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Regular Article

SiO_2@LaOF:Eu^{3+} core-shell functional nanomaterials for sensitive visualization of latent fingerprints and WLED applications

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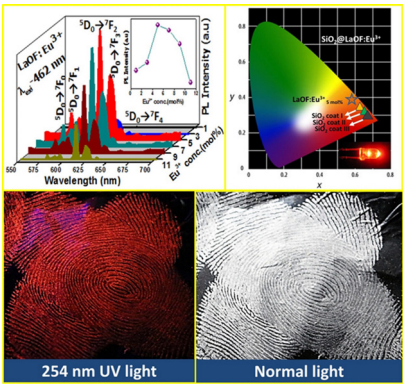
HIGHLIGHTS

- Solvothermal route is employed to fabricate nanostructured core–shell SiO_2@LaOF:Eu^{3+}.
- Core-shell and the number of coats were confirmed using advanced techniques.
- Luminescence quantum efficacy of 56.7% was observed for the prepared samples.
- Latent finger prints up to level-3 were recognized by using these powders as dust.
- Forensic and security applications were realized with the prepared samples.

GRAPHICAL ABSTRACT



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ABSTRACT

For the first time, intense red color composite of SiO_2@LaOF:Eu^{3+} core-shell nanostructures (NS) were fabricated via facile solvothermal method followed by thermal treatment. The obtained core–shell particles display better spherical shape and non-agglomeration with a narrow size distribution. Photoluminescence (PL) emission spectra exhibits intense peaks at ~593 nm, 611 nm, 650 nm corresponds to $^5D_0 \rightarrow {}^7F_J$ (J = 0, 1 and 2) Eu^{3+} transitions respectively. The spectral intensity parameters and Eu-O ligand behaviors are estimated by means of Judd-Ofelt (J-O) theory. CIE co-ordinates are found to be (x = 0.63, y = 0.36) which is very close to standard NTSC values (x = 0.67, y = 0.33). CCT value is ~3475 K which is less than 5000 K, as a result this phosphor is suitable for warm light emitting diodes. The optimized core-shell SiO_2 (coat III)@LaOF:Eu^{3+} (5 mol%) was used as a fluorescent labeling marker for the visualization of latent fingerprints on both porous and non-porous surfaces. Obtained fingerprints are highly sensitive and selective also no background hindrance which enables level-I to level-III fingerprint ridge characteristics. Observed results indicate that the significant improvement in luminescence of coreshell NS can be explored as a sensitive functional nanopowder for advanced forensic and solid state lightning applications.

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