

Supporting Information's

Influence of annealing temperature on persistent luminescence in $\text{BaAl}_2\text{O}_4:\text{Eu}^{2+}/\text{Eu}^{3+}$ nanocrystals and its application for latent fingerprint detection

Shivaramu Nagarasanakote Jayaramu*, Divya Janardhana, Lucas J. B. Erasmus, Elizabeth

Coetsee**, David E Motaung, Hendrik C. Swart

Department of Physics, University of the Free State, Bloemfontein, ZA-9300, South Africa

Corresponding author: nj.shivaram@gmail.com (Shivaramu. N. J *) and coetsee@ufs.ac.za (E. Coetsee**)

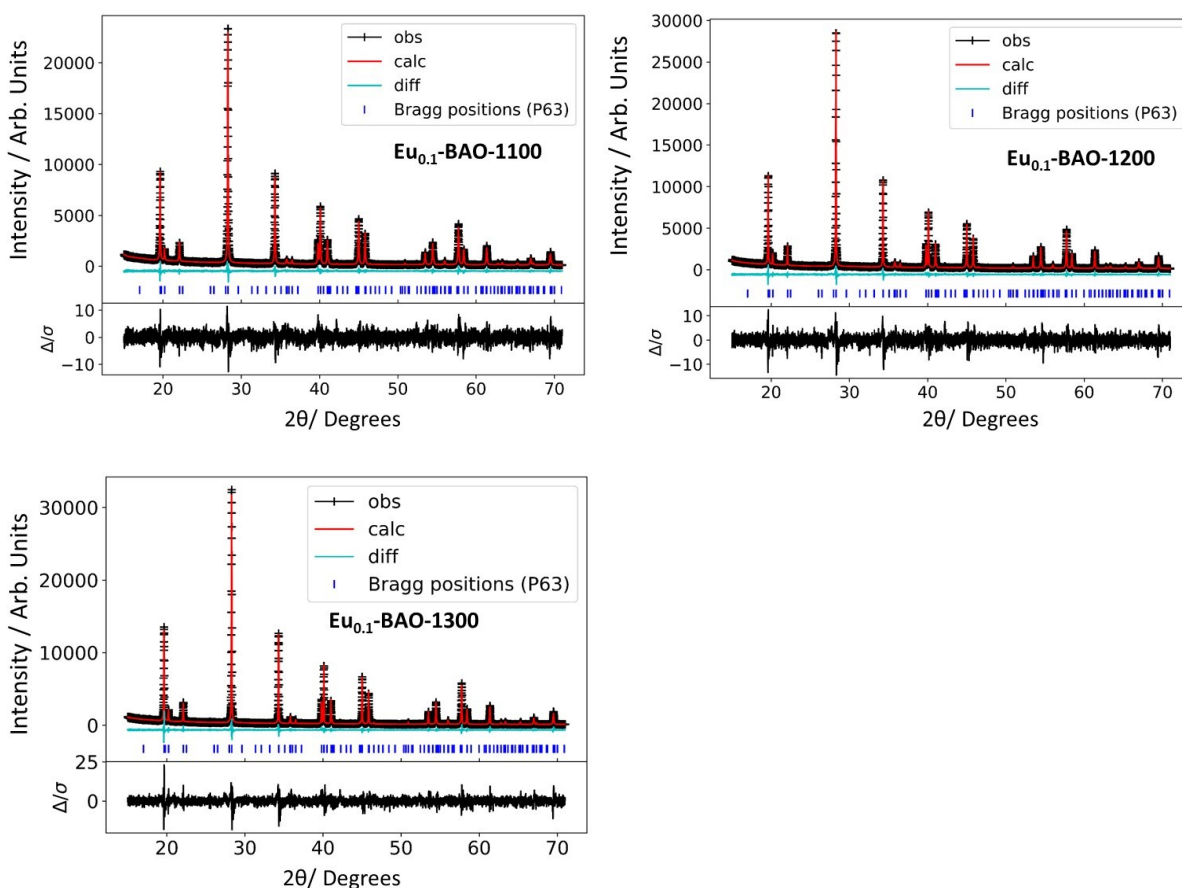


Figure S1. Rietveld refinement results of XRPD data of the $\text{Eu}_{0.1}\text{-BAO-x}$ (x: 1100-1300) phosphors at RT.

Table S1. Crystal structure refinement parameters of Eu_{0.1}-BAO-x (x = 900-1300) phosphors.

