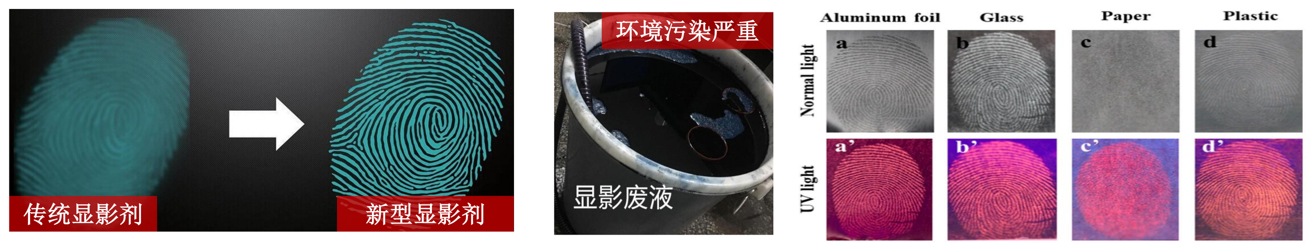
Orange-red-emitting $BaSrGd_4O_8:Sm^{3+}$ phosphors with high thermal stability for applications in w-LEDs and latent fingerprints

一种具有高热稳定性的橘红色发光$BaSrGd_4O_8:Sm^{3+}$荧光粉用于w-LEDs和潜指纹

Yilian Ran (冉一恋), Yixuan Zhao (赵艺蔙), Yangyu Su (苏杨宇), RuijinYu*(余瑞金)

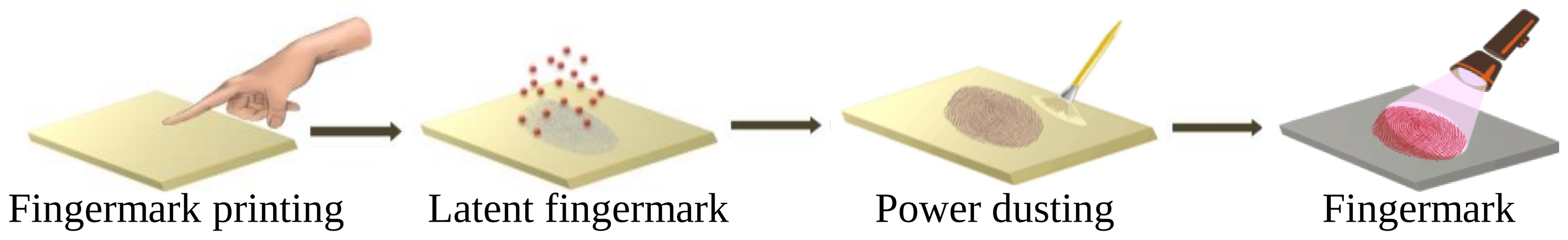
College of Chemistry & Pharmacy, Northwest A&F University, Yangling, Shaanxi 712100, PR China

Introduction



- Existing fluorescence imaging techniques such as ninhydrin are not clear, especially for **the third quarter of fingerprint characteristics such as sweat holes**, and traditional developers are **harmful to the environment**.
- Fingerprints can be used for personal identification. Leaving fingerprints invisible at the crime scene is called **latent fingerprints (LFPs)**.
- The inorganic phosphors generally **have higher security and better stability** than organic dyes and metal powder.
- The details of LFPs **can be clearly identified** under UV light with high contrast and low background interference The exploration and development of phosphors that can detect LFPs with high resolution has become **a hot topic** in recent years.
- Our work shows that $BaSrGd_4O_8:Sm^{3+}$phosphors **have the potential to be used LFPs to help with personal identification.**

Experimental details



Mixtures of $BaCO_3$ (A.R.), $SrCO_3$ (A.R.), Sm_2O_3 (A.R.), and Gd_2O_3 (A.R.) in the fixed stoichiometric ratio were finely grounded. Then calcining them at 600℃ in one muffle furnace for 2 h, following another re-grounding step, pressing samples into tablets and sintered for 5 h.

