

Electronic Supplementary Information (ESI)

**Red-emitting phosphors $\text{APF}_6:\text{Mn}^{4+}$ ($\text{A} = \text{Cs}^+, \text{Rb}^+, \text{K}^+$): synthesis,
luminescent properties and application in solid-state lighting**

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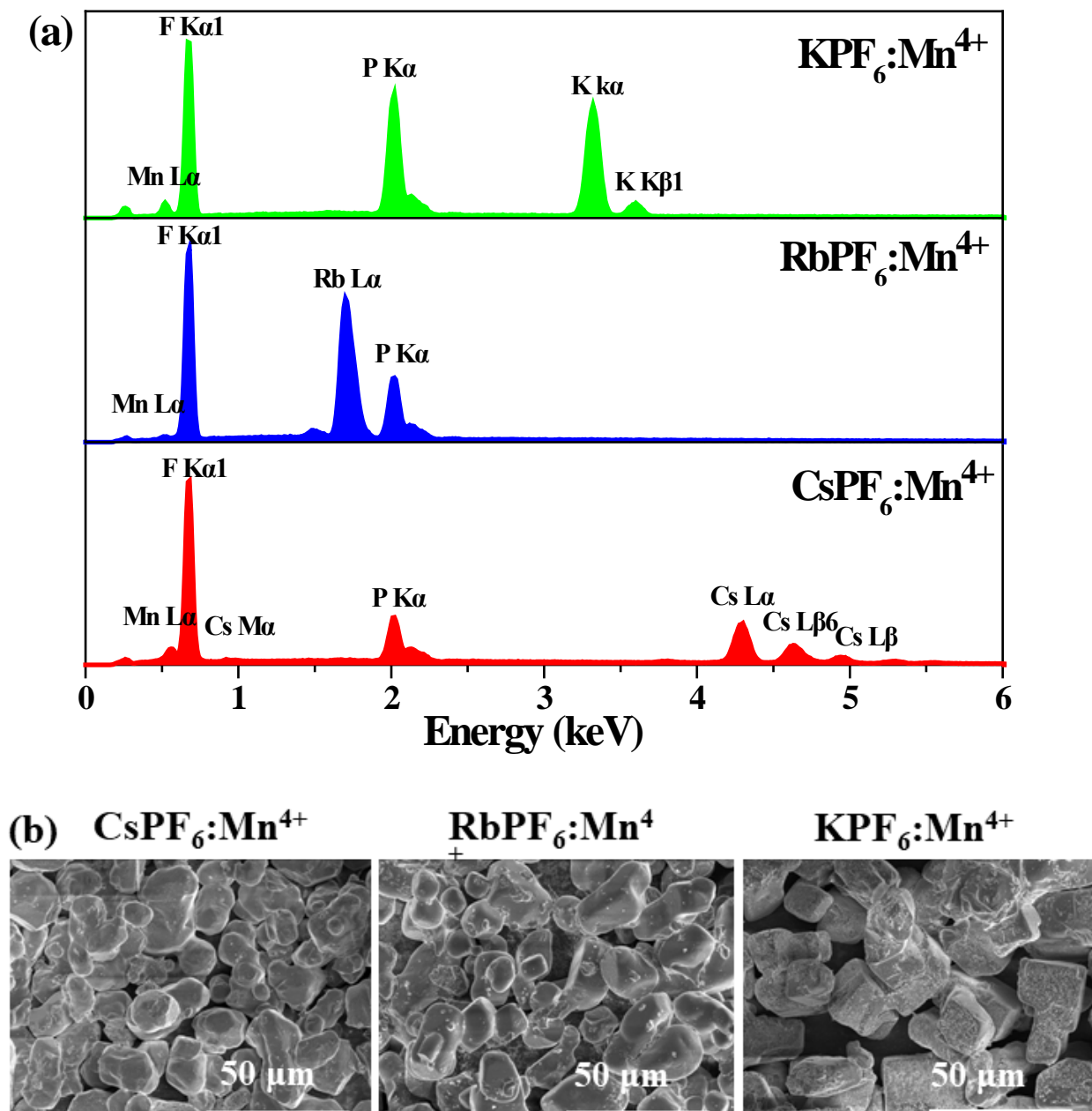


Fig. S1 (a) EDS spectra and (b) SEM images of $\text{APF}_6:\text{Mn}^{4+}$.