Phosphor	Eu _{0.1} -BAO- 900	Eu _{0.1} -BAO- 1000	Eu _{0.1} -BAO- 1100	Eu _{0.1} -BAO- 1200	Eu _{0.1} -BAO- 1300	BaAl ₂ O ₄ COD # 2002225
Crystal system	Hexagonal	Hexagonal	Hexagonal	Hexagonal	Hexagonal	Hexagonal
Space group	P6 ₃	P6 ₃	P6 ₃	P6 ₃	P6 ₃	P6 ₃
a and b (Å)	10.465	10.470	10.469	10.469	10.474	10.470
c (Å)	8.815	8.815	8.819	8.819	8.813	8.819
V (Å ³)	836.068	836.974	837.057	837.121	837.226	837.227
X-ray density (g cm ⁻²)	4.059	4.068	4.072	4.075	4.068	4.051
R _{wp} (%)	6.76	8.22	8.53	8.31	9.95	
GOF	1.80	1.75	1.85	1.87	2.16	

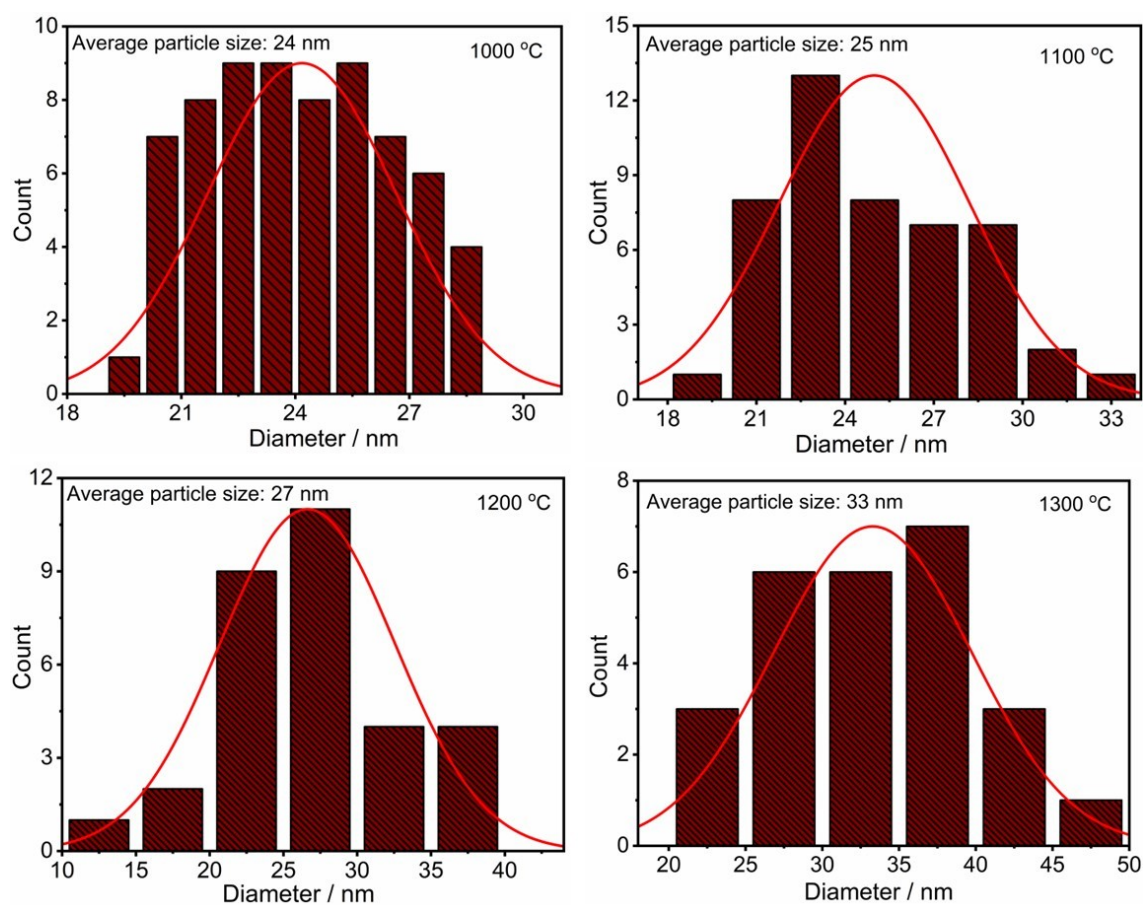


Figure S2. The size distribution diagrams of $\text{Eu}_{0.1}\text{-BAO-x}$ ($x= 900\text{-}1300$) phosphors (extracted from FE-SEM images).

