

Supporting Information

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Non-stoichiometric defect controlled reduction of mixed-valence Mn-doped hexaaluminates and the optical applications

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Table S1. The synthesis information of Mn doped BAL(BAM) samples

Number	Host lattice	Mn Concentration	Mn Source	Atmosphere
A	BAL	0.02	MnCO ₃	air
A	BAL	0.02	MnO ₂	air
A	BAL	0.02	KMnO ₄	air
B	BAL	0.02	MnO ₂	air
B	BAL	0.02	MnO ₂	5%H ₂ +95%N ₂
B	BAL	0.02	MnO ₂	O ₂
C	BAL	0.005-0.4	MnO ₂	air
D	(1-x)BAL-(x)BAM	0.02	MnO ₂	air

Table S2. CIE coordinates of the spectra corresponding to Mn-doped (1-x)BAL-xBAM solid solution

points	(1-x)BAL-xBAM	Excitation wavelength (nm)	CIE coordinates (x, y)	
1	x = 0	426	0.106	0.670
2	x = 0.25	426	0.112	0.667
3	x = 0.5	426	0.121	0.655
4	x = 0.75	426	0.165	0.616
5	x = 1	426	0.488	0.421
6	x = 1	315	0.714	0.283

Table S3. RGB CIE coordinates of the NTSC standard and the fabricated white LED device

Name	R	G	B
NTSC	(0.675, 0.303)	(0.110, 0.686)	(0.142, 0.062)
LED device	(0.670, 0.330)	(0.210, 0.710)	(0.140, 0.080)

Table S4. The CIE coordinates of the BAM:Mn at different temperatures

Temperature (°C)	CIE coordinates (x, y)	
30	0.381	0.560
40	0.377	0.563
50	0.375	0.567
60	0.370	0.569
70	0.364	0.573
80	0.362	0.574
90	0.358	0.578
100	0.356	0.579
110	0.346	0.588
120	0.338	0.594
130	0.329	0.601
140	0.321	0.607
150	0.305	0.620
160	0.293	0.630
170	0.277	0.642
180	0.266	0.652

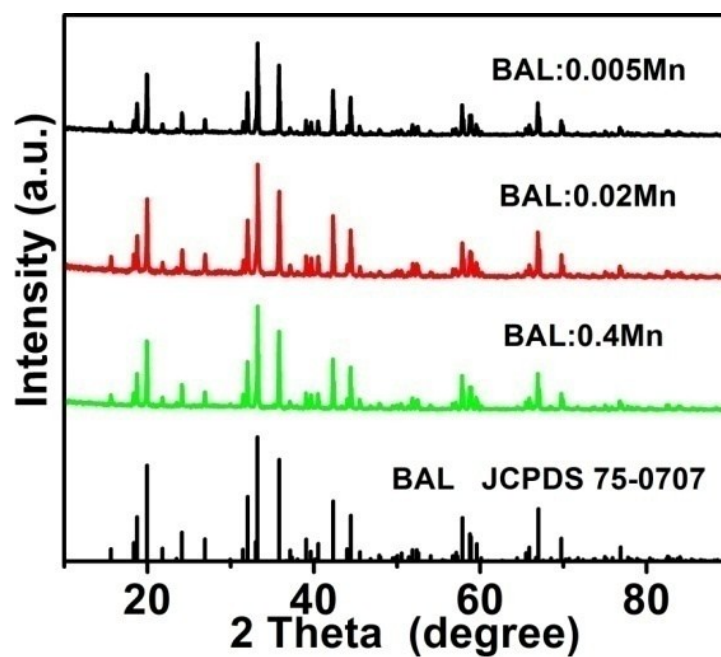


Fig. S1 XRD patterns of BAL: x Mn ($x = 0.005, 0.02, 0.4$) samples and the standard pattern of BAL is given for comparison.

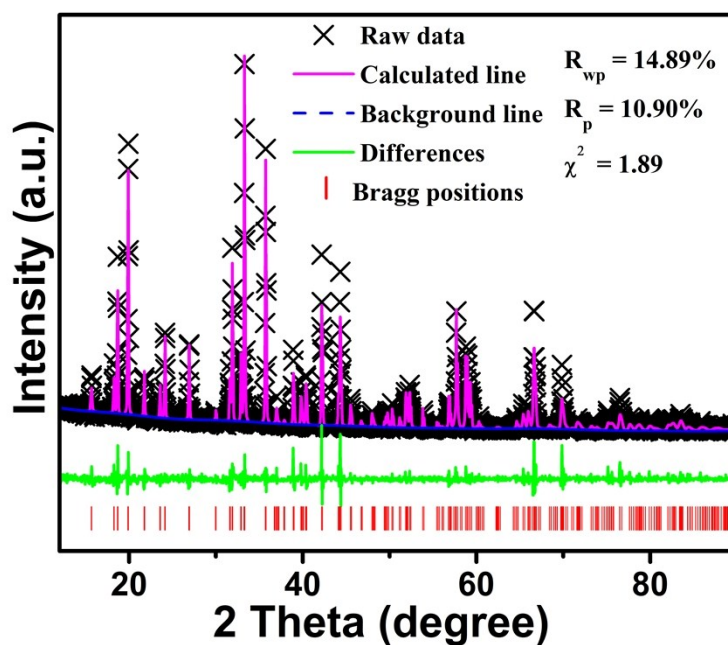


Fig. S2 XRD Rietveld refinement for the representative 0.5BAL•0.5BAM.

