



食品科学与工程学院  
College of food science and engineering

# Structural and optical properties of $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$ phosphors for potential application in w-LEDs and personal identification

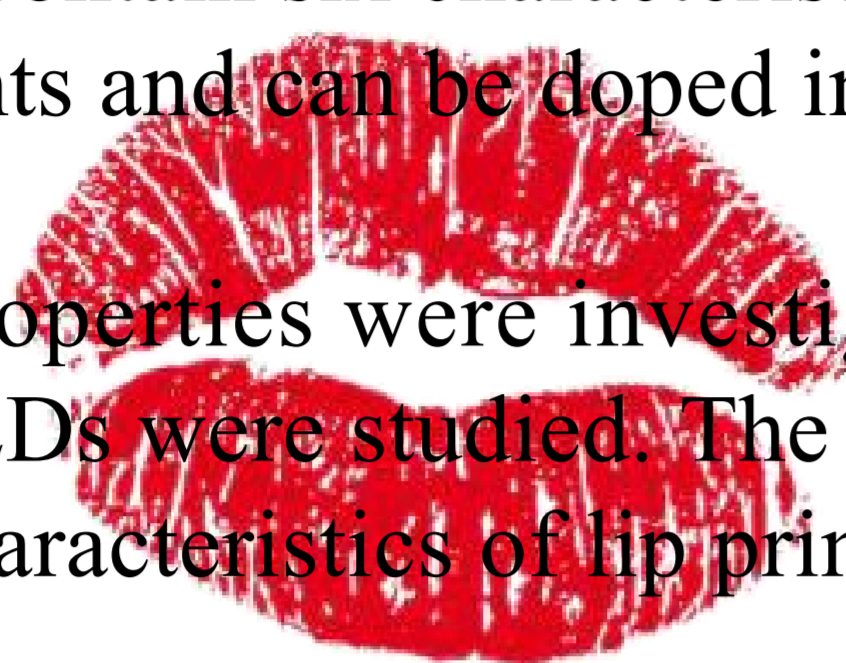


## $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$ 荧光粉的结构性质与光学性质在身份识别领域的应用

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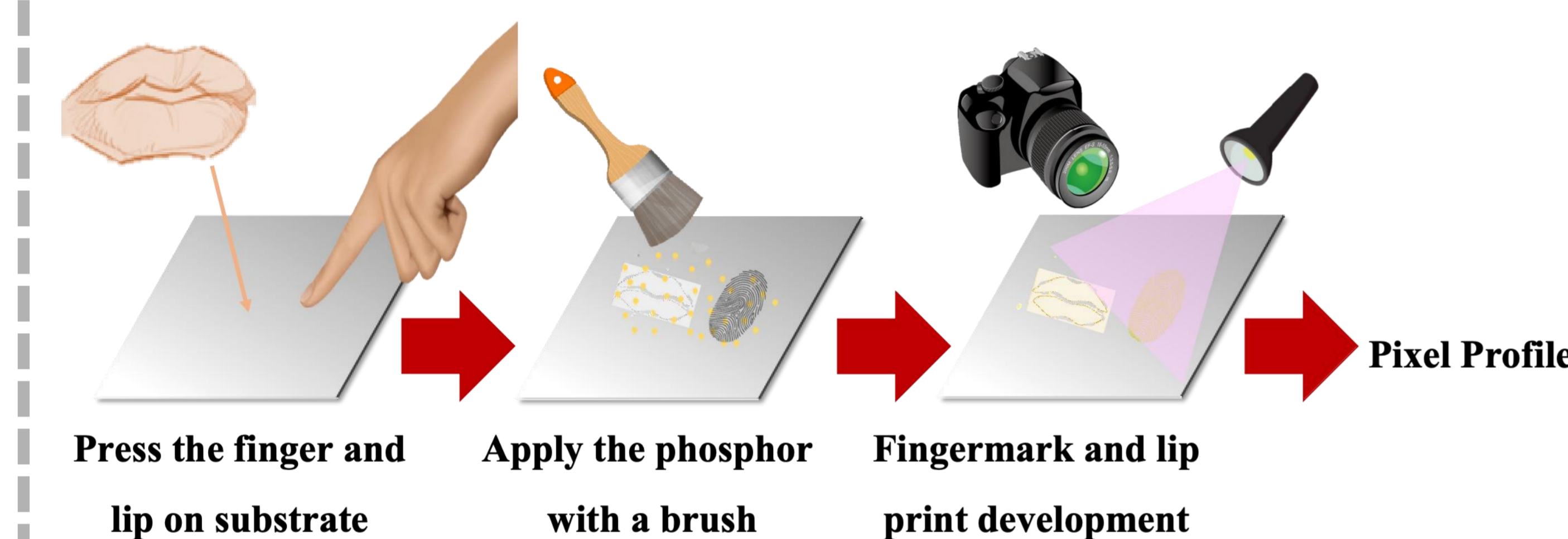
### Introduction