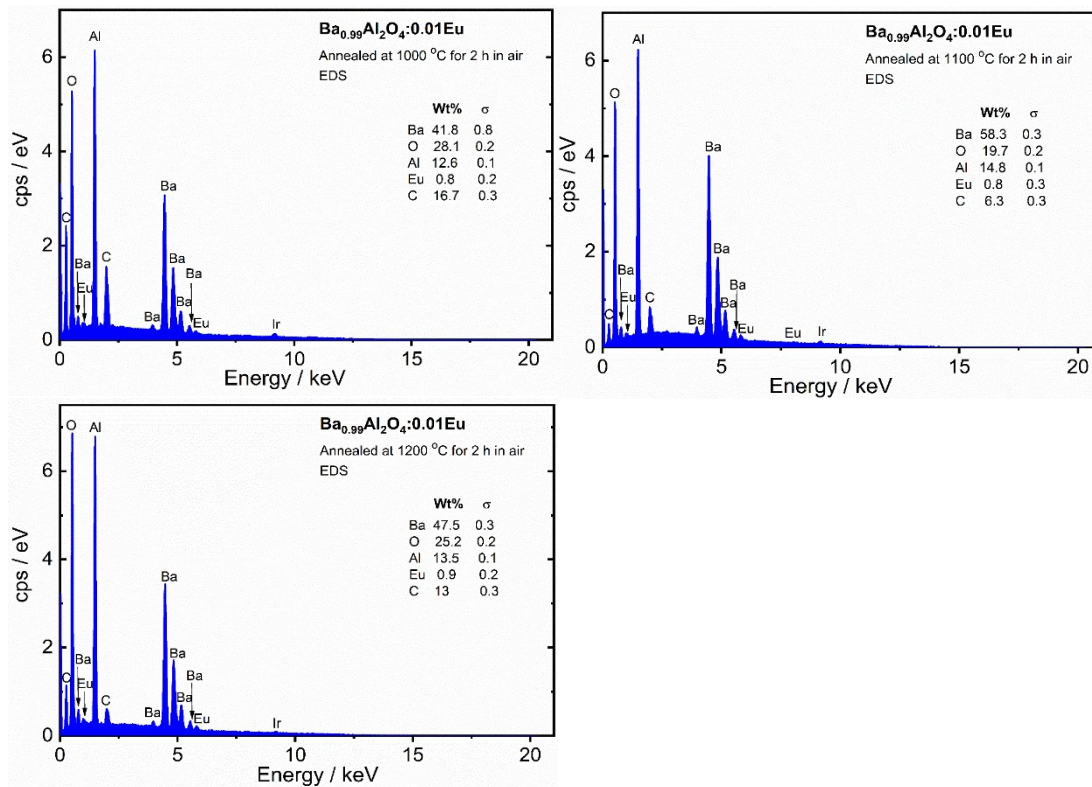


Figure S3. EDS spectra of $\text{Eu}_{0.1}\text{-BAO-x}$ ($x: 1000\text{-}1200$) phosphors.

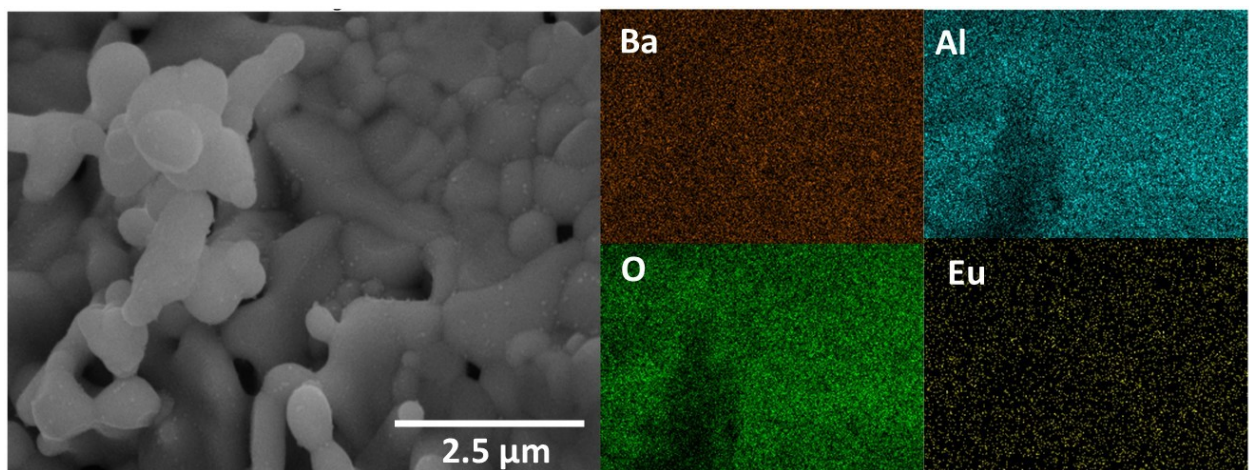


Figure S4. FE-SEM-EDS mapping of the $\text{Eu}_{0.1}\text{-BAO-1300}$ phosphor.