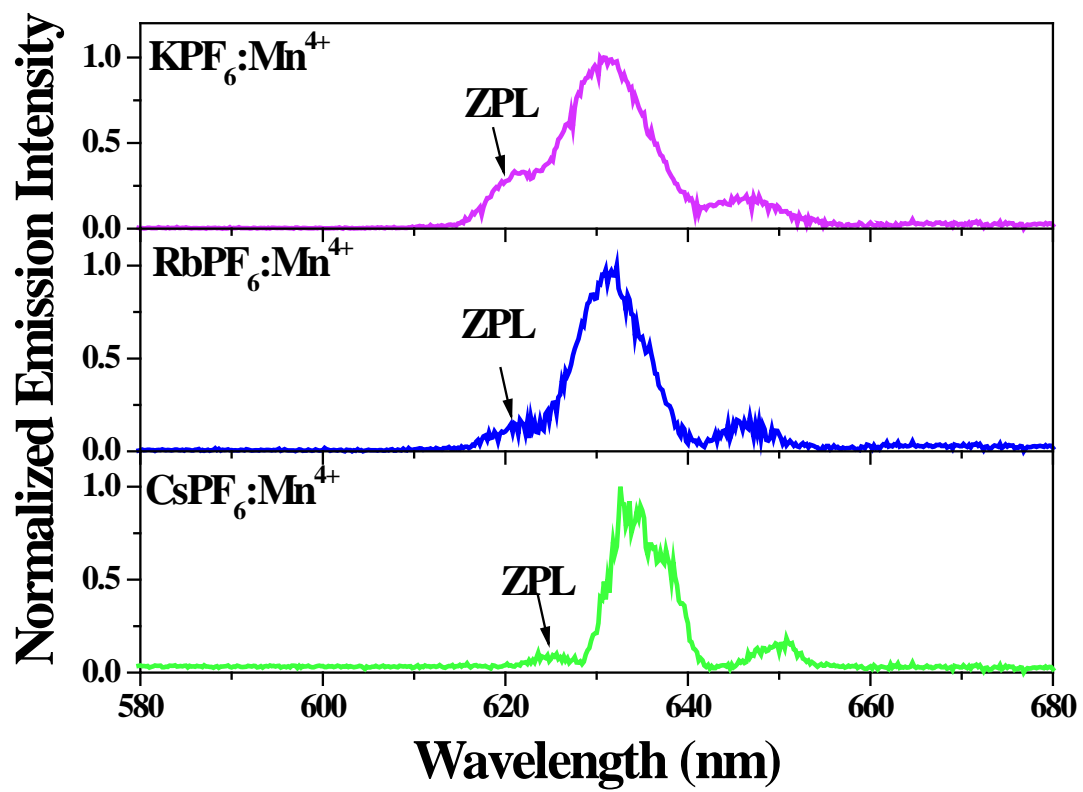


Fig. S2 Emission spectra of $\text{APF}_6:\text{Mn}^{4+}$ at 77 K