Fingerprints and lip prints are widely used in criminal science and forensic medicine. Fingerprints contain three-level features including level I, level II, and level III. Lip prints contain six characteristic.  $\text{Dy}^{3+}$  ion is one of the rare earth elements and can be doped in inorganic luminescent materials (Perovskite). In this work, structure and optical properties were investigated. The relevant parameters of the fabricated LEDs were studied. The three-level features of latent fingerprints and six characteristics of lip print had been explored.



### Experimental details

$\text{Cd}_2\text{MgTeO}_6:\text{x}\text{Dy}^{3+}, \text{x}\text{Na}^+$  ( $\text{x} = 0.5, 1, 2, 5, 10, 20, 30$  mol%) phosphors were synthesized in  $1000^\circ\text{C}$  for 12 h. The obtained powder was collected for further measurement.



### Results and discussion

#### Structural and optical properties

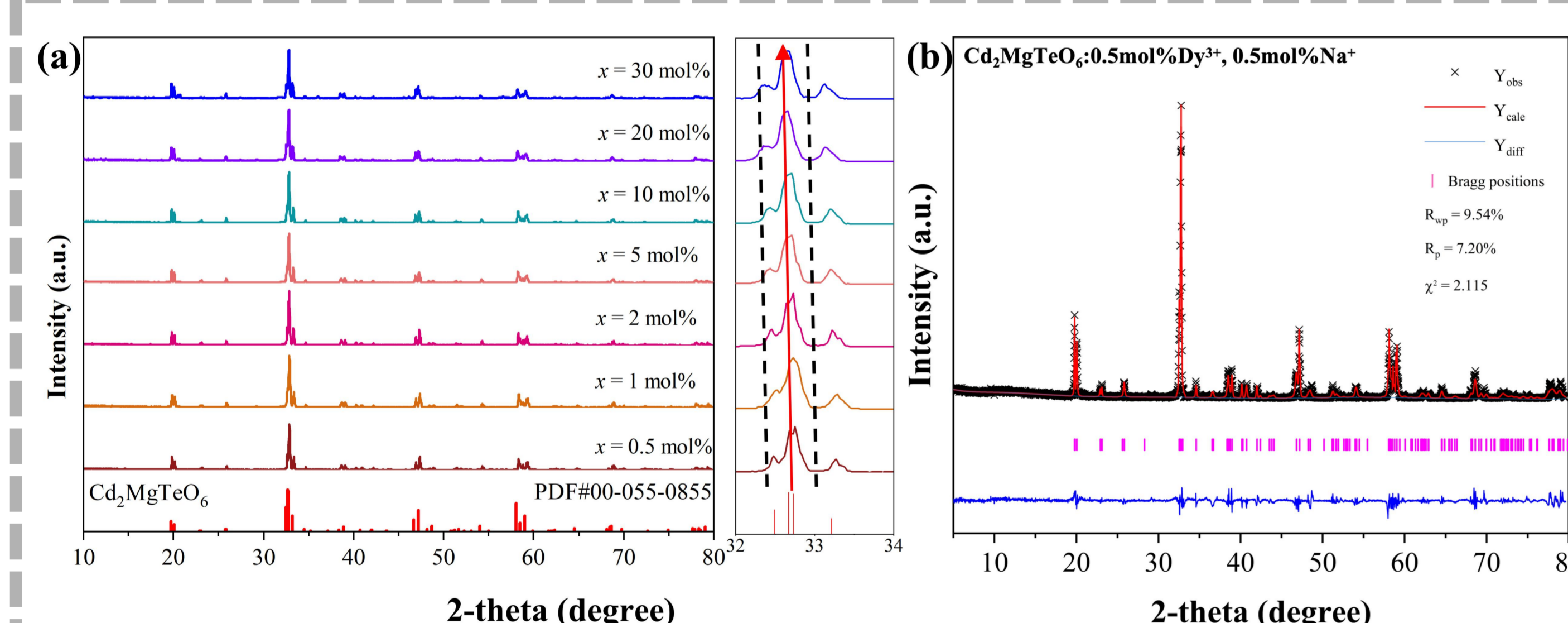


Figure 1 (a) The XRD patterns of  $\text{Cd}_2\text{MgTeO}_6:\text{x}$  mol% $\text{Dy}^{3+}$ ,  $\text{x}$  mol% $\text{Na}^+$  ( $0.5 \text{ mol}\% \leq \text{x} \leq 30 \text{ mol}\%$ ) with standard card (PDF#00-055-0855) and the enlarged diffraction peaks from 32 to 34 ( $2\theta$ ). (b) Rietveld refinement of  $\text{Cd}_2\text{MgTeO}_6:0.5 \text{ mol}\% \text{Dy}^{3+}, 0.5 \text{ mol}\% \text{Na}^+$ .

