Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.


**Supporting Information**

# Valence Regulation in Europium Doped Fluoride Phosphor for High Resolution X-ray Time-lapse Imaging

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Table S1. The refinement factors of $SrF_2$: 0.5%Eu powder and $SrF_2$: 0.5%Eu plate.

| Material | $SrF_2$:0.5%Eu powder | $SrF_2$:0.5%Eu plate |
|---|---|---|
| Synthesis temperature (K) | 1273 | 1873 |
| Measure temperature (K) | 298 | 298 |
| Symmetry | Cubic | Cubic |
| Space group | Fm-3m | Fm-3m |
| a/ Å | 5.84259 | 5.76304 |
| b/ Å | 5.84259 | 5.76304 |
| c/ Å | 5.84259 | 5.76304 |
| α | 90 | 90 |
| β | 90 | 90 |
| γ | 90 | 90 |
| V/ $Å^3$ | 199.4418 | 191.405 |
| Rwp (%) | 9.03 | 8.33 |
| Rp (%) | 6.98 | 7.25 |
| $\chi^2$ | 3.78 | 3.26 |

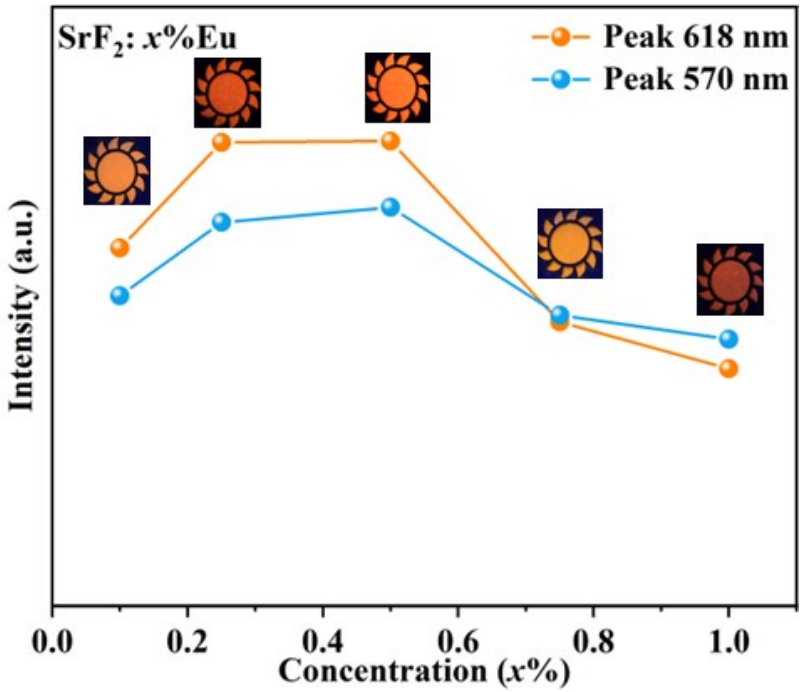


Figure S1. The PL intensity at 618 nm and 570 nm as the function of Eu concentration.

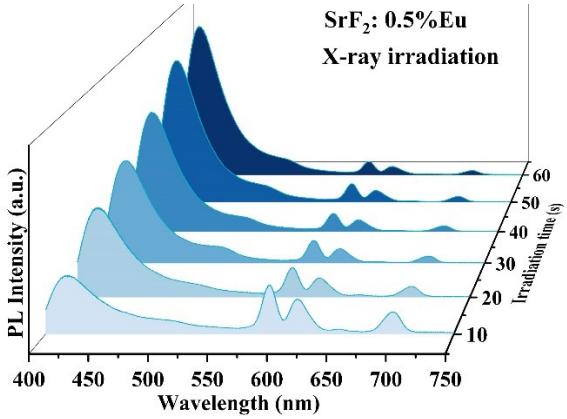


Figure S2. The PL spectra of $SrF_2$: 0.5%Eu depending on the X-ray irradiation time.

