

## Supplementary Information

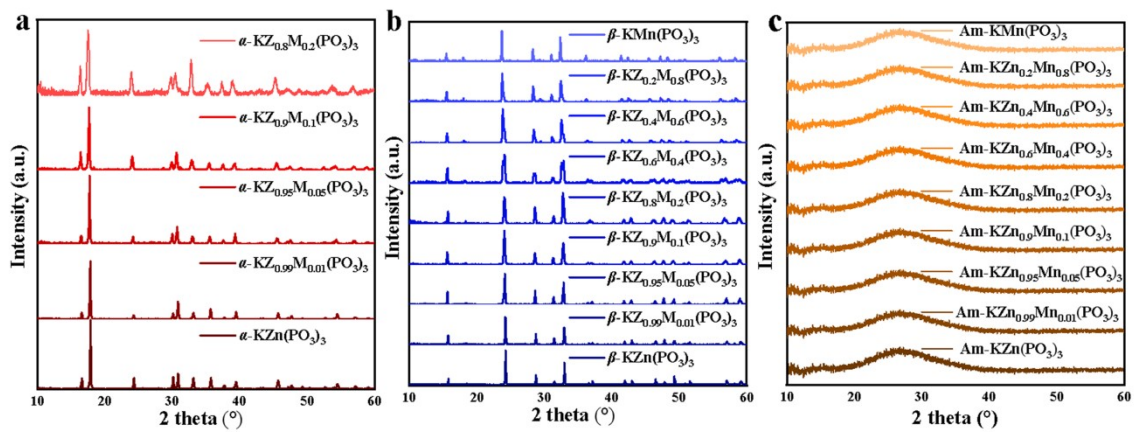
### **Tunable orange-deep red photoluminescence in amorphous $\text{KZn}_{1-x}\text{Mn}_x(\text{PO}_3)_3$ phosphors and anti-counterfeiting applications**

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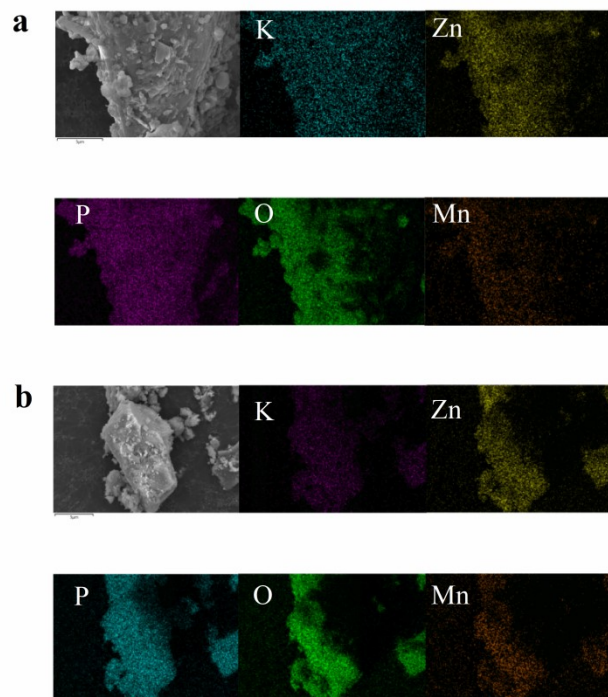
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**Fig. S1.** The XRD patterns of a)  $\alpha$ -KZn<sub>1-x</sub>Mn<sub>x</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor, b)  $\beta$ -KZn<sub>1-x</sub>Mn<sub>x</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor, and c) Am-KZn<sub>1-x</sub>Mn<sub>x</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor.



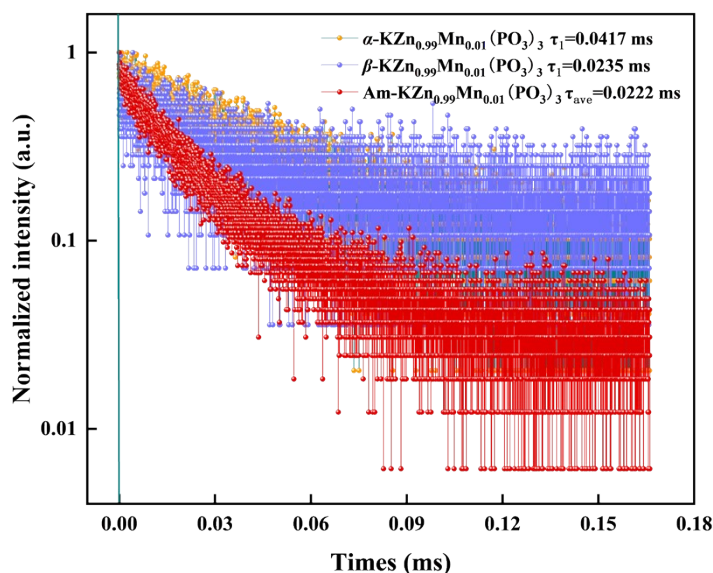
**Fig. S2.** SEM images, and 2D element mapping of a)  $\alpha$ - $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$  phosphor and b)  $\beta$ - $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$  phosphor.

