

Zero Concentration Quenching $\text{LiCaLa}(\text{MoO}_4)_3:\text{Eu}^{3+}$ Red Phosphors with Scheelite



structure for white LEDs

Priyansha Sharma, Priyadarshini Pradhan, J.P.Madda and Sivakumar Vaidyanathan*

Optoelectronics laboratory, Department of Chemistry,

National Institute of Technology - Rourkela, India. Email : vsiva@nitrkl.ac.in

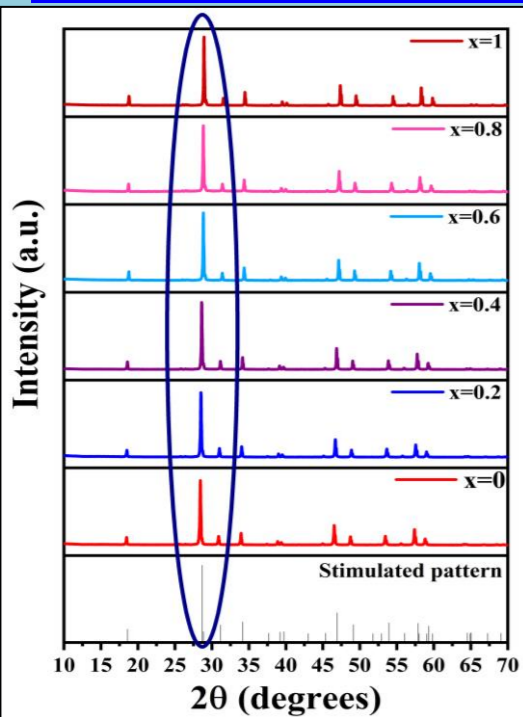
Abstract

A series of red-emitting phosphors with scheelite structure is explored for solid-state lightings. The powder XRD pattern reveals that all the compositions crystallize in a tetragonal structure with space group $I4_1/a$. The PLE and PL study reveal that the phosphor composition showed broad absorption (due to O-Mo, O-Eu (CT band) and narrow band absorption bands (due to 4f-4f electronic transition of Eu^{3+} ion). The PL emission reveals that the phosphors showed extremely narrow band emission at 615nm (FWHM 5-10 nm) with high color purity. The dominant red line implies that the Eu^{3+} ion occupies the non-centrosymmetric site. The selected phosphors showed good quantum yield and excellent thermal stability. $\text{LiCaEu}(\text{MoO}_4)_3$ phosphor conjugated with near UV LED as well as a yellow dye, the red and white LED were fabricated and the EL emission showed excellent red and white color with appropriate CIE values. The detailed results will be presented and discussed.

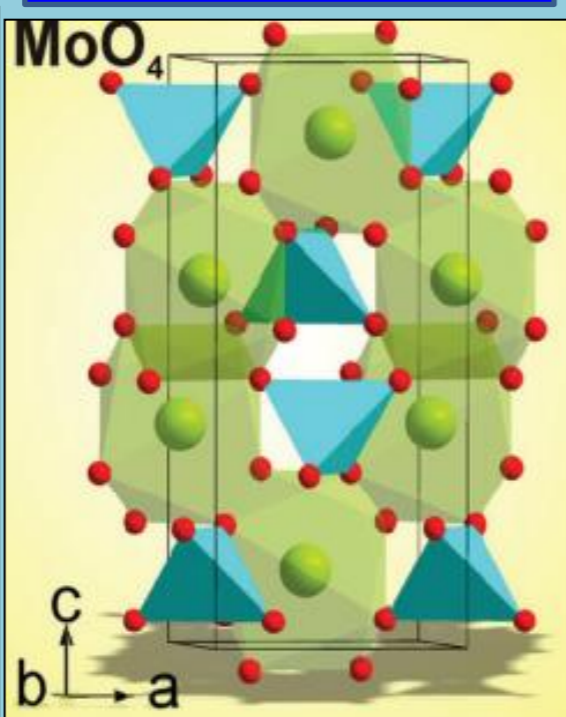
Introduction

- $\text{LiCaLa}(\text{MoO}_4)_3:\text{Eu}^{3+}$ red phosphor synthesized using solid state method at 800°C temperature
- Ionic radii of Europium (1.066Å) is less than lanthanum (1.16 Å)
- Eu^{3+} ion occupies non-centrosymmetric site in the lattice.
- Synthesised phosphor show thermal stability upto 90°C.