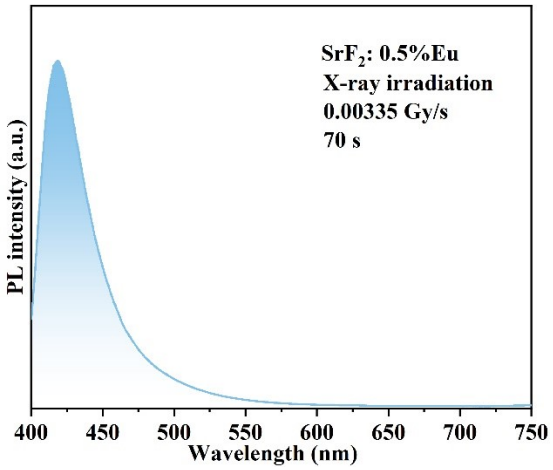


Figure S3. The PL spectra of $SrF_2$: 0.5%Eu after X-ray irradiation 70 s.

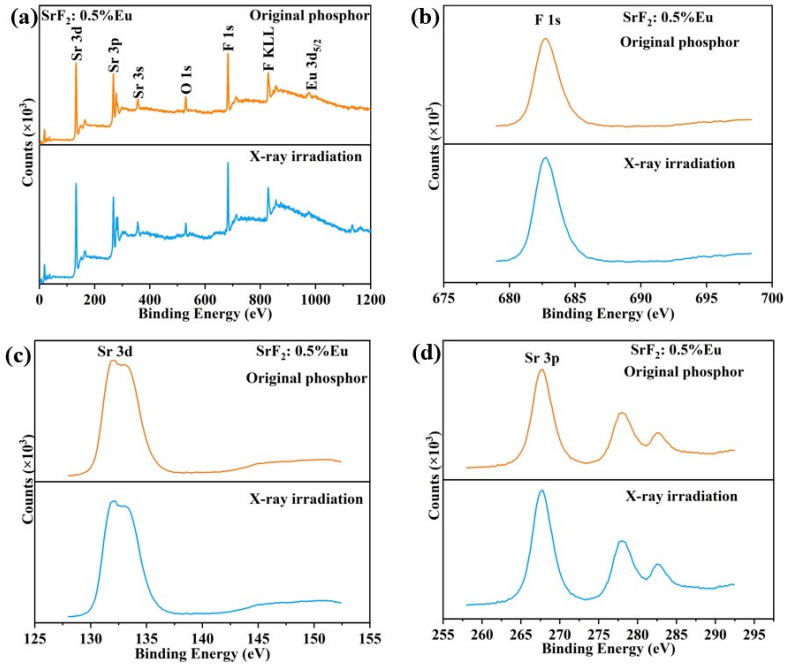


Figure S4. The XPS spectra of (a)$SrF_2$: 0.5%Eu, (b) F 1s, (c) Sr 3d, (d) Sr 3p before and after X-ray irradiation.

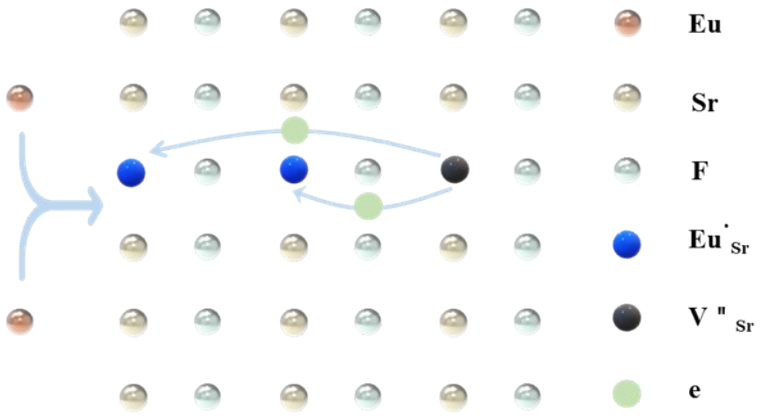


Figure S5. The mechanism of $Eu^{3+}$ self-reduction process.