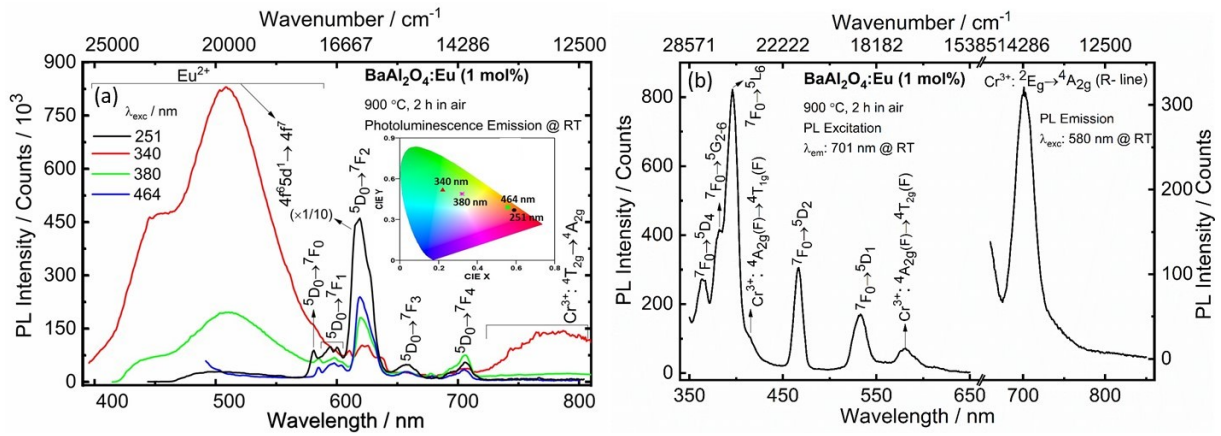


Figure S5. (a) The PL spectra and the inset figure shows the CIE chromaticity diagram of the Eu_{0.1}-BAO-900 sample obtained at different excitation wavelengths and (b) The PLE (λ_{em}: 701 nm) and PL (λ_{exc}: 580 nm) spectrum of the Eu_{0.1}-BAO-900 sample.

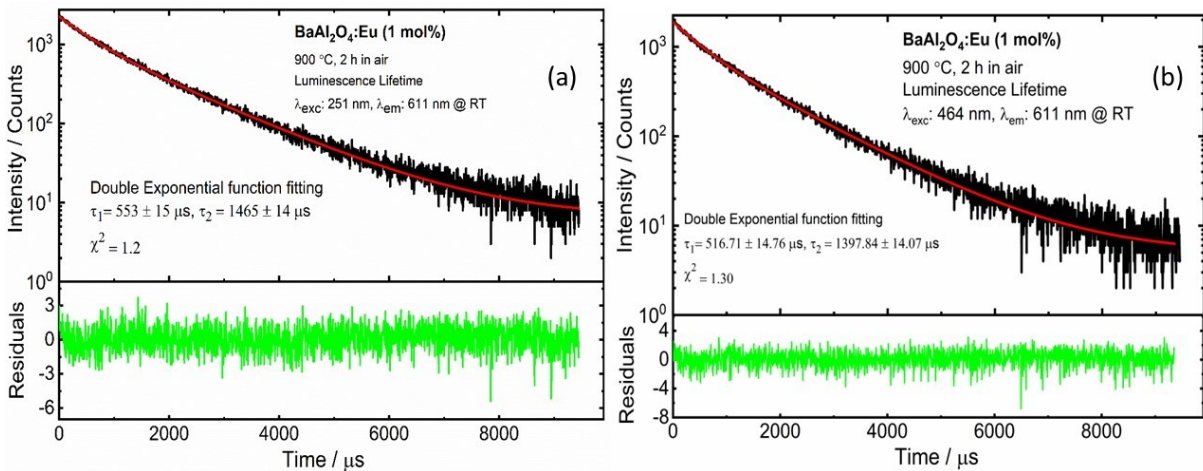


Figure S6. PL decay profile at λ_{exc} = 251 and 464 nm (a and b) and monitored at λ_{em} = 611 nm for the Eu_{0.1}-BAO-900 phosphor.