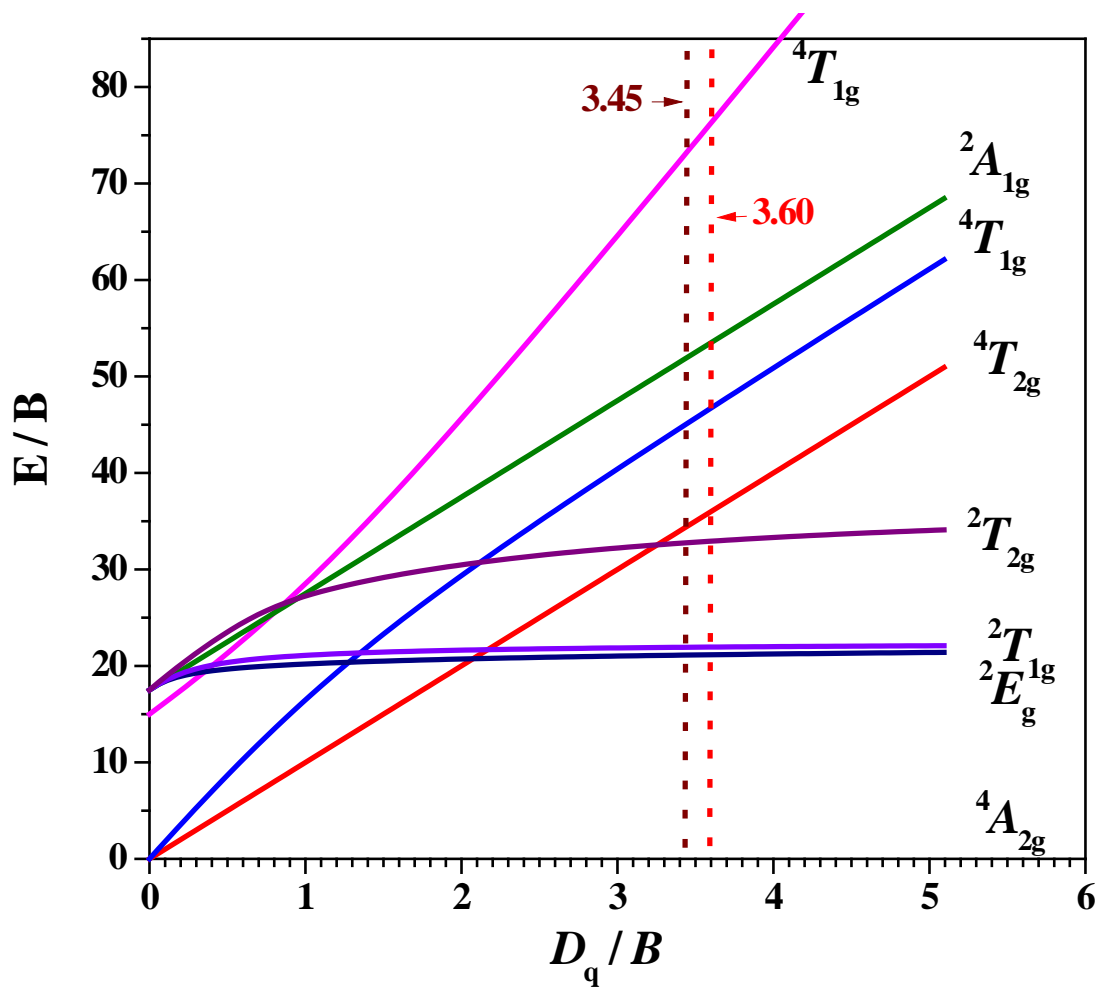


Fig. S3 Tanabe–Sugano energy-level diagram of Mn^{4+} in an octahedral crystal field.

