

Electronic Supplementary Information (ESI)

**Luminescent properties of Mn⁴⁺ with the high ²E_g level energy in
polyfluoride Na₃Li₃Sc₂F₁₂**

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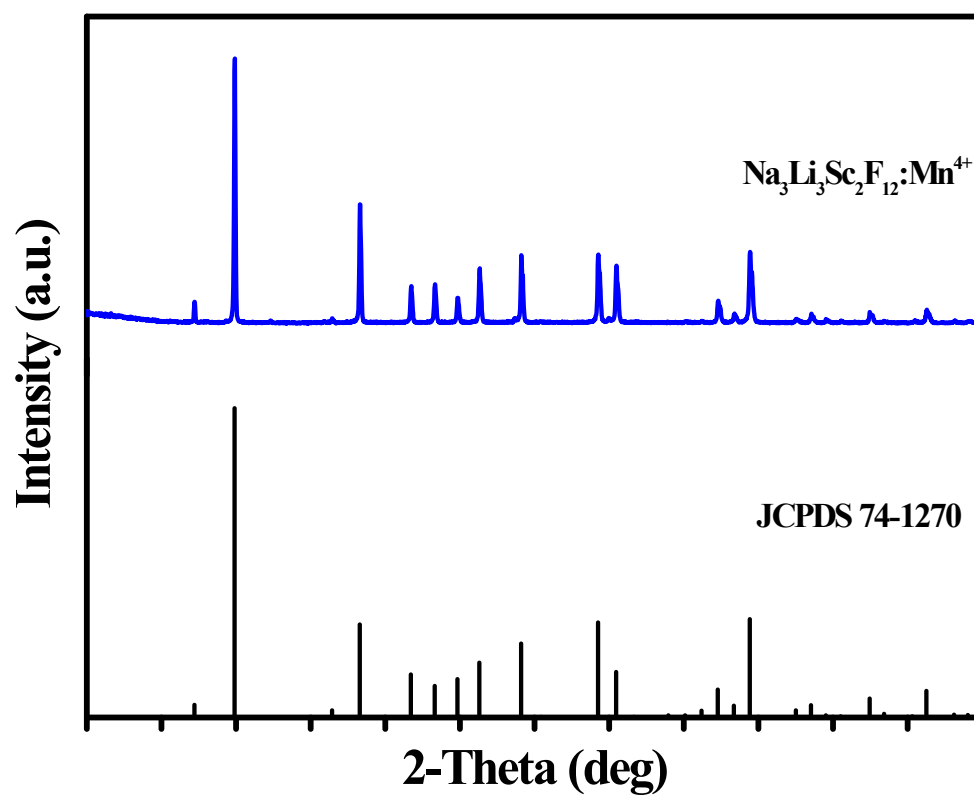


Fig. S1 XRD pattern of $\text{Na}_3\text{Li}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$