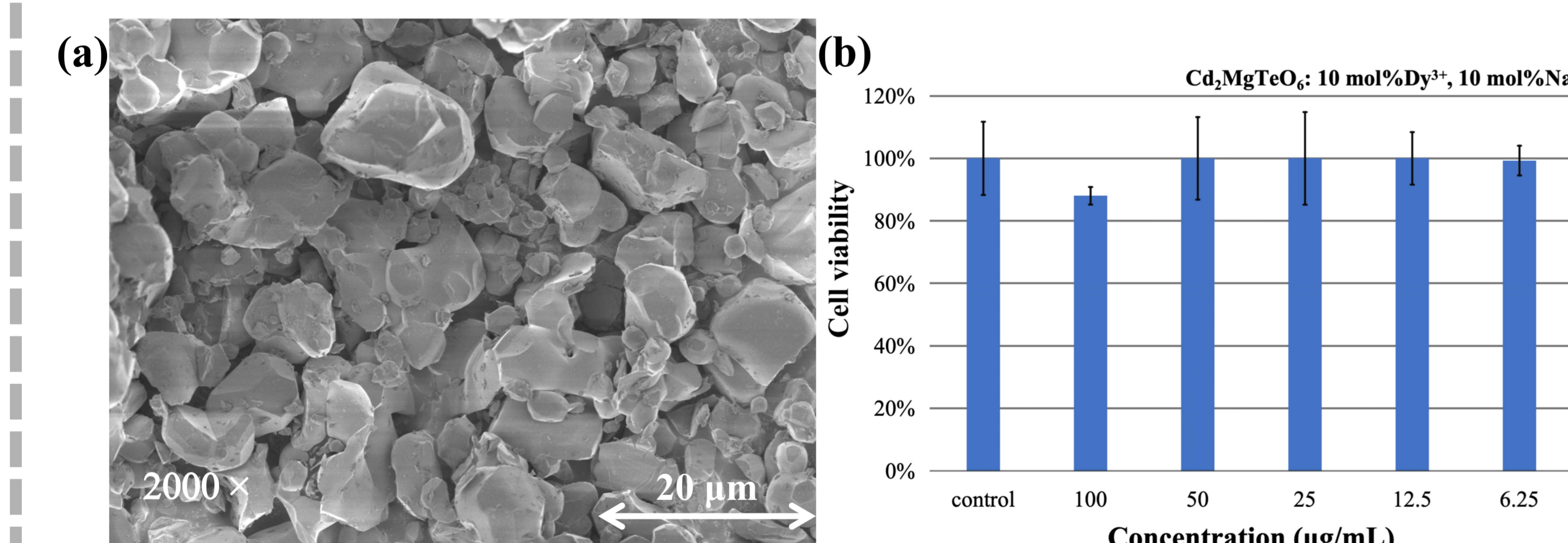
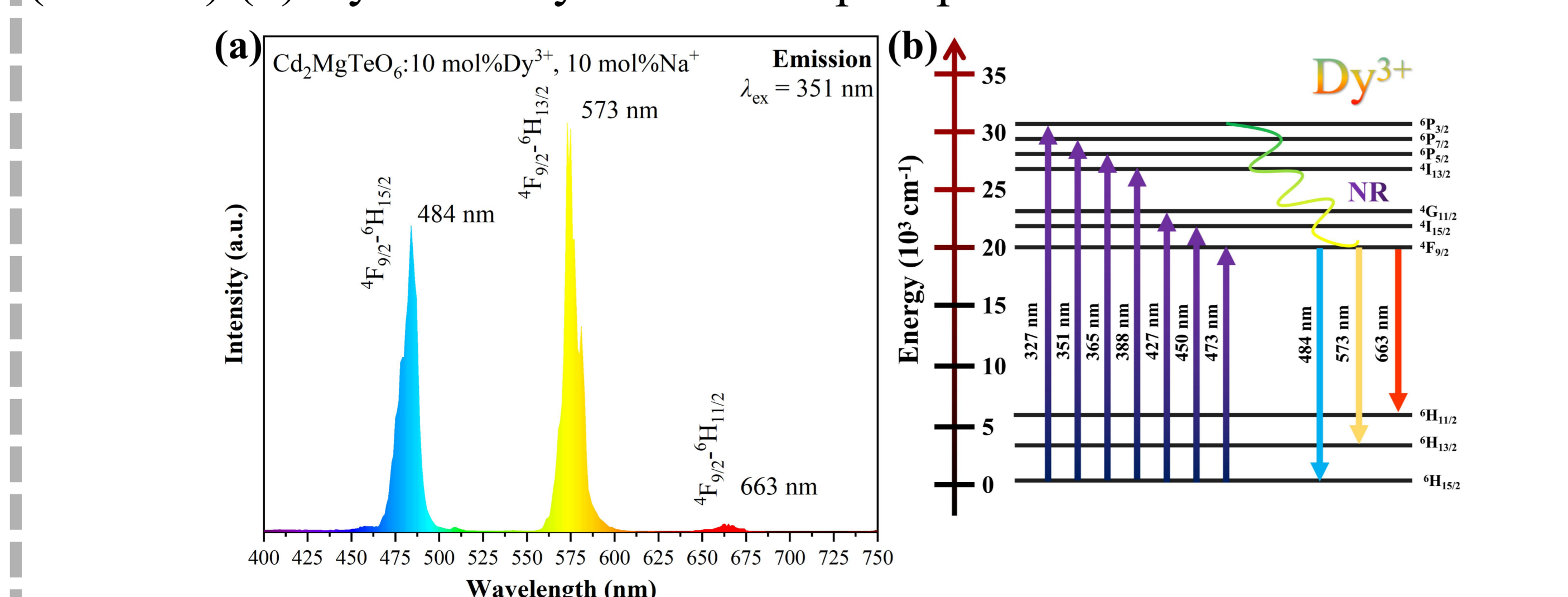