**Table. S1.** The individual lifetime components ( $\tau_1$ ,  $\tau_2$ ) and their relative amplitudes ( $A_1$ ,  $A_2$ ) at  $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$  phosphor with different phases.

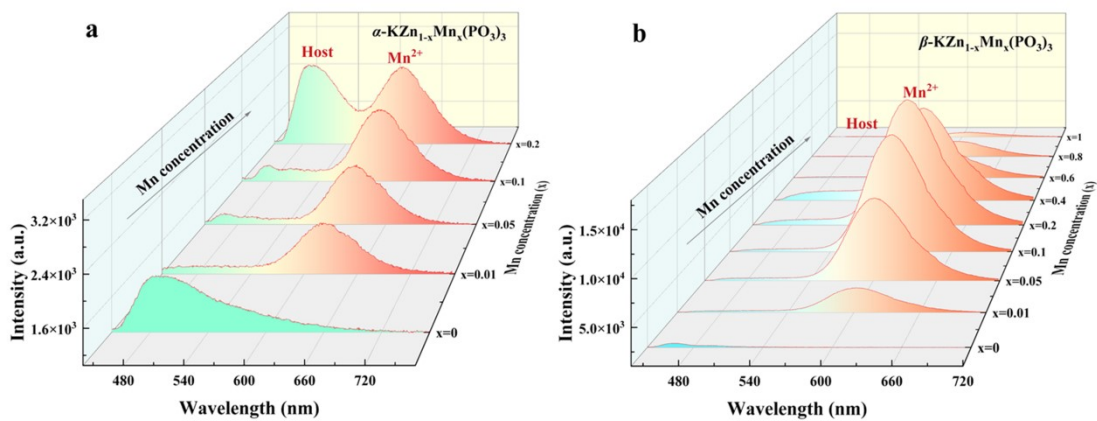
Materials	$A_1$	$\tau_1(\text{ms})$	$A_2$	$\tau_2(\text{ms})$	$\tau_{\text{ave}}$	$R^2$
$\alpha$ - $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$	0.43025	3.08456	0.33267	24.15623	21.16954	0.9693
$\beta$ - $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$	0.35486	7.76794	0.5912	26.32281	23.53072	0.99196
Am- $\text{KZn}_{0.8}\text{Mn}_{0.2}(\text{PO}_3)_3$	0.40992	2.96749	0.53371	18.56466	16.85916	0.98716

**Table. S2.** The individual lifetime components and their relative amplitudes at  $\text{KZn}_{0.99}\text{Mn}_{0.01}(\text{PO}_3)_3$  phosphor with different phases.

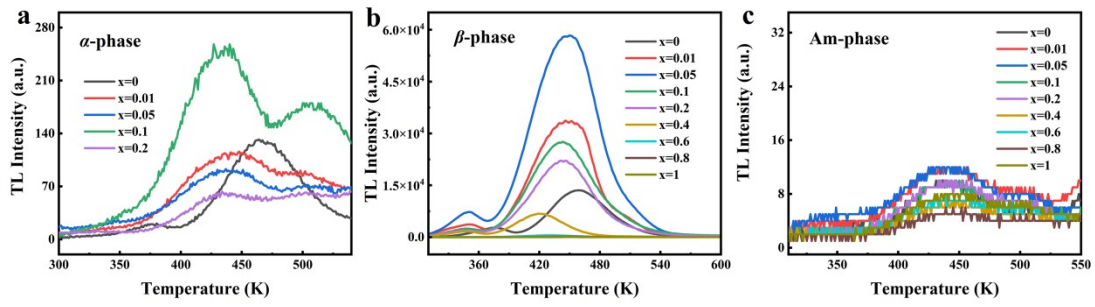
Materials	$A_1$	$\tau_1(\text{ms})$	$A_2$	$\tau_2(\text{ms})$	$\tau_{\text{ave}}$	$R^2$
$\alpha$ - $\text{KZn}_{0.99}\text{Mn}_{0.01}(\text{PO}_3)_3$	0.68972	0.04177	-	-	-	0.96125
$\beta$ - $\text{KZn}_{0.99}\text{Mn}_{0.01}(\text{PO}_3)_3$	0.42285	0.02348	-	-	-	0.95731
Am- $\text{KZn}_{0.99}\text{Mn}_{0.01}(\text{PO}_3)_3$	0.25061	0.00764	0.51181	0.02447	0.02223	0.96913