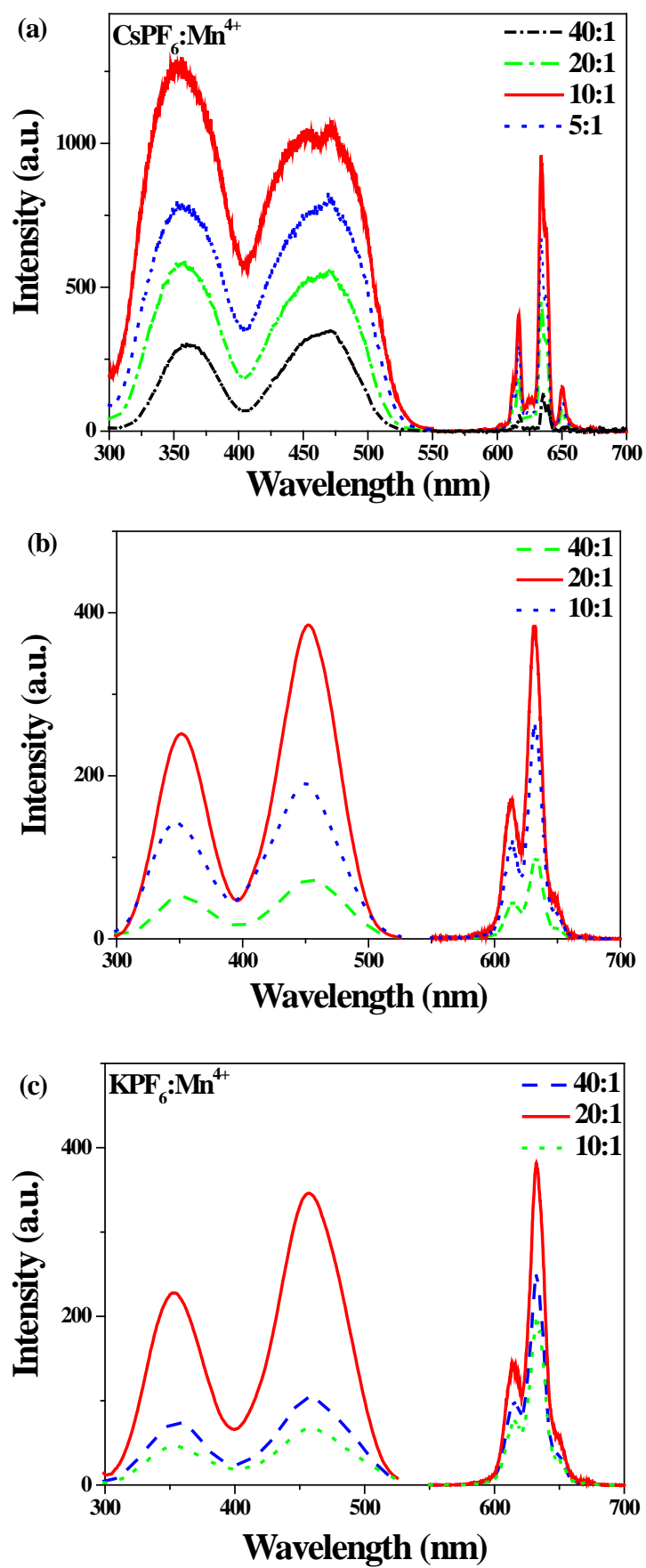


Fig. S4 PL spectra of APF₆:Mn⁴⁺ with different amounts of Mn⁴⁺