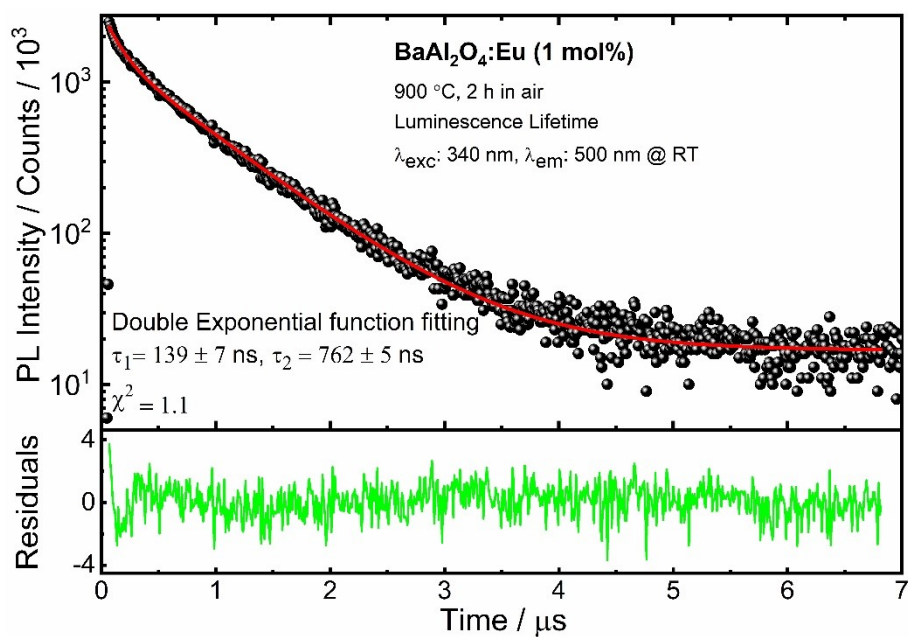


Figure S7. PL decay profile at $\lambda_{\text{exc}} = 340$ nm and monitored at $\lambda_{\text{em}} = 500$ nm for the $\text{Eu}_{0.1}\text{-BAO-900}$ phosphor.

Table S2. PL lifetimes of the $\text{Eu}_{0.1}\text{-BAO-x}$ ($x = 900\text{-}1300$) samples.

Samples	τ_{av} (μs) for λ_{exc} : 251 nm, λ_{em} : 611 nm	τ_{av} (μs) for λ_{exc} : 464 nm, λ_{em} : 611 nm	τ_{av} (ns) for λ_{exc} : 340 nm, λ_{em} : 500 nm
$\text{Eu}_{0.1}\text{-BAO-900}$	1251 \pm 15	1185 \pm 14	700 \pm 6
$\text{Eu}_{0.1}\text{-BAO-1000}$	1009 \pm 107	1111 \pm 14	635 \pm 10
$\text{Eu}_{0.1}\text{-BAO-1100}$	914 \pm 5	931 \pm 7	635 \pm 4
$\text{Eu}_{0.1}\text{-BAO-1200}$	857 \pm 2	804 \pm 7	588 \pm 4
$\text{Eu}_{0.1}\text{-BAO-1300}$	787 \pm 3	750 \pm 5	576 \pm 3

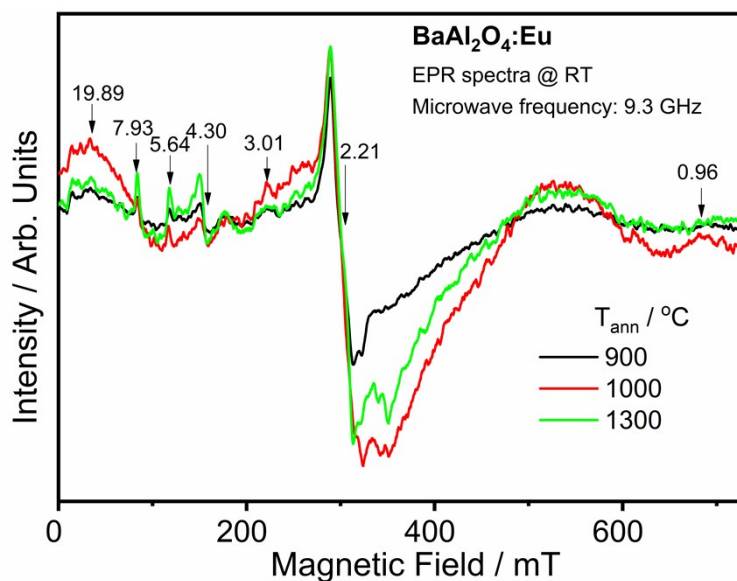


Figure S8. Room temperature EPR spectra of Eu_{0.1}-BAO samples annealed at selected temperatures.