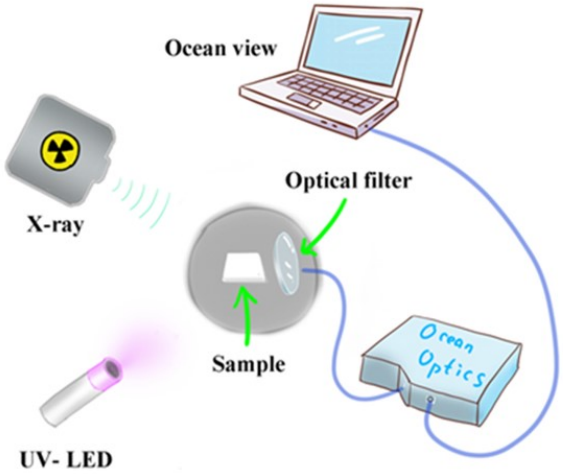


Figure S6. The schematic setup of the in-situ spectrum measurement.

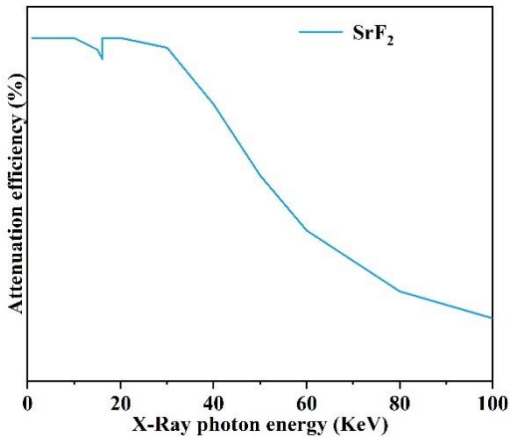


Figure S7. The X-ray attenuation efficiency of $SrF_2$.

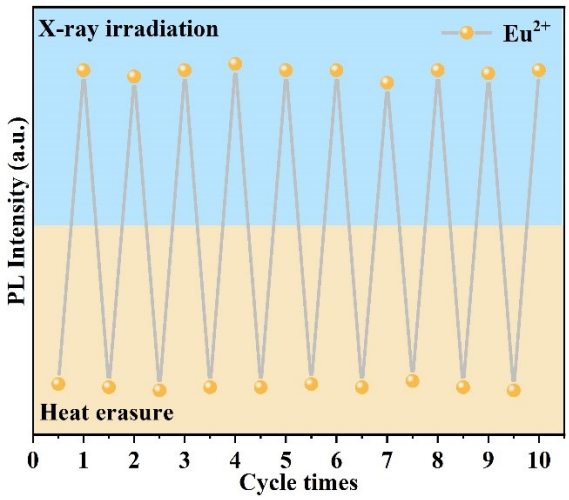


Figure S8. The reuse properties of $SrF_2$: 0.5%Eu with the treatment of X-ray irradiation and heat erasure.

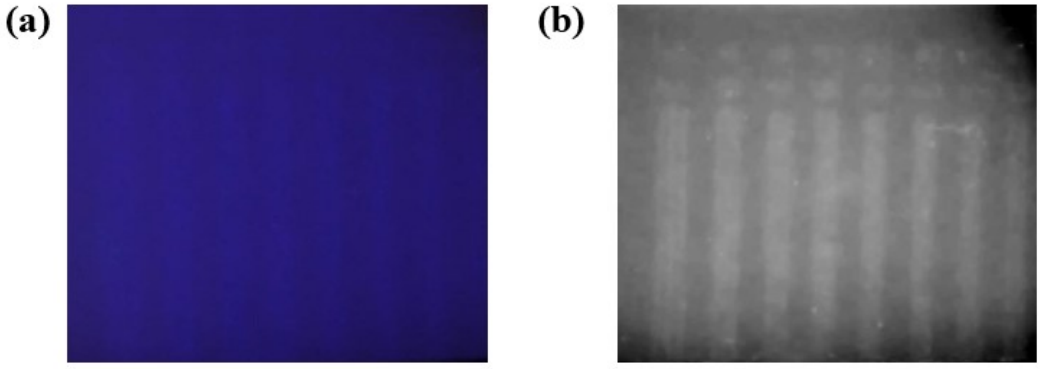


Figure S9. The digital picture and grayscale value picture of X-ray time-lapse imaging via classical imaging film technology.

