

## SUPPORTING INFORMATION

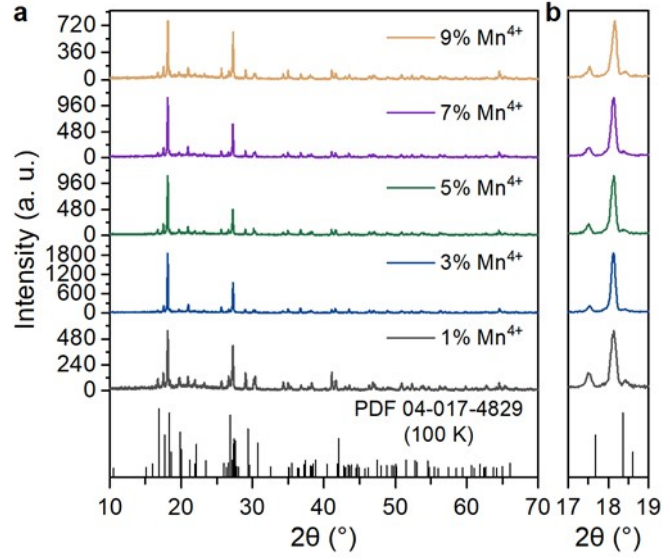
### **Non-equivalent Mn<sup>4+</sup> doping in mixed-anion host of K<sub>3</sub>Na(MoO<sub>2</sub>F<sub>4</sub>)<sub>2</sub>·H<sub>2</sub>O achieving short fluorescence lifetime and intense zero phonon line**

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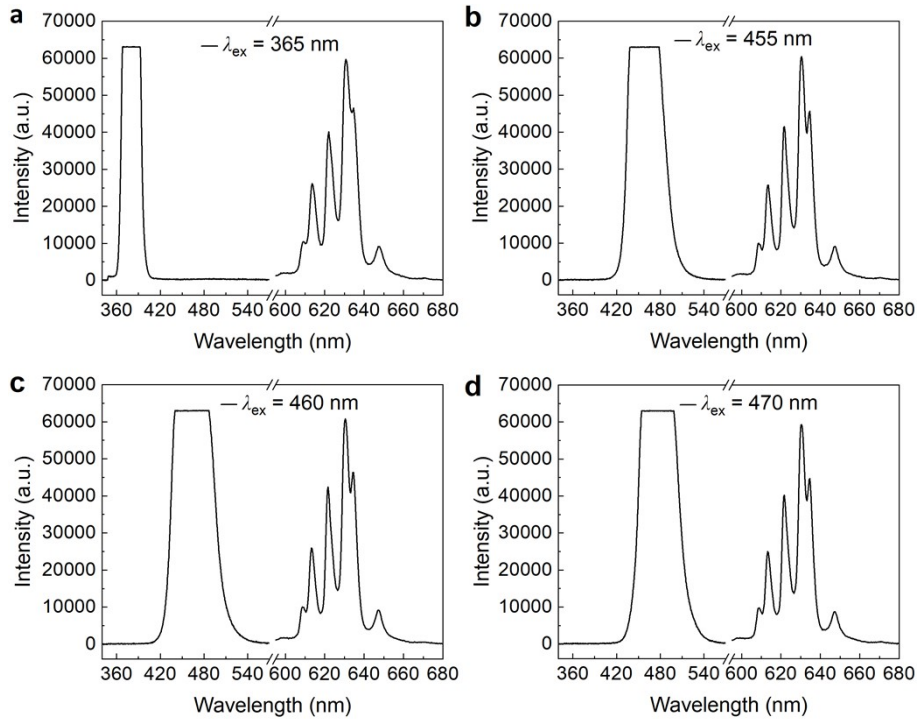
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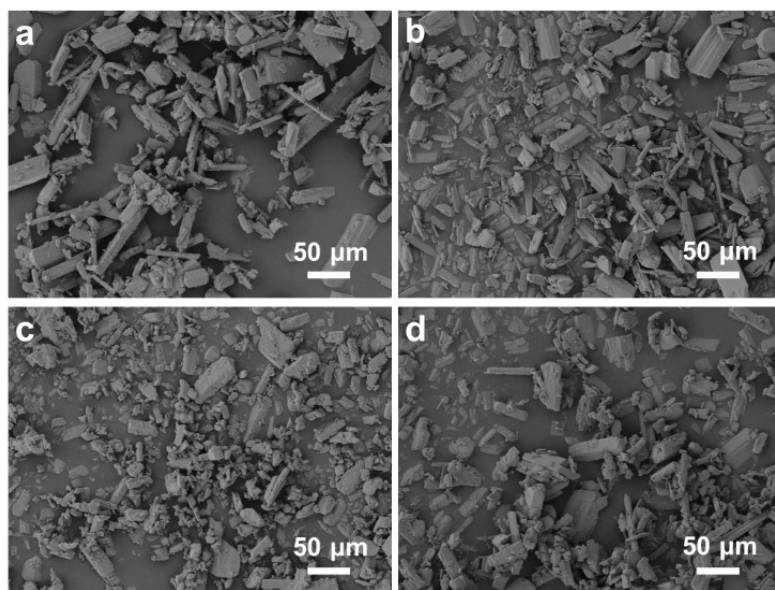
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**Fig. S1** XRD patterns in the 2θ range of 10°–70° (a), and 2θ range of 17°–19° (b) of  $\text{K}_3\text{Na}(\text{MoO}_2\text{F}_4)_2 \cdot \text{H}_2\text{O} : x\text{Mn}^{4+}$  ( $x = 1\%$ , 3%, 5%, 7%, 9%;  $x$  is the nominal atomic ratio of Mn<sup>4+</sup> designed for substituting Mo<sup>6+</sup>) phosphors.



**Fig. S2** PL spectra of  $\text{K}_3\text{Na}(\text{MoO}_2\text{F}_4)_2 \cdot \text{H}_2\text{O} : 3\%\text{Mn}^{4+}$  under different excitation wavelengths.



**Fig. S3** SEM images of  $\text{K}_3\text{Na}(\text{MoO}_2\text{F}_4)_2 \cdot \text{H}_2\text{O} : 3\% \text{Mn}^{4+}$  prepared with different HF dosage (a, 1.0 mL; b, 1.5 mL; c, 2.0 mL HF; d, 2.5 mL HF).

**Table S1.** Crystallographic parameters and refinement parameters for  $\text{K}_3\text{Na}(\text{MoO}_2\text{F}_4)_2 \cdot \text{H}_2\text{O} : 3\% \text{Mn}^{4+}$  prepared with 1 mL HF

Items	Parameters
Space group	$C2/m$
Crystal structure	Monoclinic
$a$ (Å)	20.4882(8)
$b$ (Å)	5.9242(3)
$c$ (Å)	11.8238(3)
$\alpha = \beta$ (°)	90
$\gamma$ (°)	124.2527
Volume (Å <sup>3</sup> )	1186.238(4)
$R_{\text{wp}}$ (%)	8.74
$R_{\text{p}}$ (%)	7.36
$\chi^2$	1.82