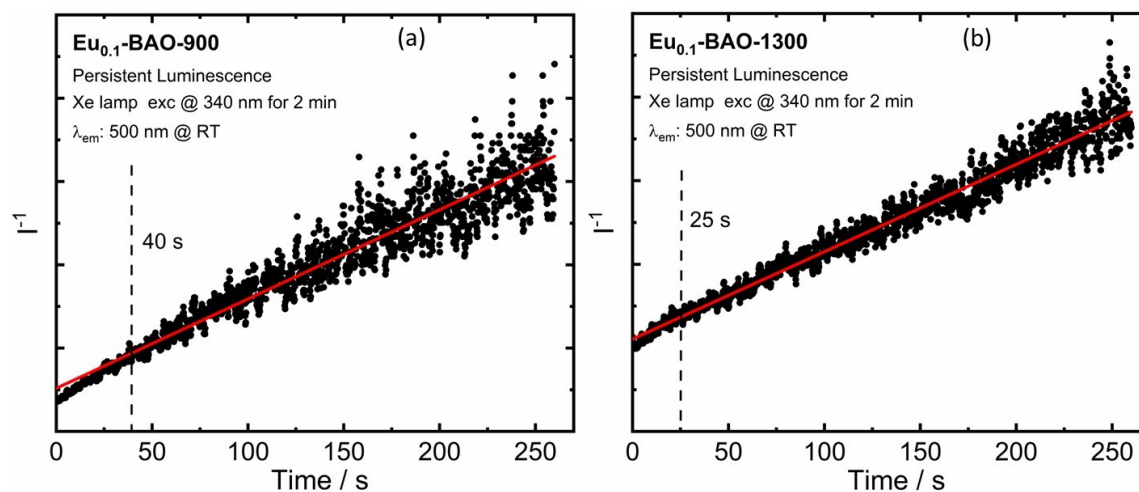


Figure S9. The function of reciprocal afterglow intensity (I^{-1}) versus time (t) for the Eu_{0.1}-BAO-900 and Eu_{0.1}-BAO-1300 phosphors monitored at 500 nm after being irradiated for 2 min with 340 nm UV radiation.

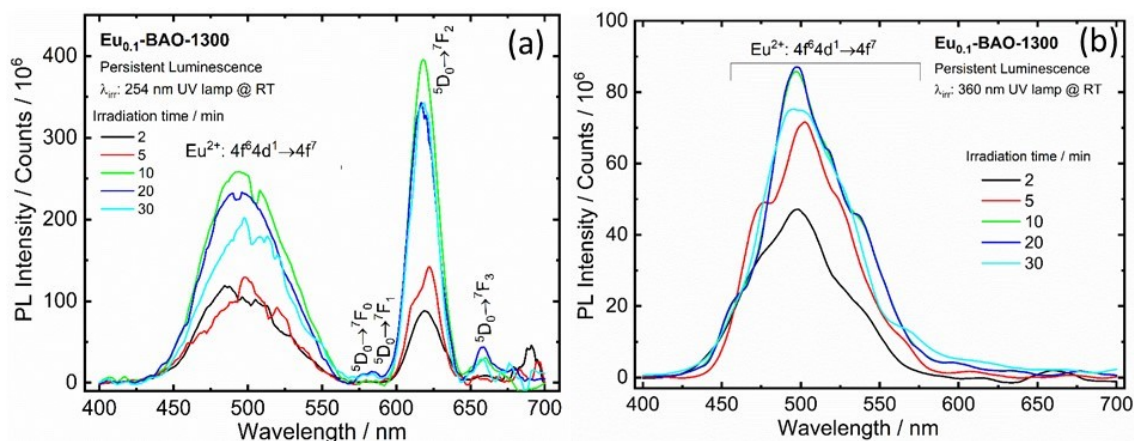


Figure S10. Effect of irradiation duration on the charging capability and the persistent luminescence performance of the $\text{Eu}_{0.1}\text{-BAO-1300}$ sample. The persistent luminescence emission was monitored in the range of 400 to 700 nm after irradiation by a 254 nm (a) and 360 nm (b) UV lamp for various times from 2 min to 30 min.