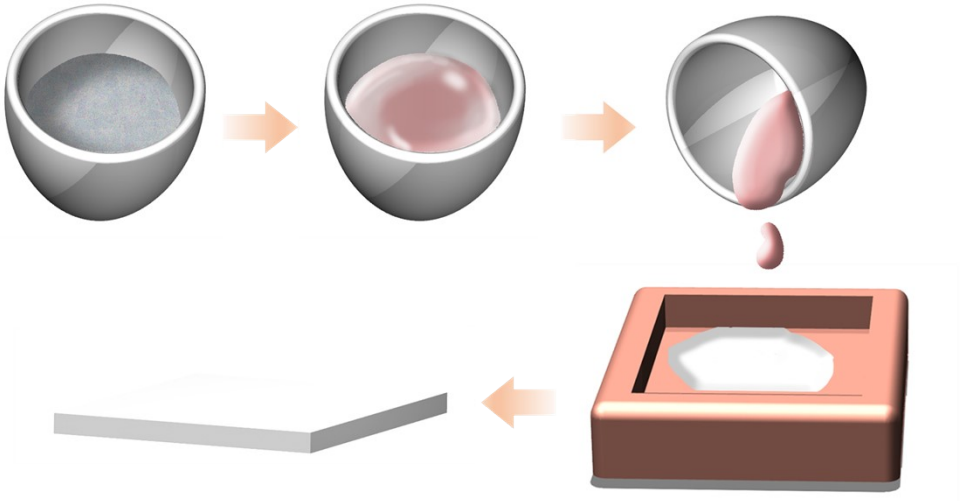

Figure S10. The fabricated process of $SrF_2$:0.5%Eu bulk.

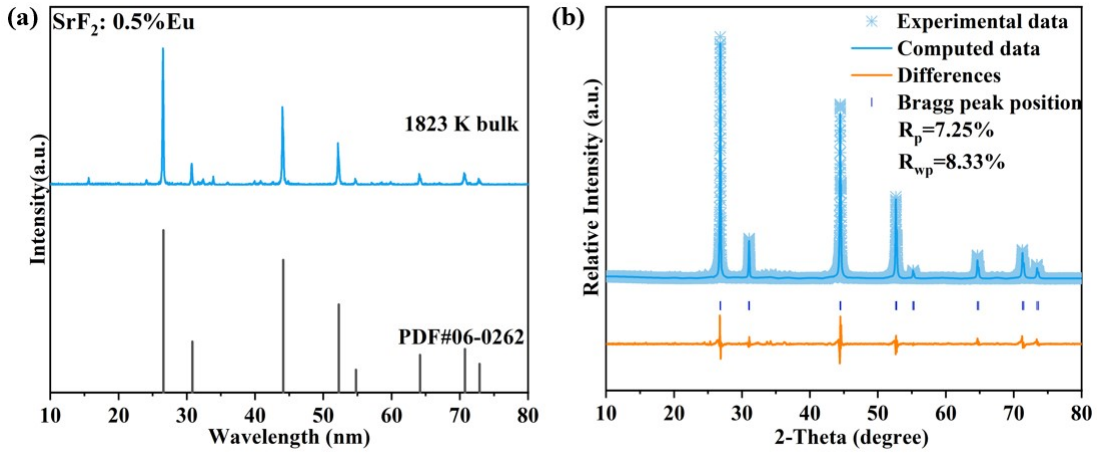


Figure S11. (a) The XRD patterns of $SrF_2$: 0.5%Eu plate and phosphor. (b) The Rietveld refinement patterns of representative $SrF_2$: 0.5%Eu plate.