Phase purity

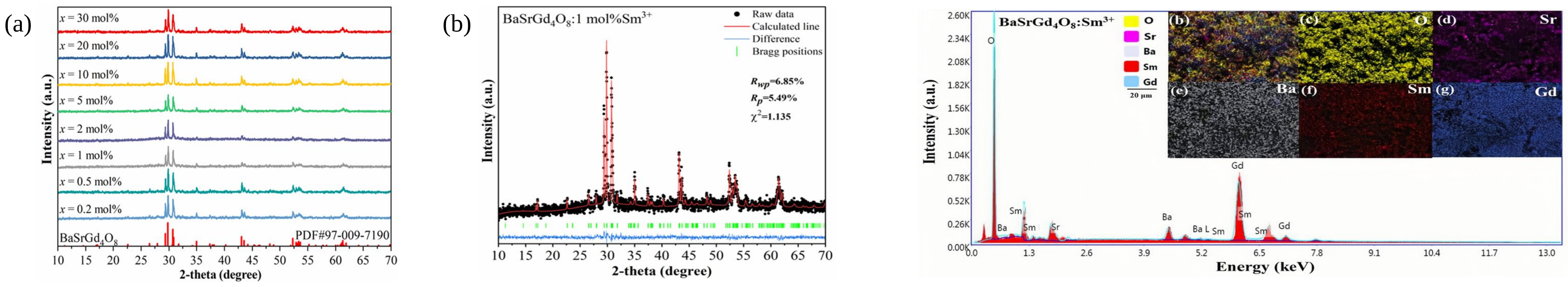


Fig. 1. (a) XRD patterns of $BaSrGd_4O_8$ and $BaSrGd_4O_8$ standard PDF card. (b) Rietveld refinement of $BaSrGd_4O_8$:1 mol%Sm^{3+} sample.

Fig. 2. EDS spectrum of $BaSrGd_4O_8$:1 mol%Sm^{3+} sample. (b-g) Elemental mapping images of $BaSrGd_4O_8$:1 mol%Sm^{3+} sample.

Optical and structural properties

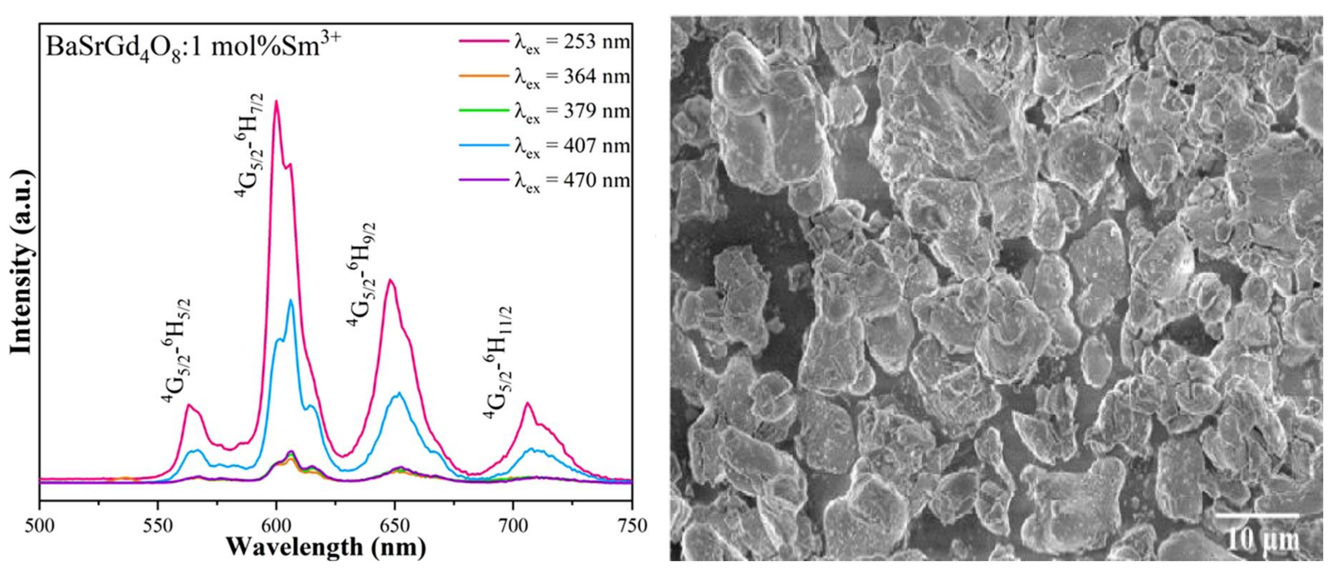


Fig. 3. PL spectra of $BaSrGd_4O_8$:1 mol%Sm^{3+} at different excitation wavelengths.

Fig. 4. SEM images of $BaSrGd_4O_8$:1 mol%Sm^{3+} .