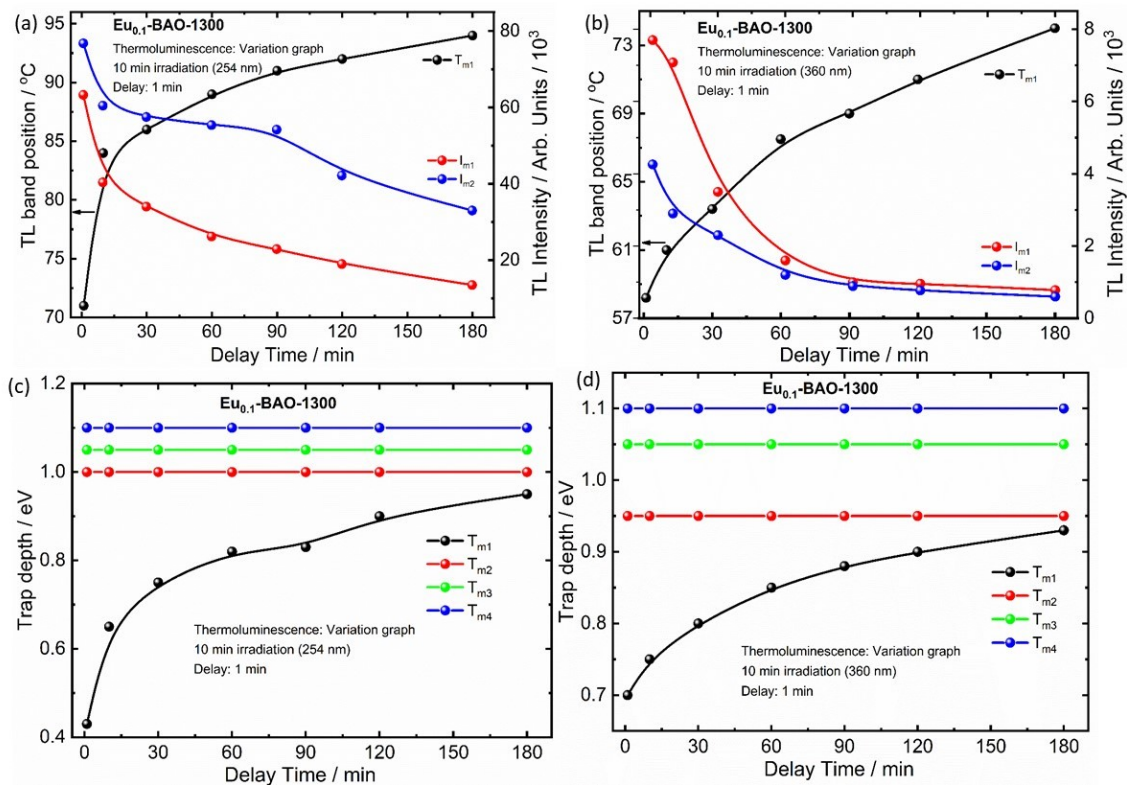
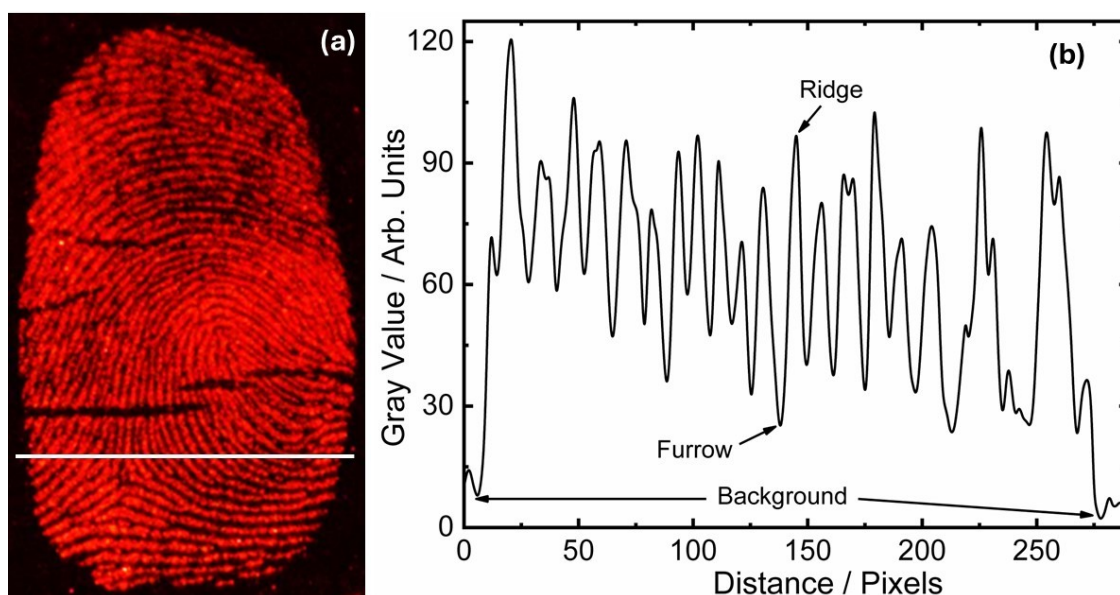


