

Calotropis mediated hydrothermal route for the synthesis of Eu³⁺ activated La(OH)₃ and La₂O₃ red phosphors

MChandrashekar^{1,2}, HNagabhushana¹, SCSharma³, YS Vidya⁴, KS Anantharaju⁵, Daruka Prasad⁶, SCPrashantha⁵, DKavyashree^{1,7} and P Sadananda Maiya⁸

¹ Prof. C.N.R. Rao Centre for Advanced Materials, Tumkur University, Tumkur–572103, India

² Department of Physics, Acharya Institute of Technology, Bangalore–560107, India

³ Dayananda Sagar University, Shavige Malleshwara Hills, Kumaraswamy layout, Bangalore 560078, Karnataka, India

⁴ Department of Physics, Lal Bahadur Shastri Government First Grade College, Bangalore–560032, India

⁵ Research Centre, Department of Science, East West Institute of Technology, Bangalore–560091, India

⁶ Department of Physics, BMS Institute of Technology, Yelahanka, Bangalore–560064, India

⁷ Department of Physics, Channabasaveshwara Institute of Technology, Gubbi–572216, India

⁸ Dr P. Sadananda Maiya Center for Food Science Research, 4th Bldg, Jayanagara, Bangalore–560011, India

E-mail: bhushanvlc@gmail.com and vidya_rajnal@rediffmail.com

Abstract

The study details a green-mediated hydrothermal route for the synthesis of Eu³⁺ activated La(OH)₃ and La₂O₃ nanophosphors using Calotropis milk latex (CML) as a surfactant. The functionalization of as-formed La(OH)₃: Eu³⁺ (10 ml, 1, 5, 9, 11 mol%), calcined La₂O₃: Eu³⁺ (2–12 ml, 9 mol%) and La₂O₃: Eu³⁺ (10 ml, 1–11 mol%) nanophosphors was investigated through PXRD, FTIR, SEM, TEM and photoluminescence (PL) studies. From the surface morphology, it was noticed that the CML/ Eu³⁺ concentration showed tremendous potential in the self-assembly process and has been utilized as a soft template for the engineering of ordered nanostructures. The energy band gap of calcined La₂O₃: Eu³⁺ (10 ml, 1–11 mol%) was found to decrease from 4.68 to 3.91 eV. The PL intensities of transitions between different J levels depend on the symmetry of the local environment of Eu³⁺ activators. The high ratio of intensity of (5D₀→7F₂) and (5D₀→7F₁) provides the conclusion that the Eu³⁺ ion occupies a site with a low symmetry and without an inversion centre. La(OH)₃: Eu³⁺ (10 ml, 9 mol%) and La₂O₃: Eu³⁺ (10 ml, 9 mol%) nanophosphors show an intense red emission with CIE coordinates (0.56, 0.43) and (0.58, 0.41) respectively. The correlated color temperature (1893 K, 1786 K) was within the range of vertical daylight. The present study successfully demonstrates biotemplated mediated green synthesis of hexagonal La(OH)₃: Eu³⁺ and La₂O₃: Eu³⁺ nanophosphors for display applications.

Keywords: Calotropis milk latex, nanostructure, photoluminescence