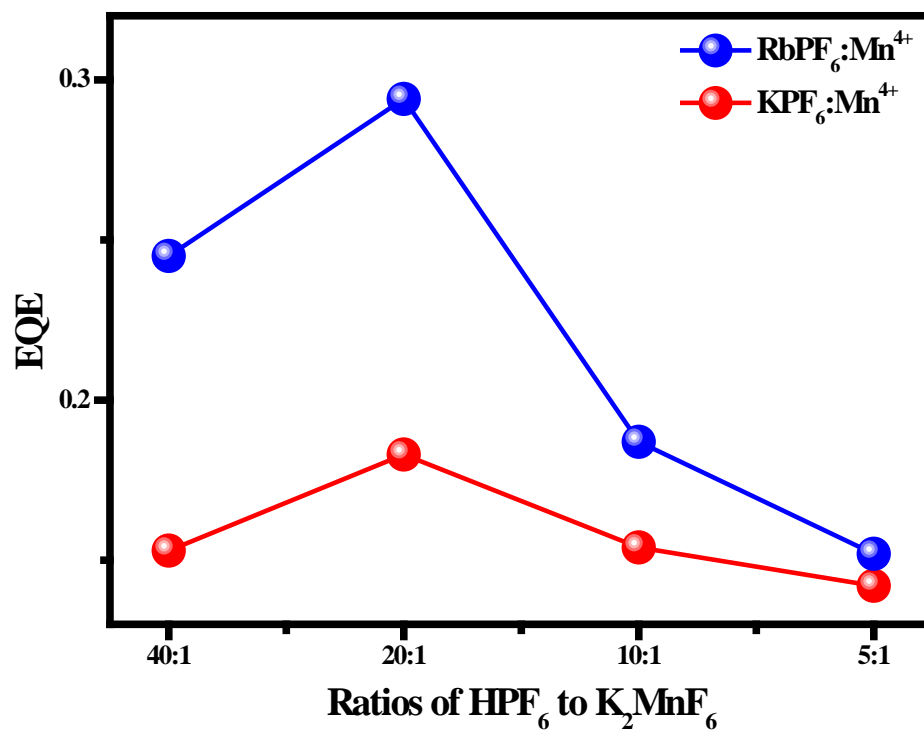


Fig. S5 EQE of RbPF₆:Mn⁴⁺ and KPF₆:Mn⁴⁺ prepared with different molar