Figure 2 (a) SEM of  $\text{Cd}_2\text{MgTeO}_6:10 \text{ mol}\% \text{Dy}^{3+}, 10 \text{ mol}\% \text{Na}^+$  phosphor ( $2000\times$ ) (b) Cytotoxicity test for the phosphor.



### Results and discussion

Figure 3 (a) Emission spectrum of  $\text{Cd}_2\text{MgTeO}_6:10 \text{ mol}\% \text{Dy}^{3+}, 10 \text{ mol}\% \text{Na}^+$  phosphor. (b) Emission spectral mechanism of  $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$  phosphors.

#### Personal identification

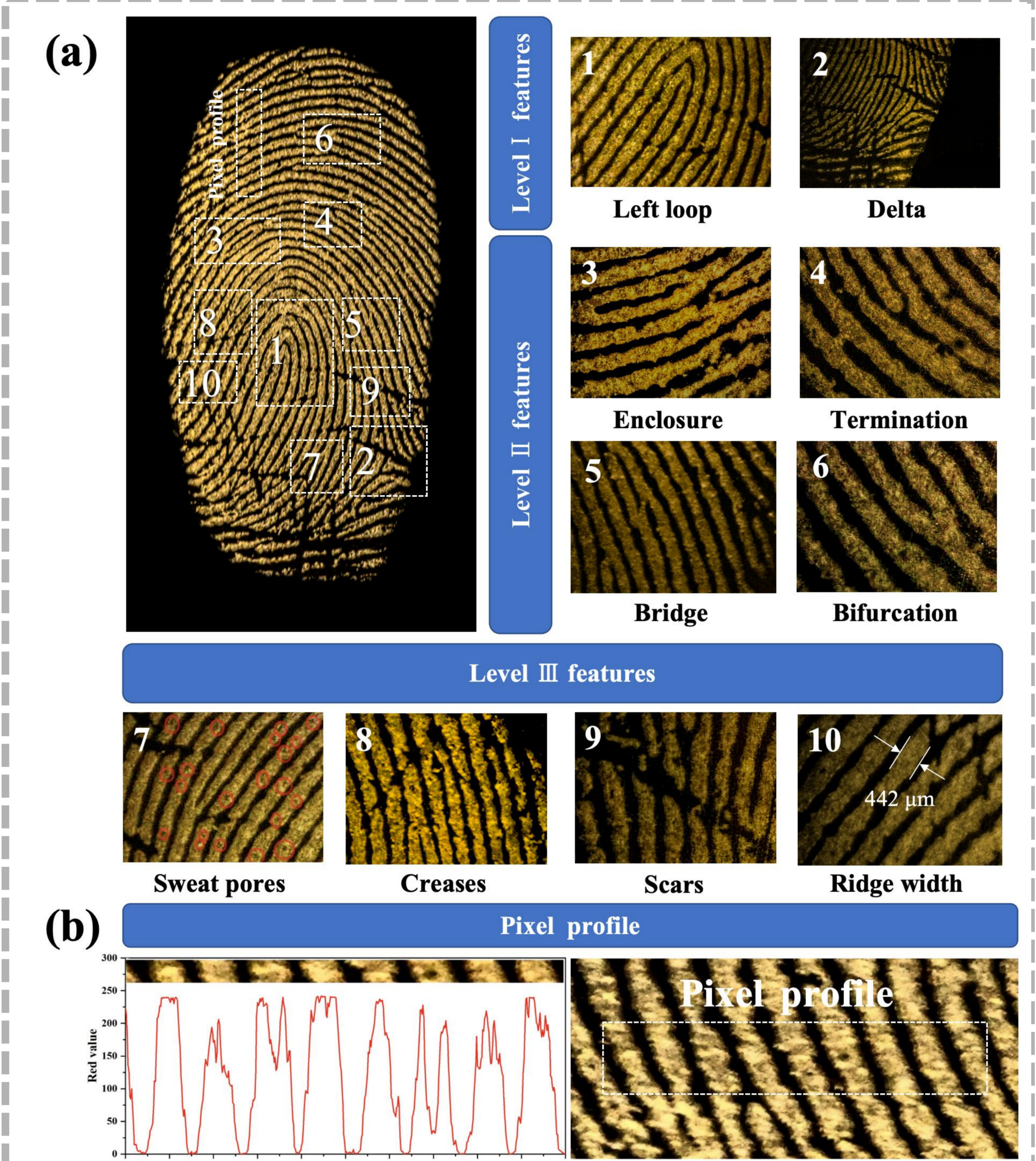


Figure 4 (a) Distinctive features of fingerprints (level I-III), and (b) pixel profile of the LFP adhered by  $\text{Cd}_2\text{MgTeO}_6:10 \text{ mol}\% \text{Dy}^{3+}, 10 \text{ mol}\% \text{Na}^+$  phosphor on aluminum foil, respectively.