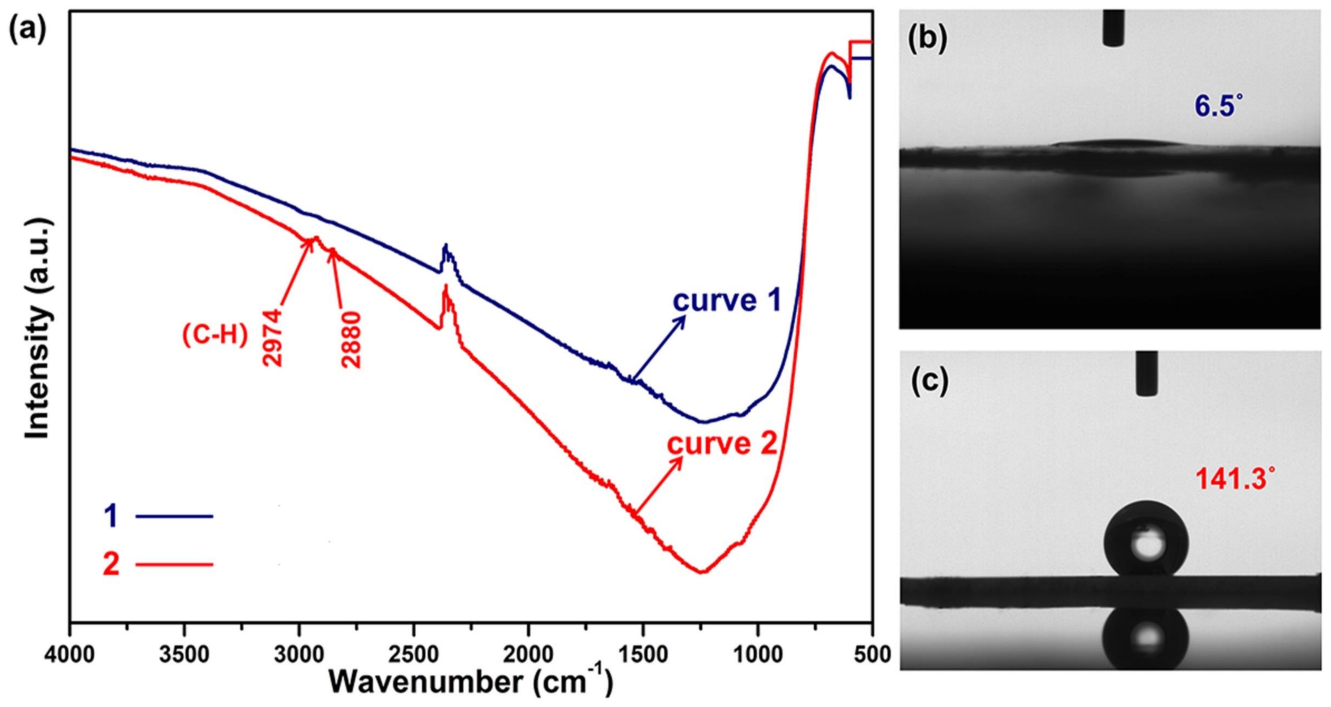


Fig. 5. Comparison of (a) FT-IR spectra and (b–c) Contact angles of water droplets of MISO: 1 mol%Sm^{3+} and MISO: 1 mol%Sm^{3+} @OA.