ratio of HPF₆ to K₂MnF₆

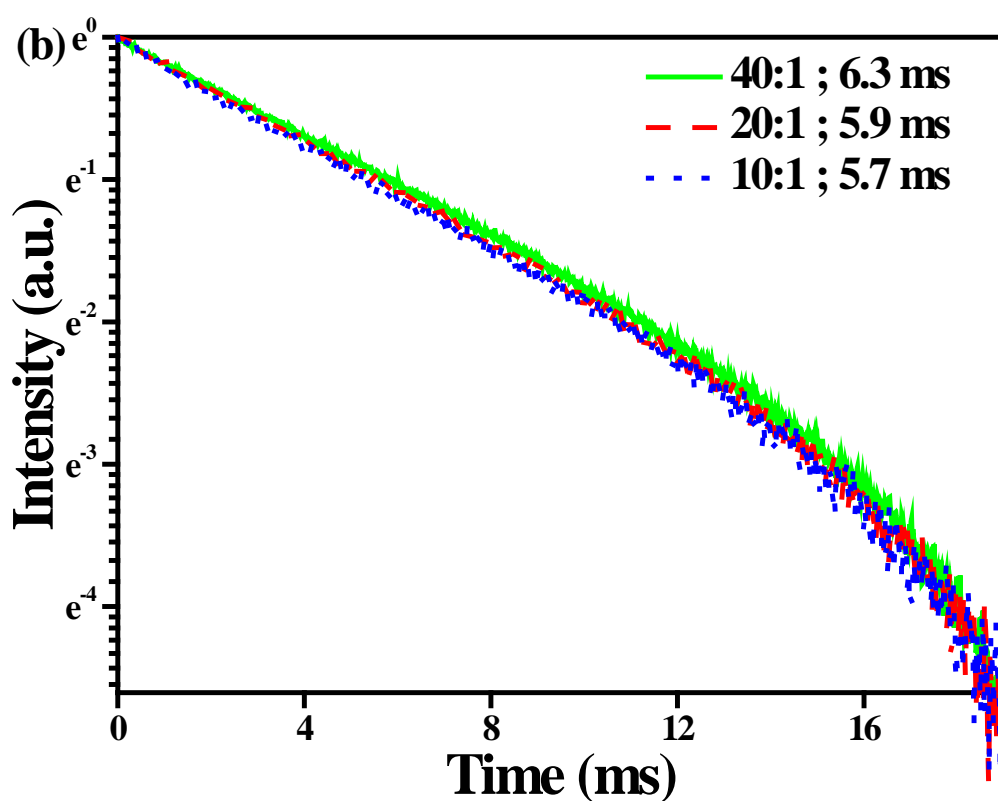
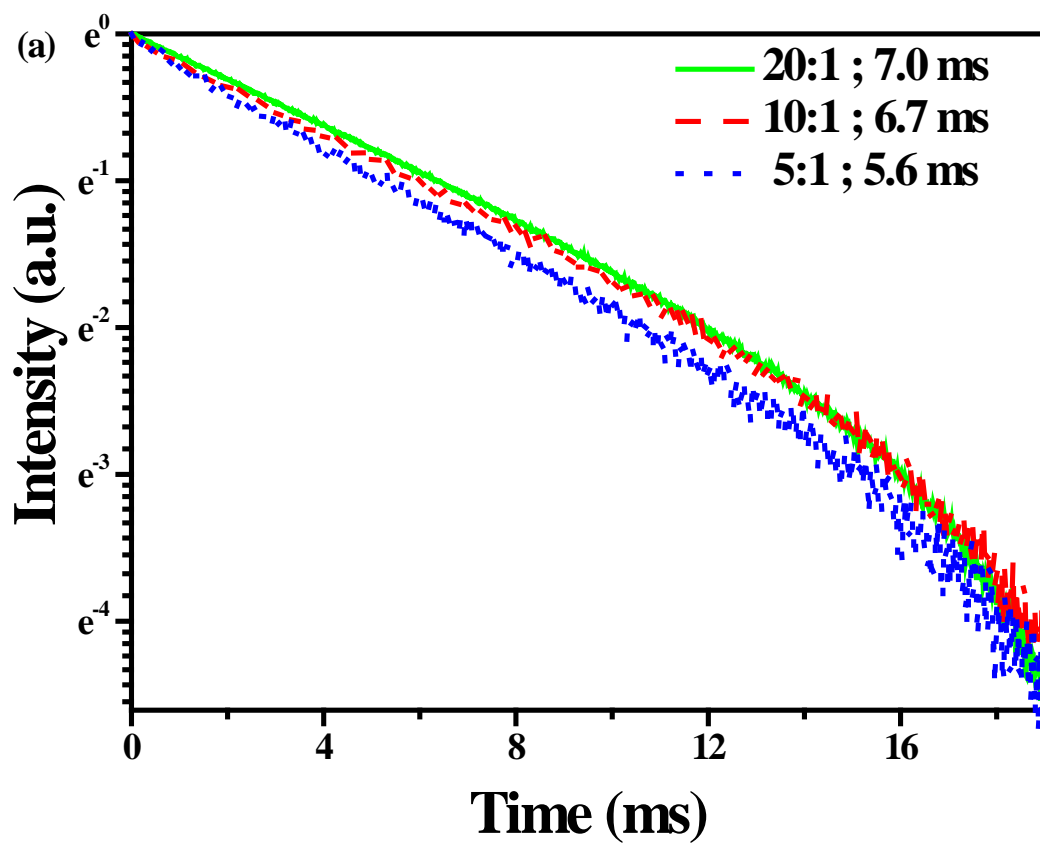