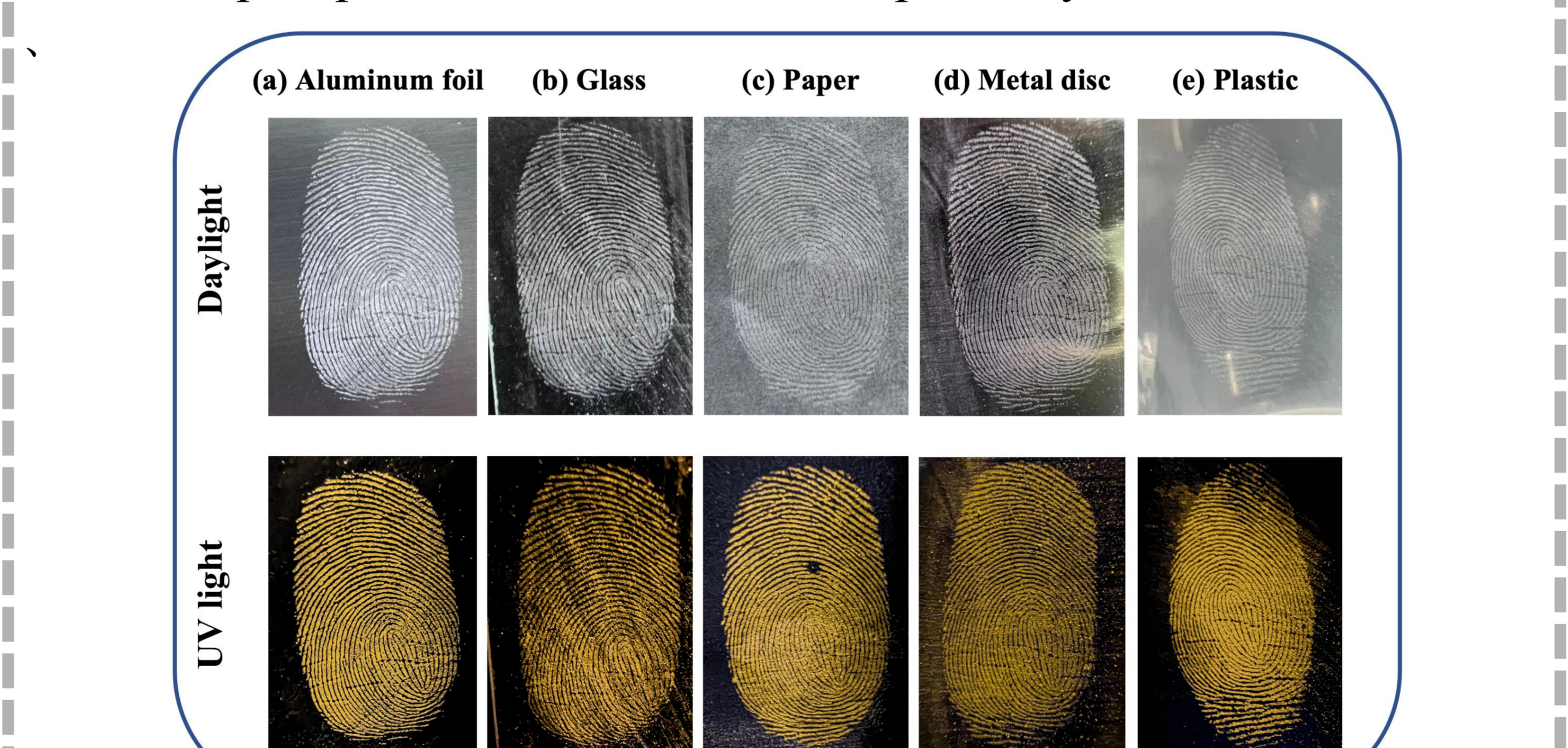


Figure 5 The comparison of fingerprints at porous substrates and non-porous substrate.

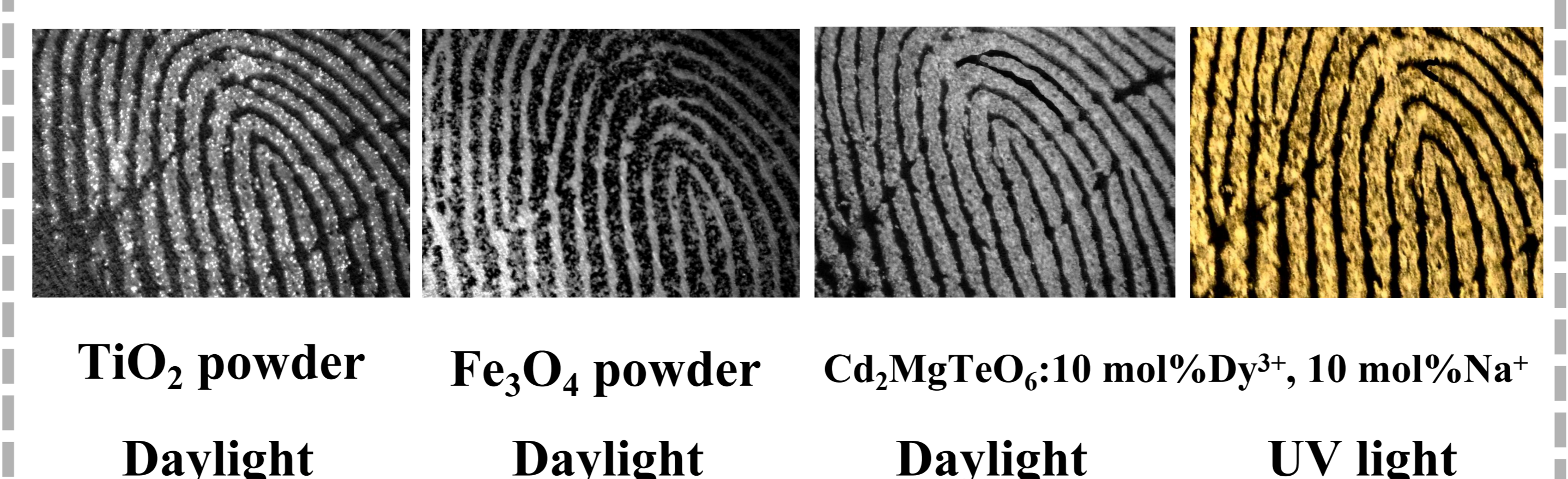


Figure 6 Comparison of traditional reagents ( $\text{Fe}_3\text{O}_4$  and  $\text{TiO}_2$  powder) and the  $\text{Cd}_2\text{MgTeO}_6:10 \text{ mol}\% \text{Dy}^{3+}, 10 \text{ mol}\% \text{Na}^+$  phosphor.