Personal identification

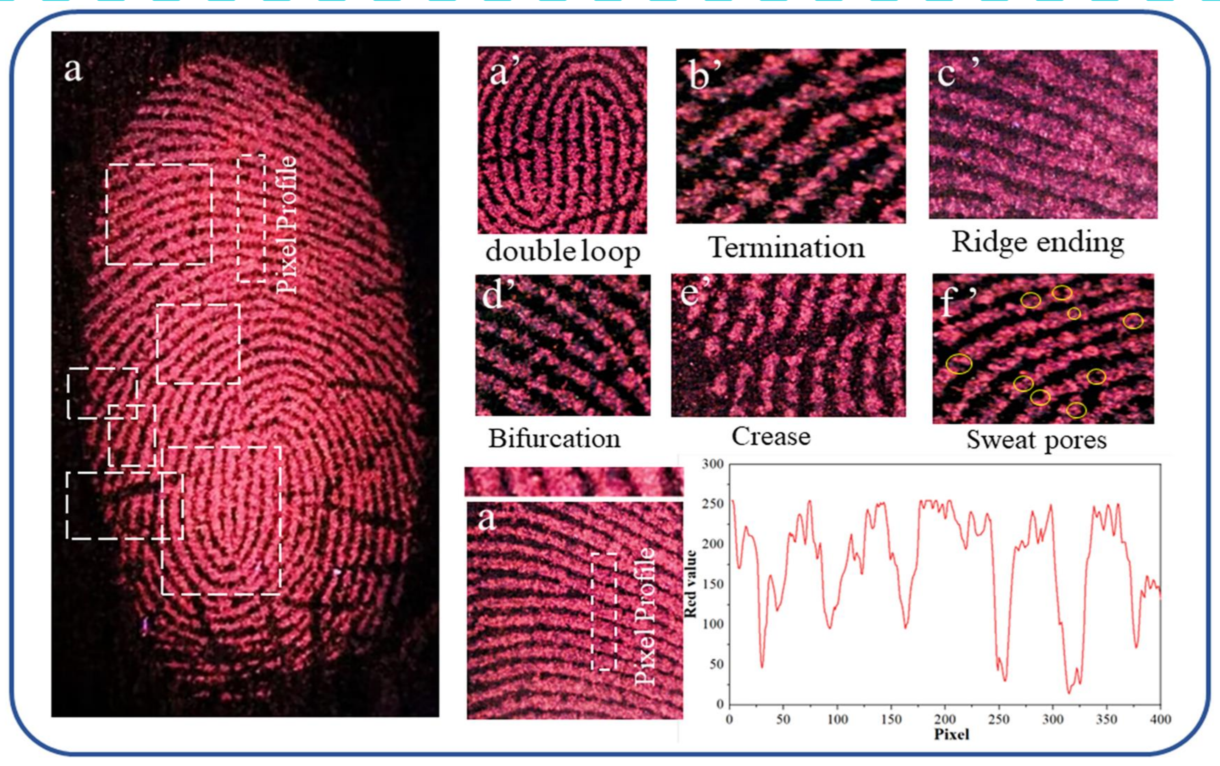


Fig. 6. (a) Fluorescent images of LFPs stained with $BaSrGd_4O_8:Sm^{3+}$. (a')–(f') Enlarged view of each feature of LFPs.