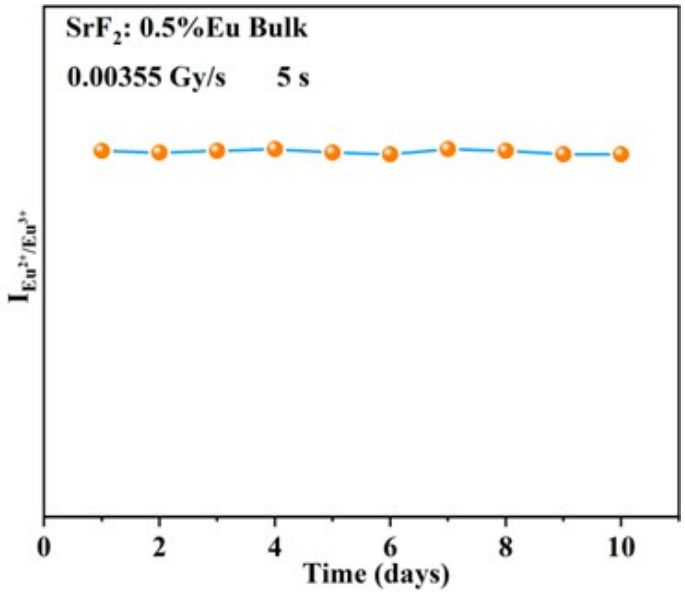


Figure S12. The X-ray irradiation stability of $SrF_2$: 0.5%Eu plate.

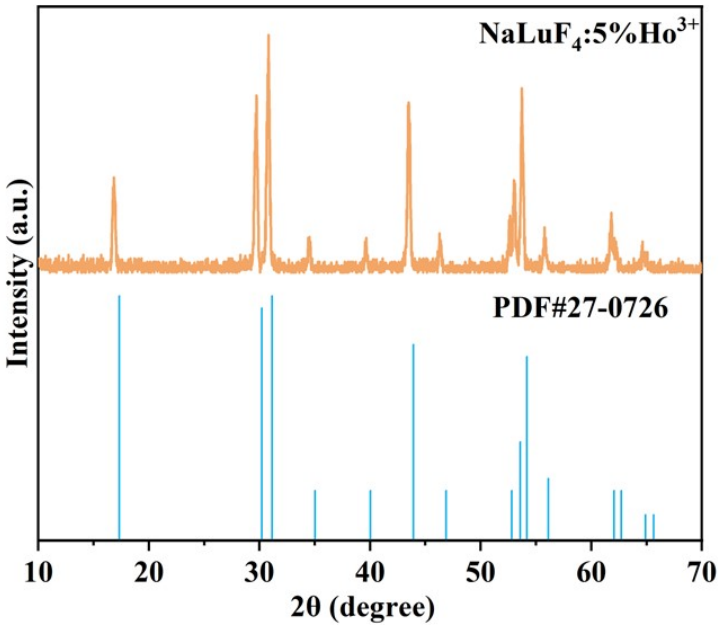


Figure S13. The XRD pattern of $NaLuF_4$: 5%$Ho^{3+}$.

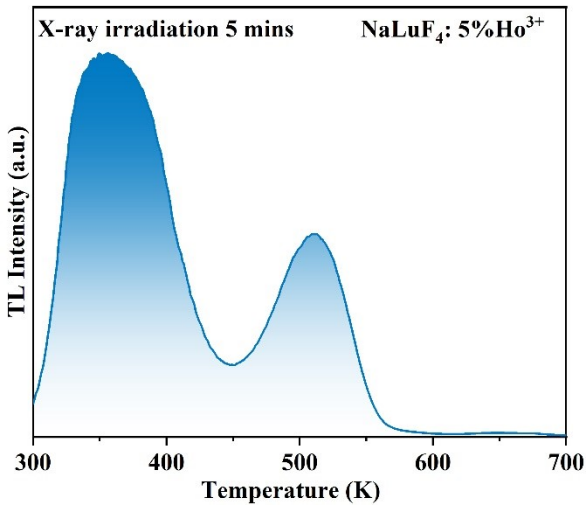


Figure S14. The TL curve of $NaLuF_4$: 5%$Ho^{3+}$ charging with X-ray for 5 mins.