### Results and discussion

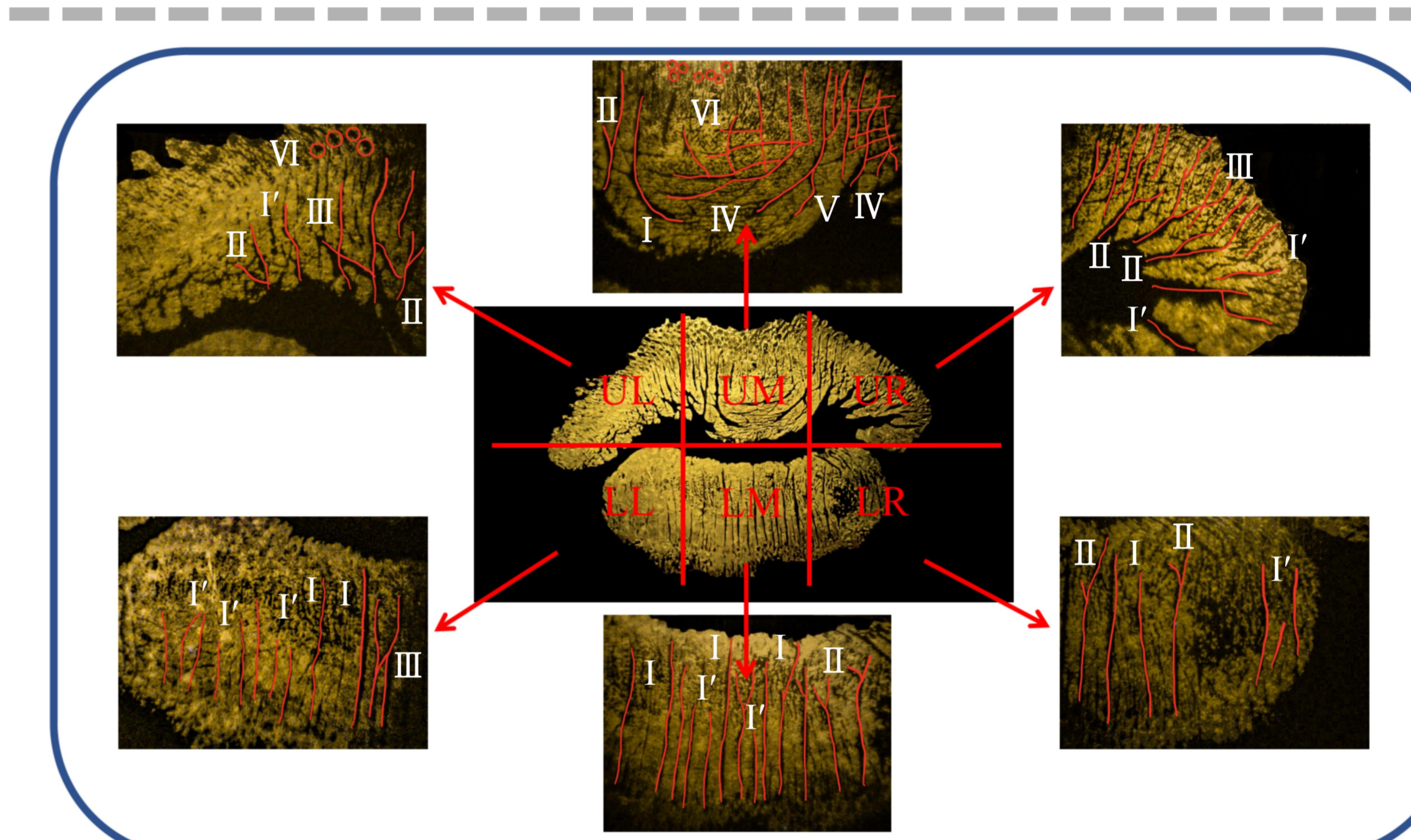


Figure 7 Six characteristics of the LP with  $\text{Cd}_2\text{MgTeO}_6:10 \text{ mol}\% \text{Dy}^{3+}, 10 \text{ mol}\% \text{Na}^+$  phosphor.