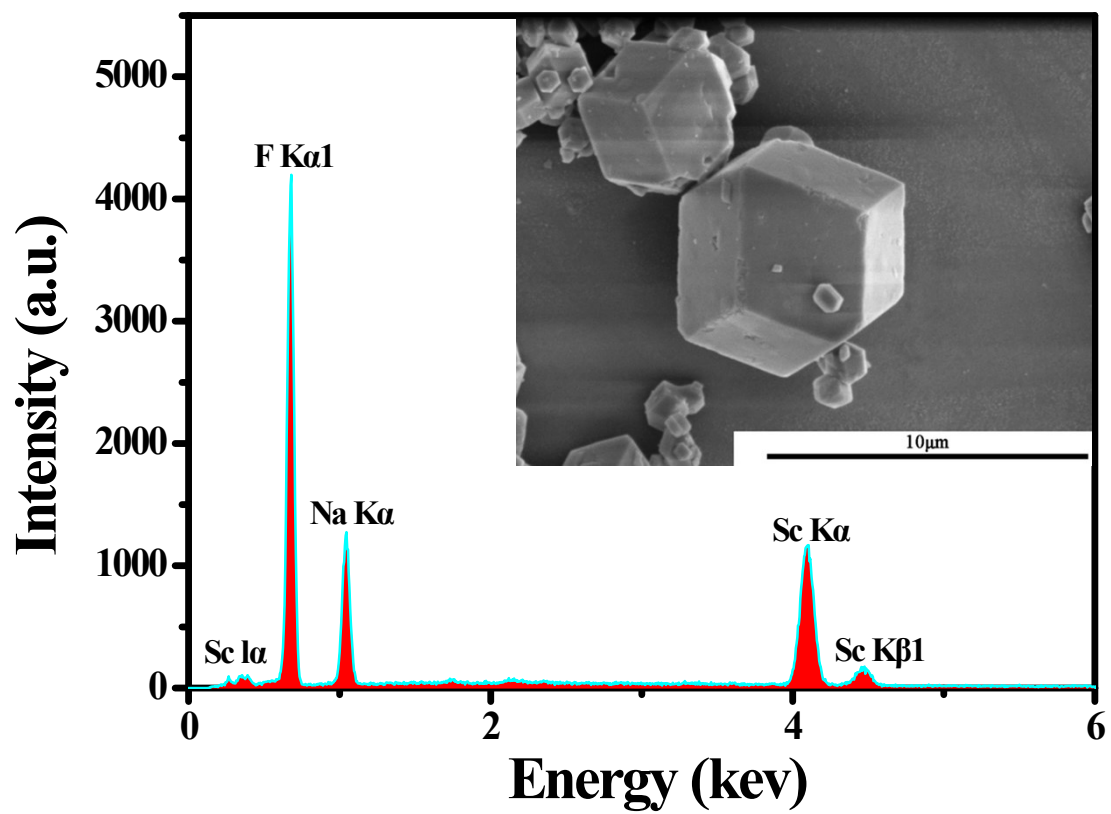


Fig. S2 EDS spectrum and SEM image of $\text{Na}_3\text{Li}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$

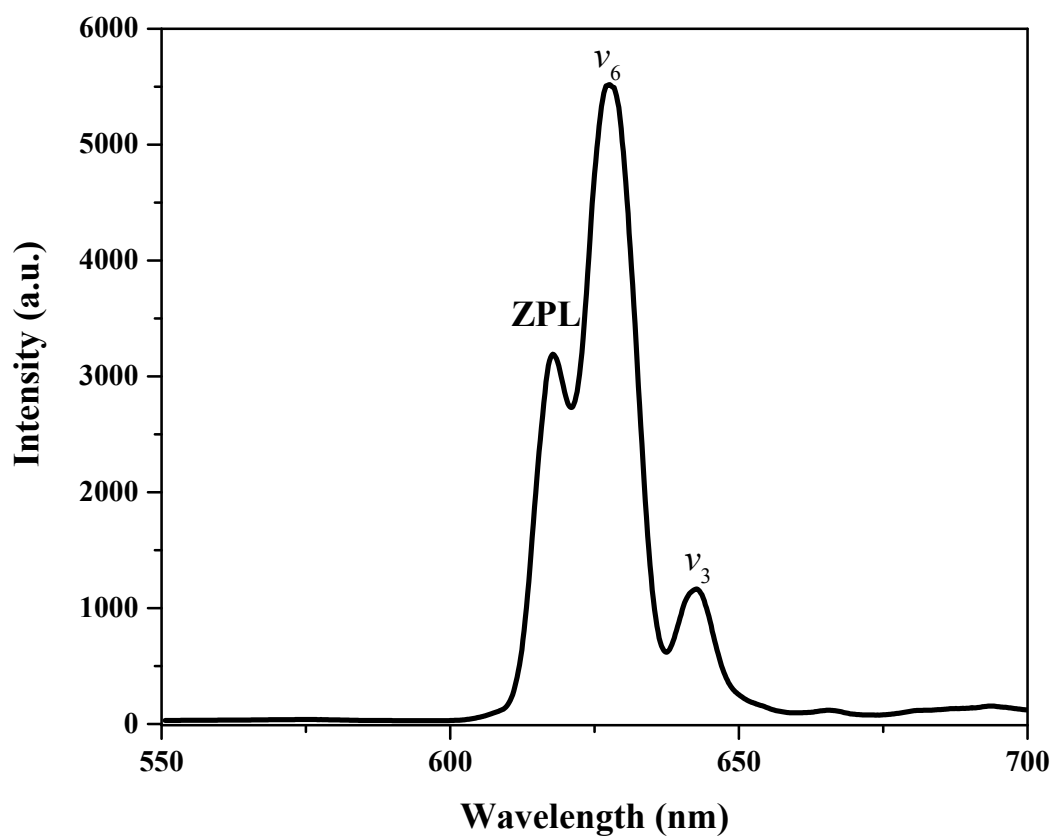


Fig. S3 Emission spectrum of $\text{Na}_3\text{Li}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$ at 77 K ($\lambda_{\text{ex}} = 461$ nm)