XRD analysis

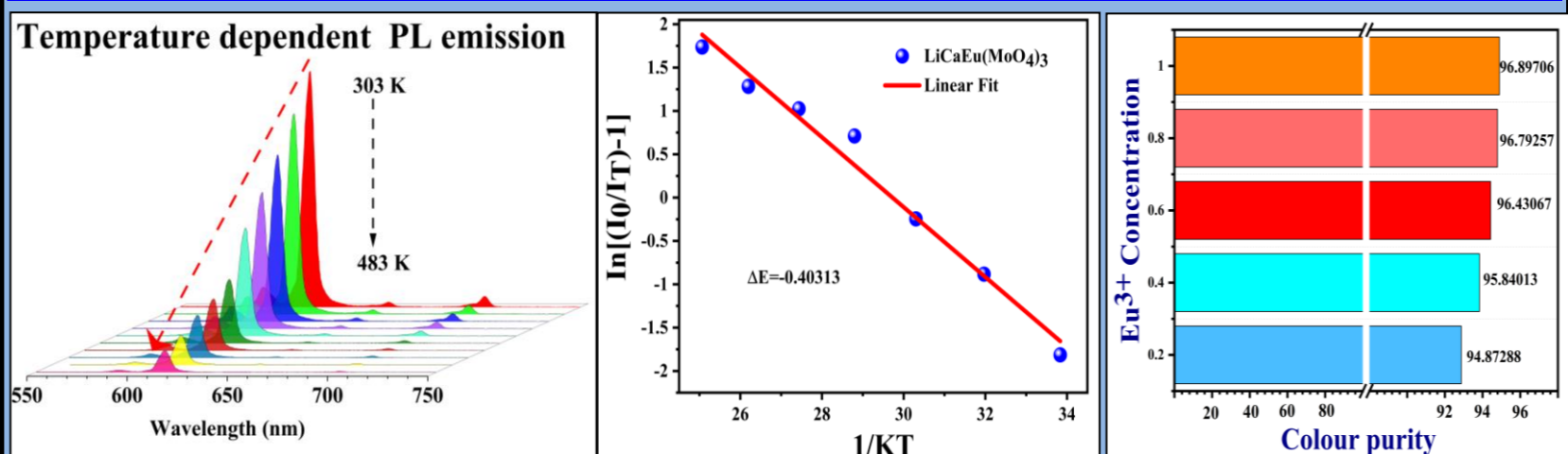


Crystal Structure

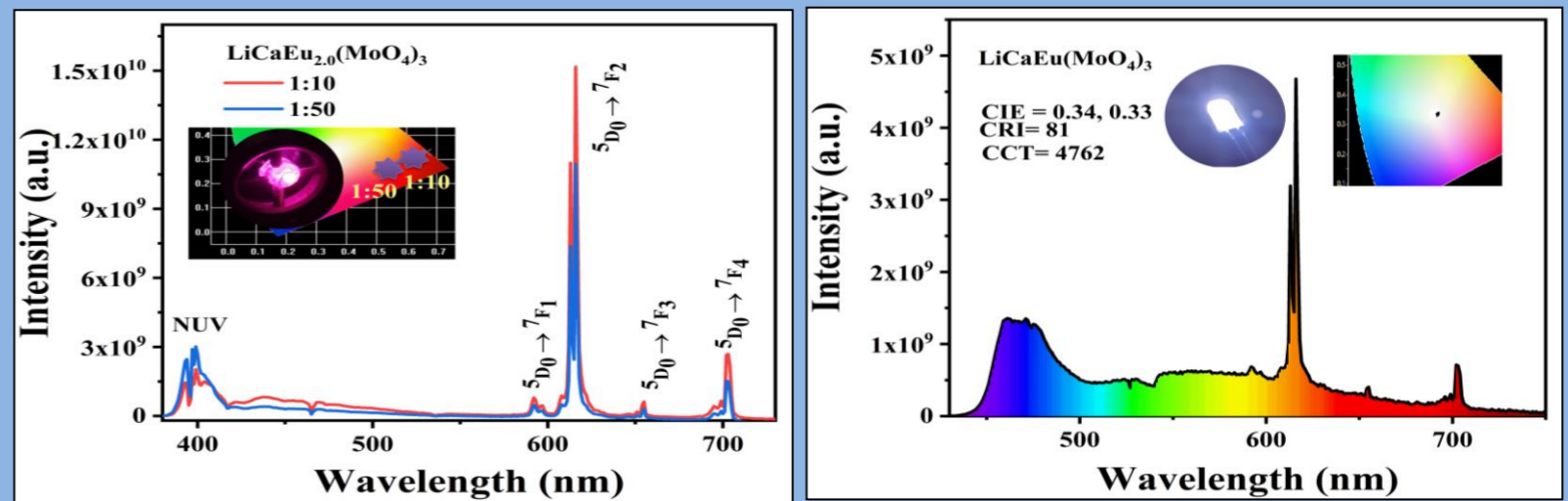


Results and Discussion