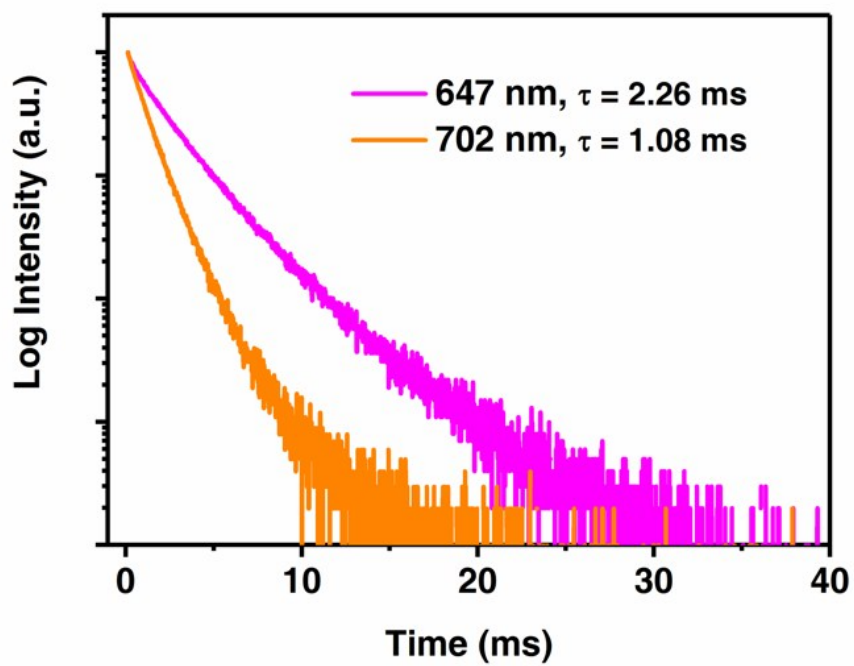


Fig. S3 Luminescence decay curves and the corresponding emission lifetimes of emission peaks at 647 and 702 nm for the sample synthesized in O₂ atmosphere.

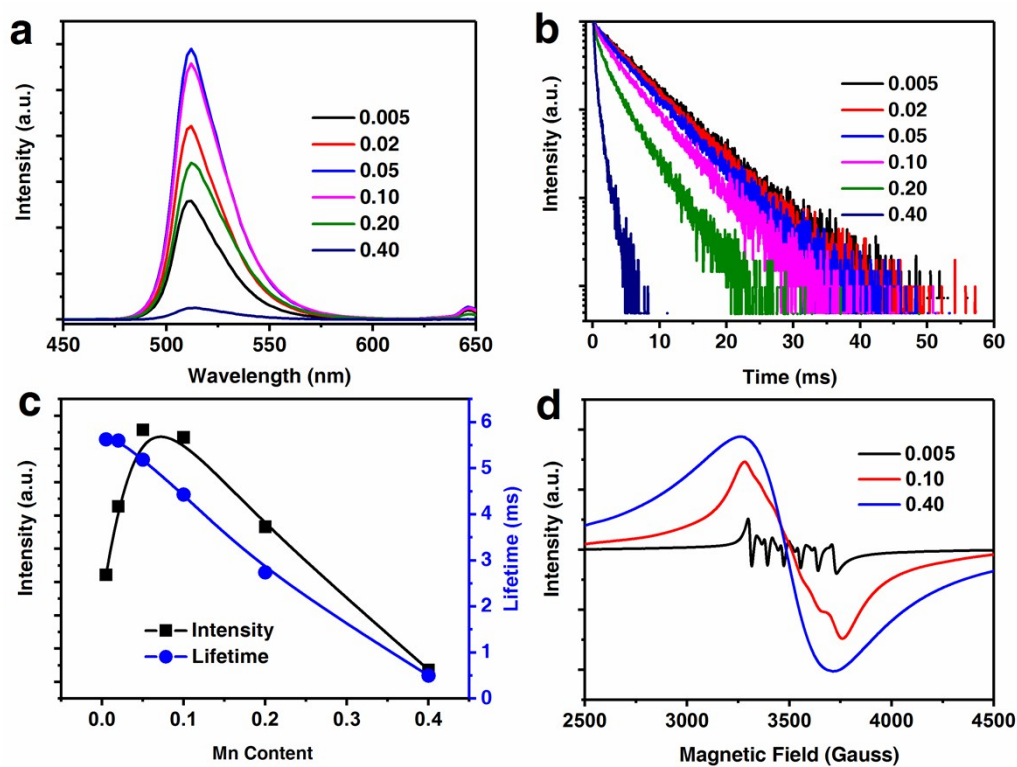


Fig. S4 (a) Emission spectra ($\lambda_{ex} = 426$ nm) of BAL:xMn ($x = 0.005, 0.02, 0.05, 0.1, 0.2, 0.4$) prepared with MnO₂ in air and (b) their luminescence decay curves and (c) corresponding emission intensities and lifetimes. (d) EPR spectra of BAL:xMn ($x = 0.005, 0.1, 0.4$) samples.