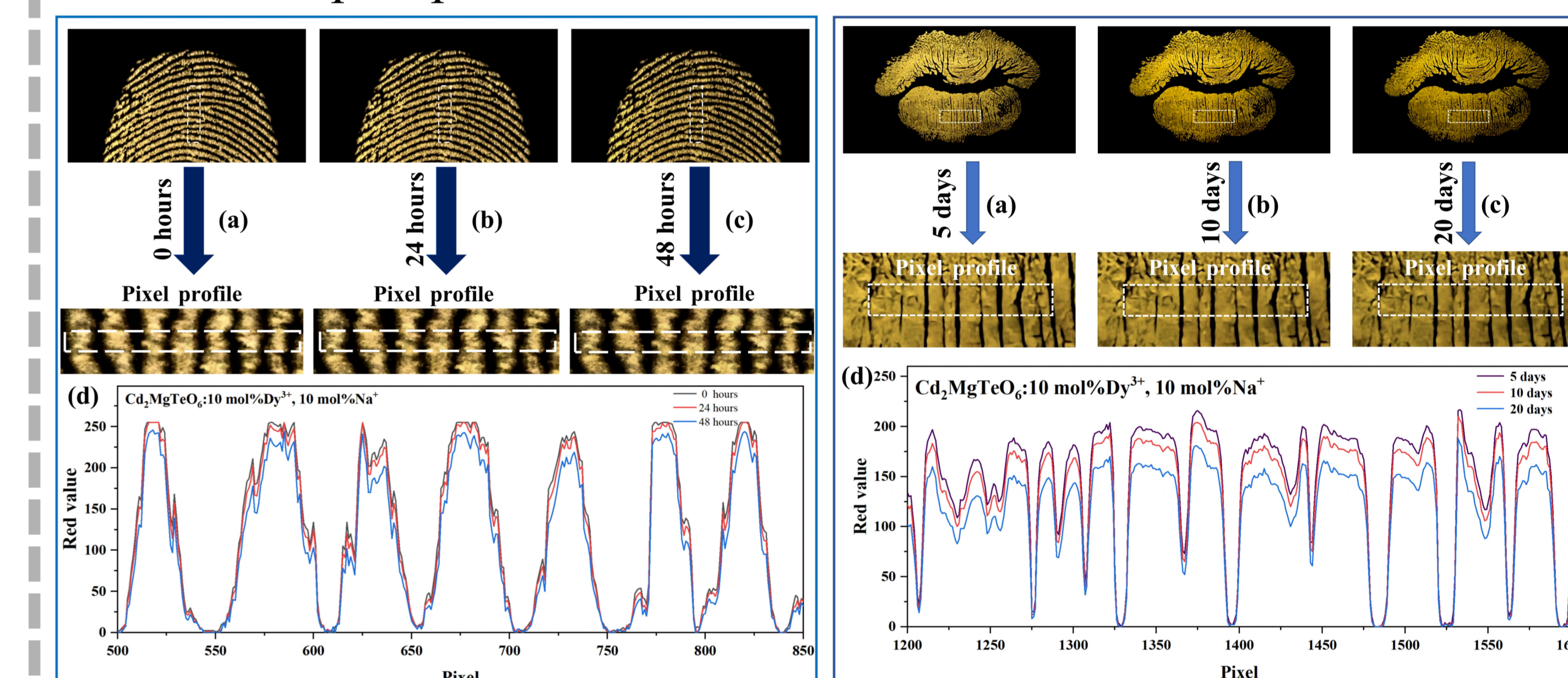


Figure 8 The partial LFP and LP images with the phosphor over 0, 24, and 48 hours treated under 365 nm and 5, 10, 20 days treated under daylight, respectively.

### Conclusions

- $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$  phosphors are synthesized via solid-state reaction and have high phase purity.
- $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$  phosphors have potential to be used for LFP and LP detection fields.

### Achievements

Ju Li (李举), Xinjing Xie(谢鑫晶), Ruiqi Yang(杨瑞奇), Jiaming Li, Zishuo Wang, Chaoyue Wang (王超悦), *et al.* Structural and optical properties of  $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$  phosphors for potential application in w-LEDs and personal identification. *J. Alloys Compds.* (Under Review) (IF = 6.2, JCR 1区, 中科院2区)

View Submission	JALCOM-D-23-10391R1	Structural and optical properties of $\text{Cd}_2\text{MgTeO}_6:\text{Dy}^{3+}, \text{Na}^+$ phosphors for potential application in w-LEDs and personal identification	Oct 02, 2023	Oct 10, 2023	Under Review
View Attachments					
View Reference Checking Results					
Send E-mail					

Ruiqi Yang (杨瑞奇), Ju Li(李举), Xinjing Xie(谢鑫晶), Jiangjing Lian(廉静静), Chaoyue Wang (王超悦), *et al.* Spectroscopic investigation of  $\text{K}_5\text{La}(\text{MoO}_4)_4:\text{Sm}^{3+}$  red phosphor with excellent thermal stability and color purity for white LEDs. *J. lumin.* (Required Reviews Completed) (IF = 3.6, JCR 2区, 中科院2区)

Action Links	LUMIN-D-23-01591	Spectroscopic investigation of $\text{K}_5\text{La}(\text{MoO}_4)_4:\text{Sm}^{3+}$ red phosphor with excellent thermal stability and color purity for white LEDs	Sep 28, 2023	Oct 20, 2023	Required Reviews Completed
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第四届全国大学生化学实验创新设计大赛西北赛区一等奖  
第九届全国青年科普创新实验暨作品大赛陕西赛区二等奖  
第八届全国大学生生命科学竞赛(创新创业类)一等奖  
第十一届中国创新创业大赛现代农业产业技术比赛优秀奖  
国家专利(ZL2023301694698)(杨瑞奇)

本研究依托于国家级大创(重点支持领域项目)基于发光材料的生物特征(指纹,唇纹)的提取、识别及机器学习与LED应用(项目编号202310712027)