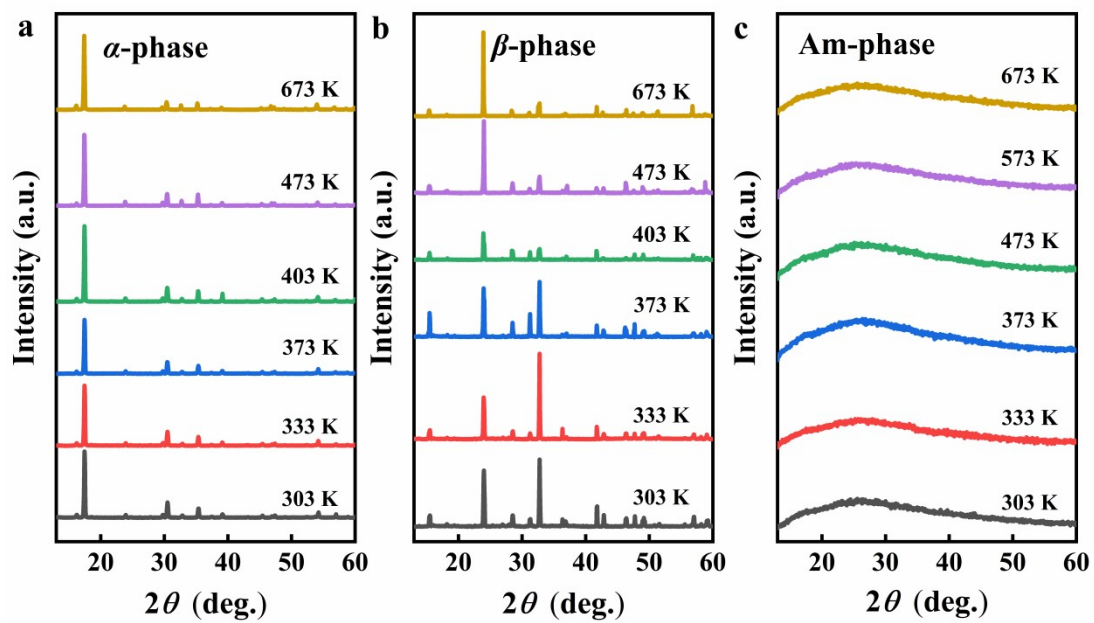
**Fig. S3.** The decay curves of  $\text{KZn}_{0.99}\text{Mn}_{0.01}(\text{PO}_3)_3$  phosphor for different phases.



**Fig. S4.** The 3D PL spectra of a)  $\alpha$ -KZn<sub>1-x</sub>Mn<sub>x</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor and b)  $\beta$ -KZn<sub>1-x</sub>Mn<sub>x</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor.



**Fig. S5.** The TL curves of a)  $\alpha$ - $\text{KZn}_{1-x}\text{Mn}_x(\text{PO}_3)_3$  phosphor, b)  $\beta$ - $\text{KZn}_{1-x}\text{Mn}_x(\text{PO}_3)_3$  phosphor, and c) Am- $\text{KZn}_{1-x}\text{Mn}_x(\text{PO}_3)_3$  phosphor at heating rates of  $1 \text{ K s}^{-1}$ .



**Fig. S6.** The temperature-dependent XRD patterns of a)  $\alpha$ -KZn<sub>0.95</sub>Mn<sub>0.05</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor, b)  $\beta$ -KZn<sub>0.95</sub>Mn<sub>0.05</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor, and c) Am-KZn<sub>0.95</sub>Mn<sub>0.05</sub>(PO<sub>3</sub>)<sub>3</sub> phosphor.

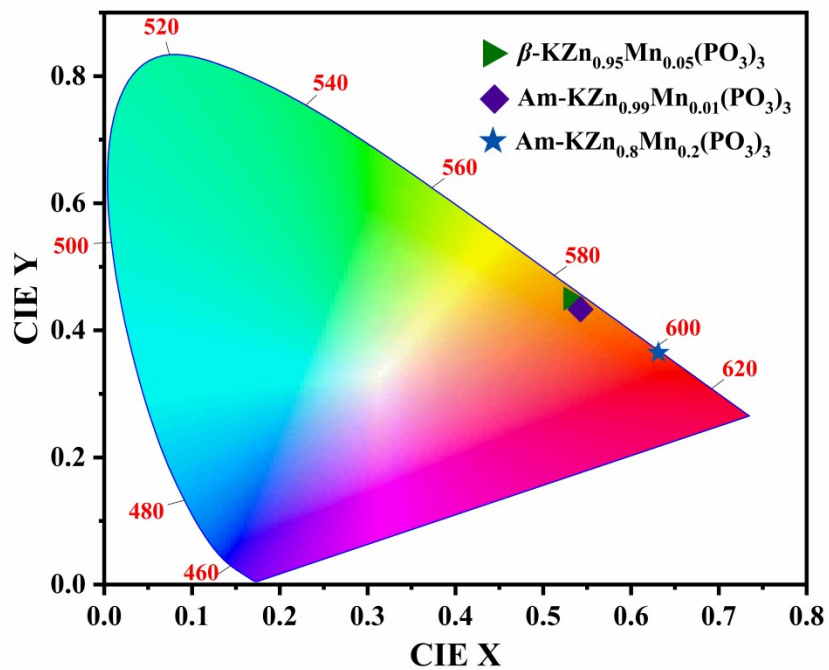


Fig. S7. The CIE chromaticity coordinates of  $\beta$ -KZn<sub>0.95</sub>Mn<sub>0.05</sub>(PO<sub>3</sub>)<sub>3</sub>, Am-KZn<sub>0.99</sub>Mn<sub>0.01</sub>(PO<sub>3</sub>)<sub>3</sub>, and Am-KZn<sub>0.8</sub>Mn<sub>0.2</sub>(PO<sub>3</sub>)<sub>3</sub> phosphors.