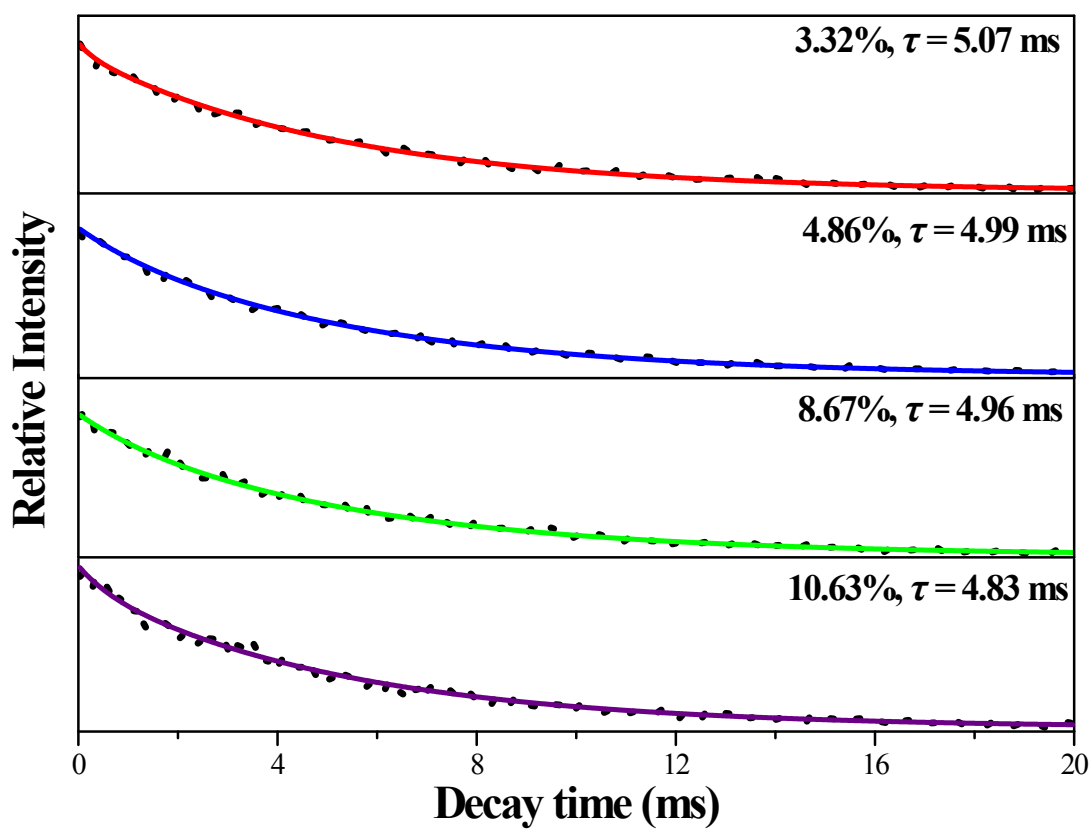


Fig. S4 Decay curves of $\text{Na}_3\text{Li}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$ with different contents of Mn^{4+} ($\lambda_{\text{em}} = 627 \text{ nm}$, $\lambda_{\text{ex}} = 461 \text{ nm}$)

Table S1 Contents of Mn⁴⁺ in Li₃Na₃Sc₂F₁₂:Mn⁴⁺

Samples	Molar ratios of K ₂ MnF ₆ / Sc ₂ O ₃	Doping amounts of Mn ⁴⁺
i	1:40	3.32%
ii	1:20	4.86%
iii	1:15	8.67%
v	1:10	10.63%

Table S2 Atomic parameters for $\text{Li}_3\text{Na}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$

Atom	X	Y	Z	Occ.	U	Site
Na	0.25000	0.12500	0.00000	1.004	0.035	24c
Li	0.25000	0.37500	0.00000	1.038	0.037	24d
Sc	0.00000	0.00000	0.00000	0.900	0.032	16a
F	-0.03011	0.04912	0.14861	1.054	0.035	96h
Mn	0.00000	0.00000	0.00000	0.100	0.001	16a

Table S3 Crystal data and structure refinement for $\text{Li}_3\text{Na}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$

Formula	$\text{Li}_3\text{Na}_3\text{Sc}_2\text{F}_{12}:\text{Mn}^{4+}$
Crystal system	Cubic
Space group	<i>Ia-3d</i> (230)
<i>a</i> (Å)	12.59956
<i>b</i> (Å)	12.59956
<i>c</i> (Å)	12.59956
<i>α</i>	90.0000
<i>β</i>	90.0000
<i>γ</i>	90.0000
V_{cell} (Å ³)	2000.166341
<i>Z</i>	8
R_{wp}	9.77%
R_{p}	6.40%
χ^2	2.001