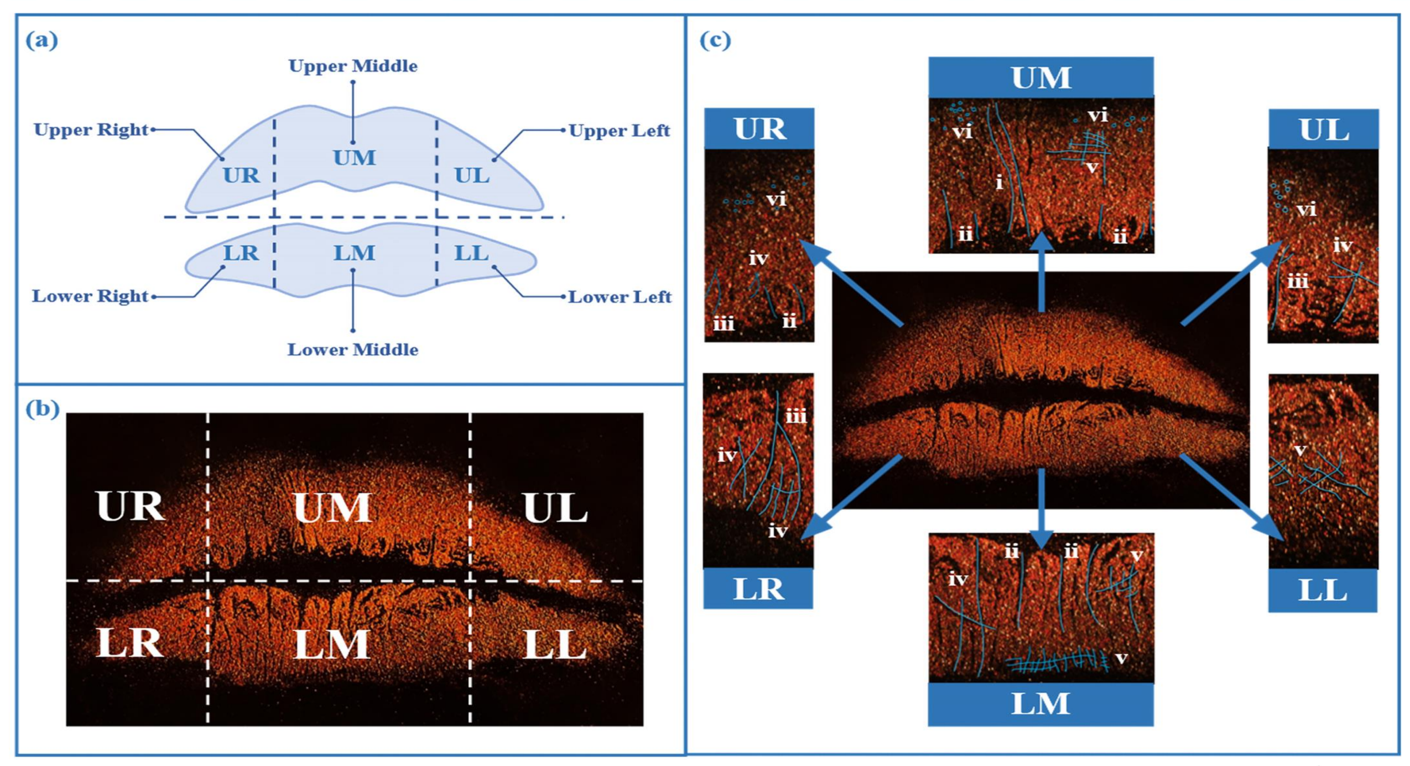


Fig. 7. (a) A lip print identification model. (b) Lip print stained by BGSO:0.02Sm^{3+}@OA phosphor under UV light. (c) Development and identification of different lip print features.

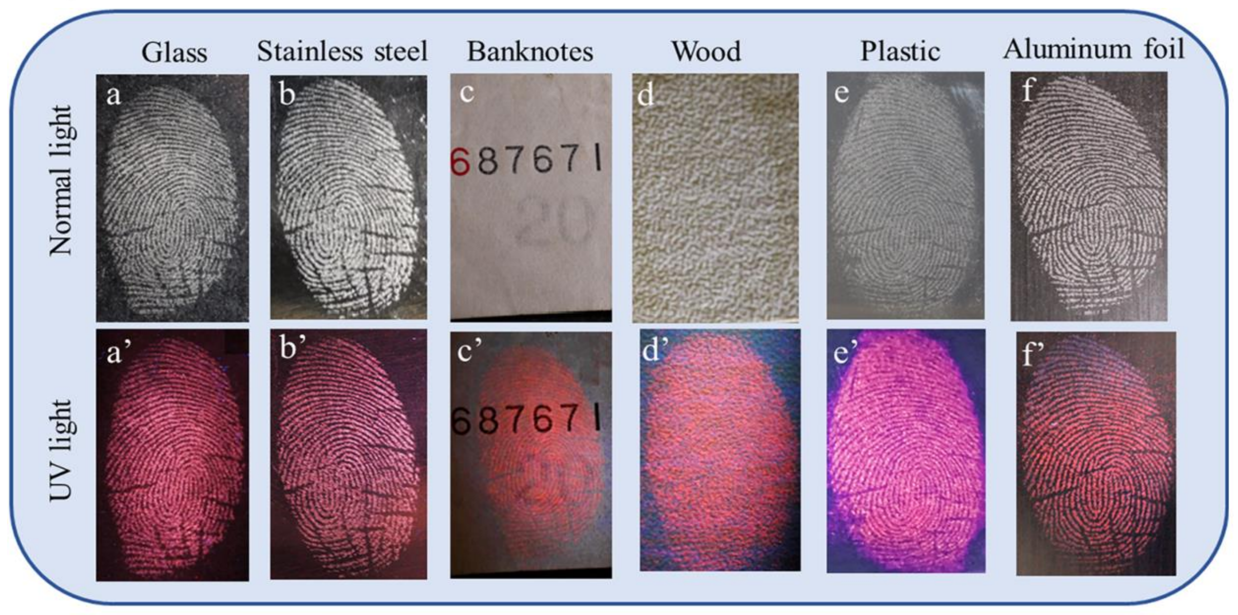


Fig. 8. (a)-(f) and (a'-f') LFPs on the surfaces of different materials visualized by $BaSrGd_4O_8$: 1 mol%Sm^{3+} phosphor under daylight and UV light.