Figure S11. (a and b) The variation in the positions and intensities of the TL bands for the Eu_{0.1}-BAO-1300 sample as a function of delay time. (c and d) The plot of trap depths as a function of delay time. The sample was pre-irradiated with 254 nm and 360 nm UV lamps for 10 minutes.



Figures S12. (a) Digital photograph of the latent fingerprint developed on the plastic petri dish using the $\text{Eu}_{0.1}\text{-BAO-900}$ nanophosphor observed under the UV lamp (254 nm). (b) Variation of the gray value for the ridges and furrows observed in the fingerprints across the white line is indicated in figure (b).

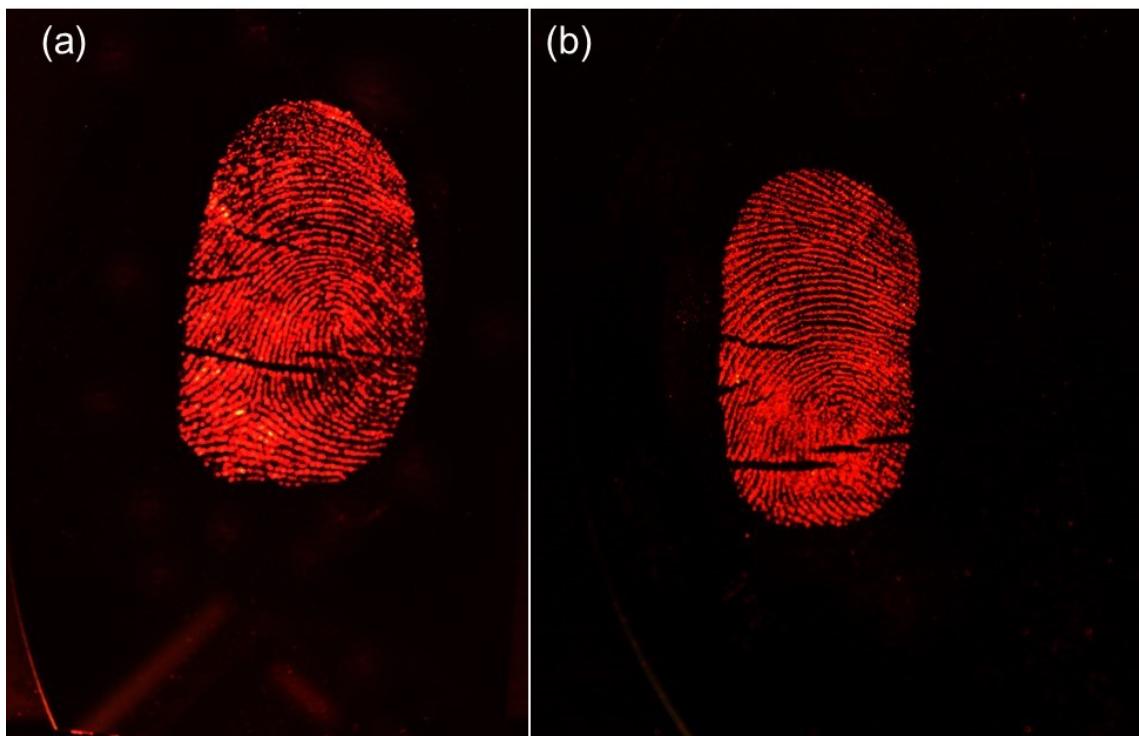


Figure S13. Comparison of finger marks from the right and left thumbs of the same volunteer on a silicon wafer surface using the $\text{Eu}_{0.1}\text{-BAO-900}$ nanophosphor observed under a 254 nm mercury-vapour UV lamp.