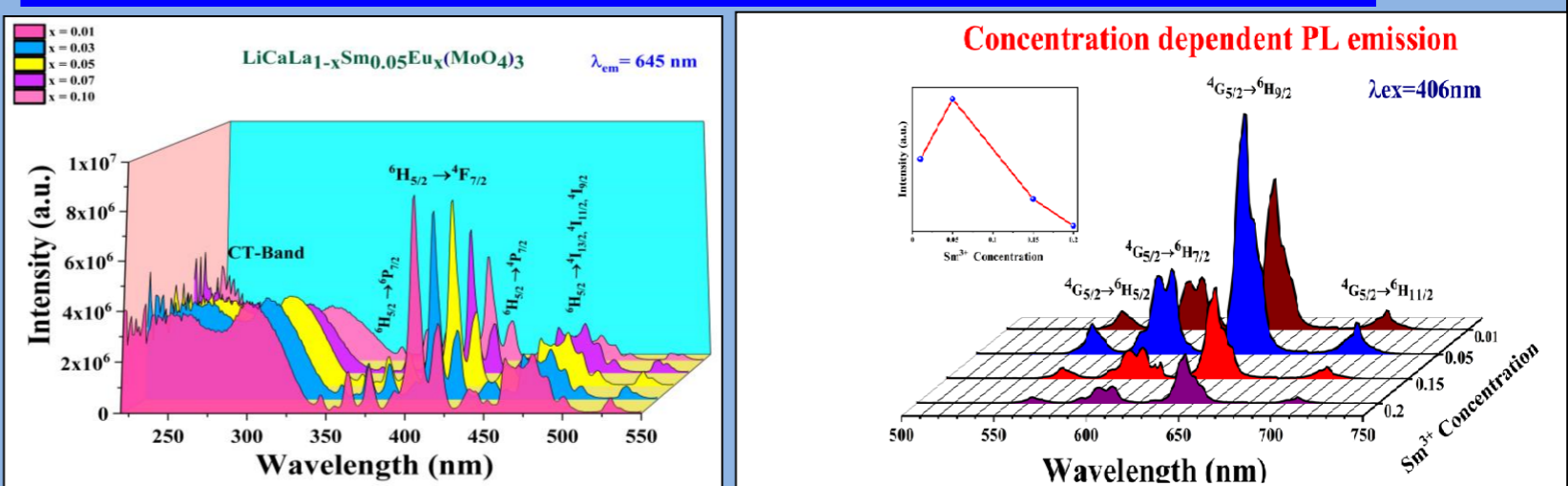
Temperature dependent PL analysis and color purity



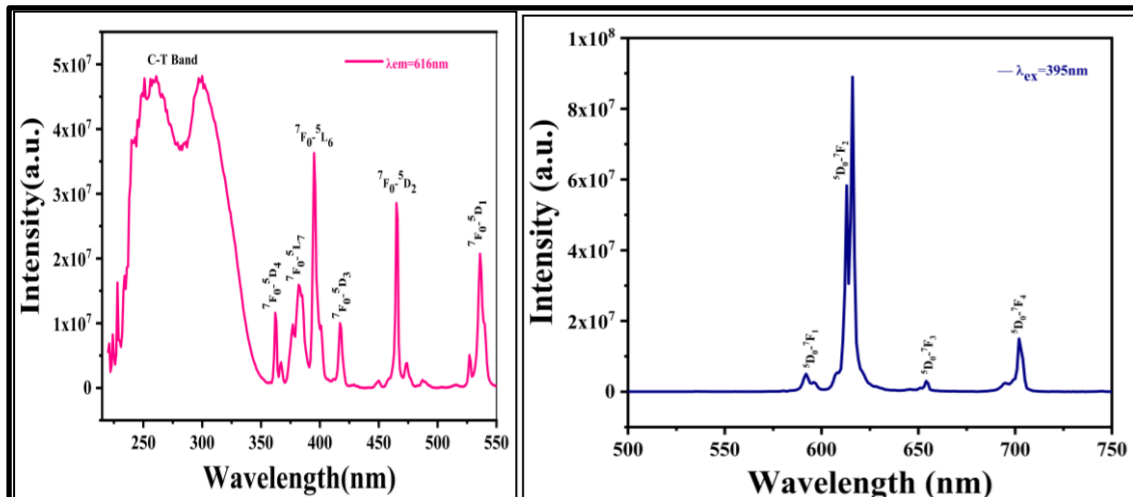
EL spectrum of Red and hybrid white LEDs