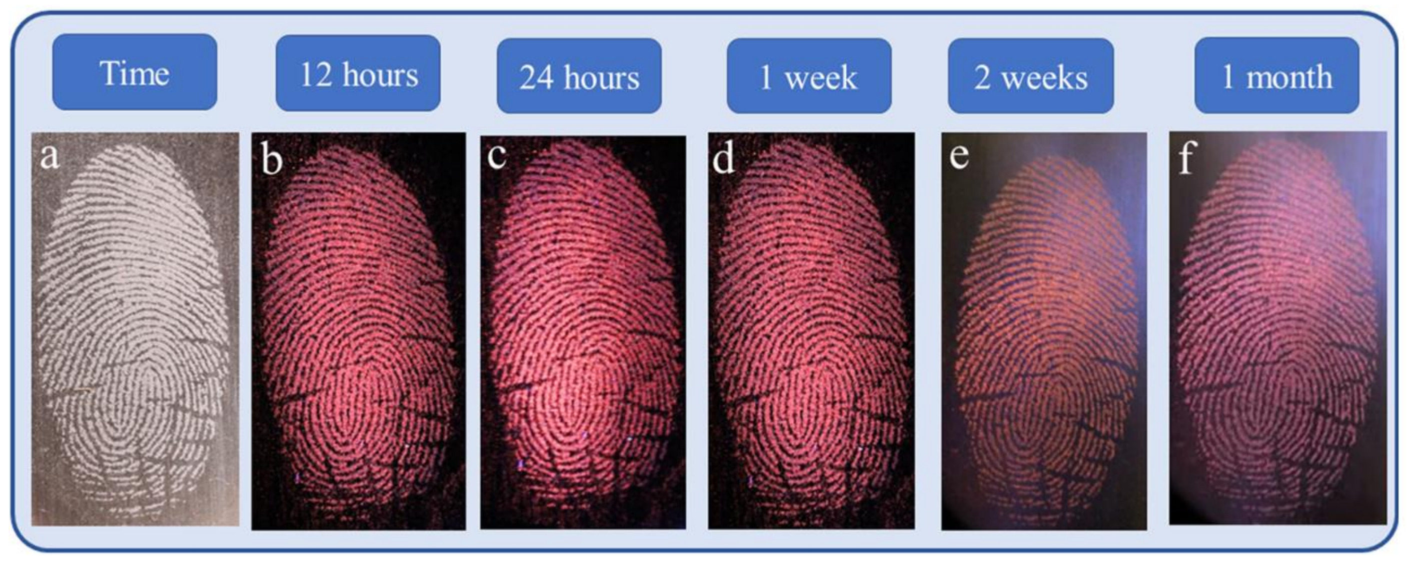
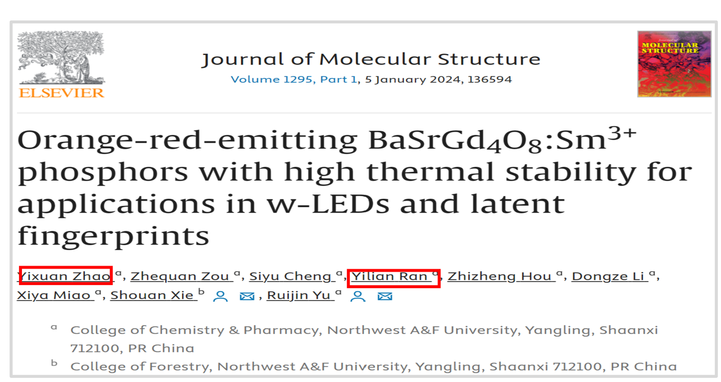


Fig. 9. (a) Image of LFPs under daylight. (b)–(f) images pictures under UV light storing for different time.

Conclusions

1. Orange-red $BaSrGd_4O_8:Sm^{3+}$ phosphors were prepared via the solid-state reaction. Obvious orange-red emission peaks were observed by reason of the $^4G_{5/2}\rightarrow{}^6H_{7/2}$ (605 nm) transition of Sm^{3+} ions. The optimal Sm^{3+} doped concentration in $BaSrGd_4O_8$ was 1 mol%.
2. LFPs using $BaSrGd_4O_8$: Sm^{3+} phosphor on various object surfaces are clearly visible.
3. All above results illustrate the great potential of orange-red-emitting material BaSrGd4O8:Sm3+ phosphors for LFPs detection.

Achievements



中科院三区 **IF=3.800**