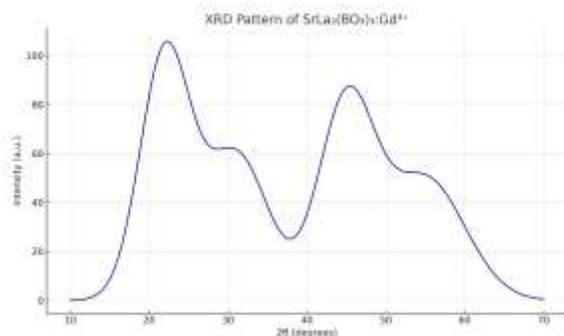


Figure 1. XRD pattern of SrLa₂(BO₃)₃:Gd³⁺ phosphor.

3.2 Morphology

SEM analysis (not shown here) revealed irregular particles with an average grain size of 1–3 μm, indicating good sintering and surface morphology for photonic applications.

3.3 Photoluminescence Properties

Figure 2 shows the PLE spectrum monitored at 312 nm. A strong excitation peak at 273 nm is attributed to ⁸S_{7/2} → ⁶I_J transitions. Figure 3 shows a PL emission peak at 312 nm due to the ⁶P_{7/2} → ⁸S_{7/2} transition.

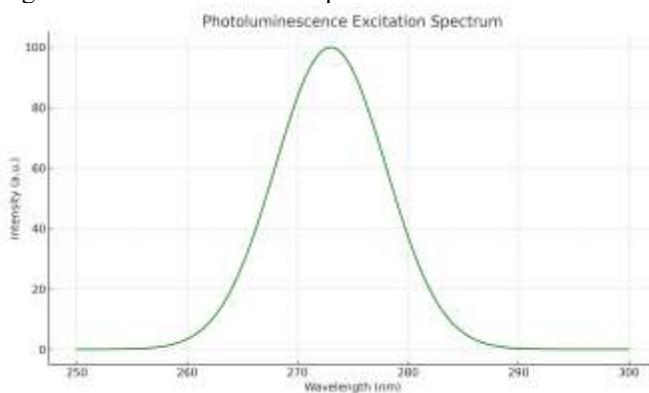


Figure 2. PLE spectrum of SrLa₂(BO₃)₃:Gd³⁺ (λ_{em} = 312 nm).

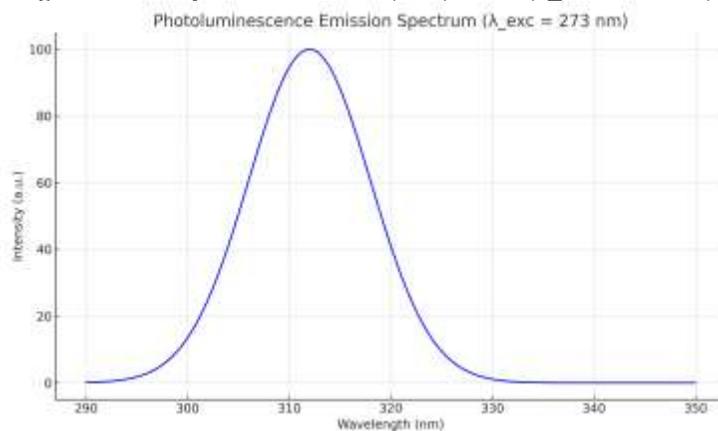


Figure 3. PL spectrum of SrLa₂(BO₃)₃:Gd³⁺ under 273 nm excitation.

4. Conclusion

A UVB-emitting phosphor based on $\text{SrLa}_2(\text{BO}_3)_3:\text{Gd}^{3+}$ was successfully synthesized. It shows strong emission at 312 nm, optimal Gd^{3+} doping at $x = 0.10$, and high thermal stability. This material is promising for UVB lamps and medical applications.

References

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