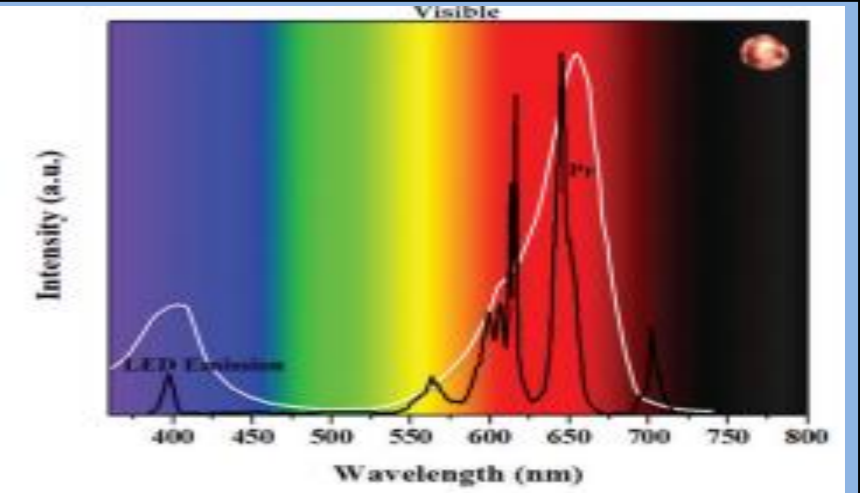
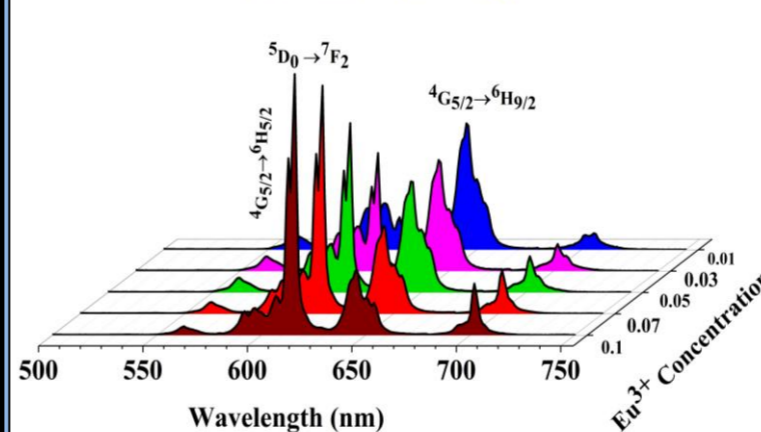
PL analysis of LCLM:Sm³⁺ and LCLM:Eu³⁺, Sm³⁺



PL Analysis of LCLM:Eu³⁺



$\text{LiCaLa}_{1-x}\text{Sm}_{0.05}\text{Eu}_x(\text{MoO}_4)_3$ $\lambda_{\text{ex}} = 406\text{nm}$



Conclusion

- Oxide based red phosphor $\text{LiCaEu}(\text{MoO}_4)_3$ with zero-concentration quenching.
- Red and white LED of CRI 81% is fabricated using synthesized red phosphor.
- Sm^{3+} and Eu^{3+} co doped give emission at 645 and 615 nm, thus the wider spectral line covers Pr absorption.
- Light source from red LED can be used for plant growth application.

References

- Rajendran, Marikumar and Sivakumar Vaidyanathan, *Dalton Trans*, 2020,49, 9239.
- Rajendran, Marikumar and Sivakumar Vaidyanathan, *NJC*, 2020,49, 5354.

Acknowledgement