Fig. S6 Decay curves of transitions ${}^2E_g \rightarrow {}^4A_{2g}$ of Mn⁴⁺ in (a) RbPF₆:Mn⁴⁺ and (b) KPF₆:Mn⁴⁺ prepared with different molar ratios of HPF₆ to K₂MnF₆ (40:1, 20:1, 10:1)

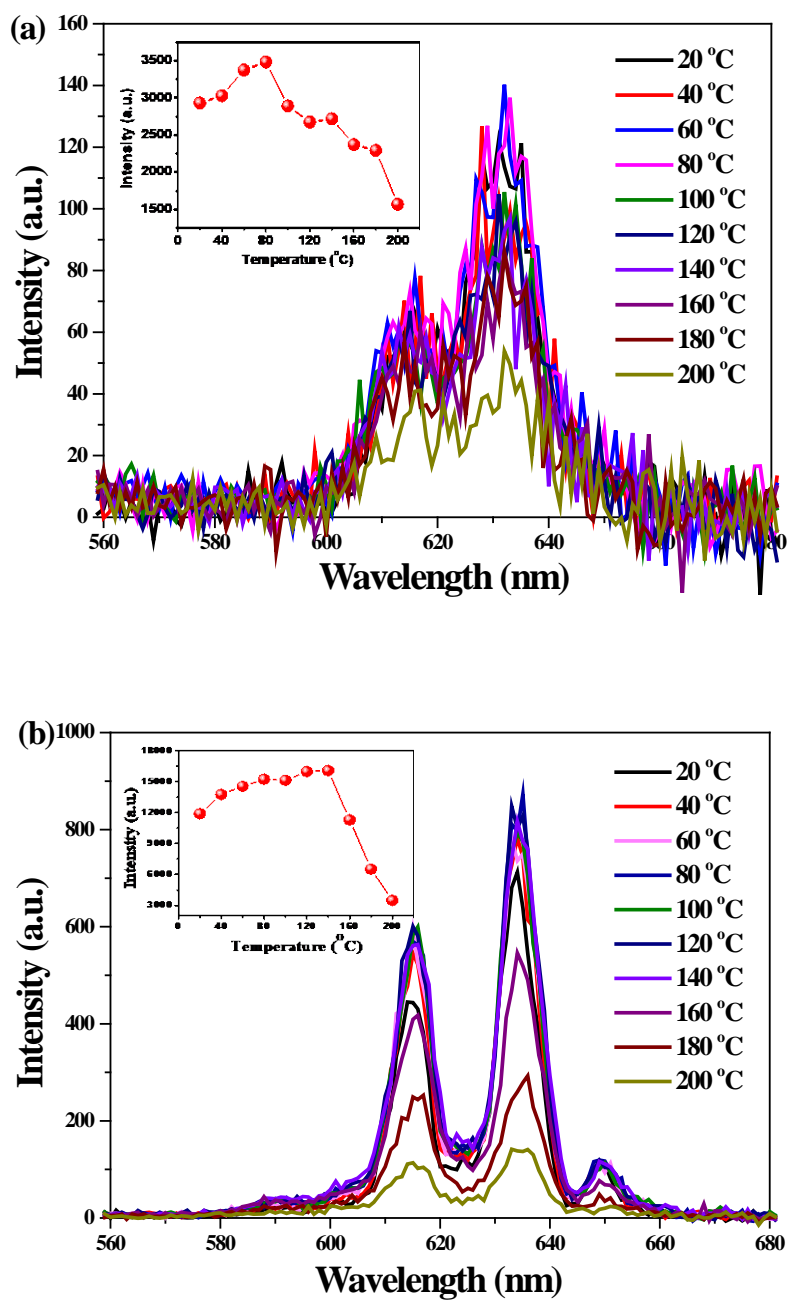


Fig. S7 Emission spectra of (a) RbPF₆:Mn⁴⁺ and (b) KPF₆:Mn⁴⁺ prepared with the HPF₆/K₂MnF₆ molar ratio of 10:1 at different temperatures. The inserted figures are the temperature dependence of emission intensity of RbPF₆:Mn⁴⁺ and KPF₆:Mn⁴⁺

Table S1 The contents of Mn⁴⁺ in CsPF₆:Mn⁴⁺ prepared with different molar ratios between HPF₆ and K₂MnF₆

Samples	Molar ratios of HPF ₆ : K ₂ MnF ₆	Doping amount of Mn ⁴⁺ (mol %)
1	40 : 1	0.84
2	20 : 1	2.28
3	10 : 1	3.58
4	5 : 1	11.91

Table S2 The contents of Mn⁴⁺ in RbPF₆:Mn⁴⁺ prepared with different molar ratios between HPF₆ and K₂MnF₆

Samples	Molar ratios of HPF ₆ : K ₂ MnF ₆	Doping amount of Mn ⁴⁺ (mol %)
1	40 : 1	1.13
2	20 : 1	3.18
3	10 : 1	6.55
4	5 : 1	15.59

Table S3 The contents of Mn⁴⁺ in KPF₆:Mn⁴⁺ prepared with different molar ratios between HPF₆ and K₂MnF₆

Samples	Molar ratios of HPF ₆ : K ₂ MnF ₆	Doping amount of Mn ⁴⁺ (mol %)
1	40 : 1	1.56
2	20 : 1	3.84
3	10 : 1	7.34
4	5 : 1	16.00