Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Determination of phase-formation of $(Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ (x=0-1) cordierite solid-solutions via crystallographic sites and luminescence dynamics of Mn^{2+} centers

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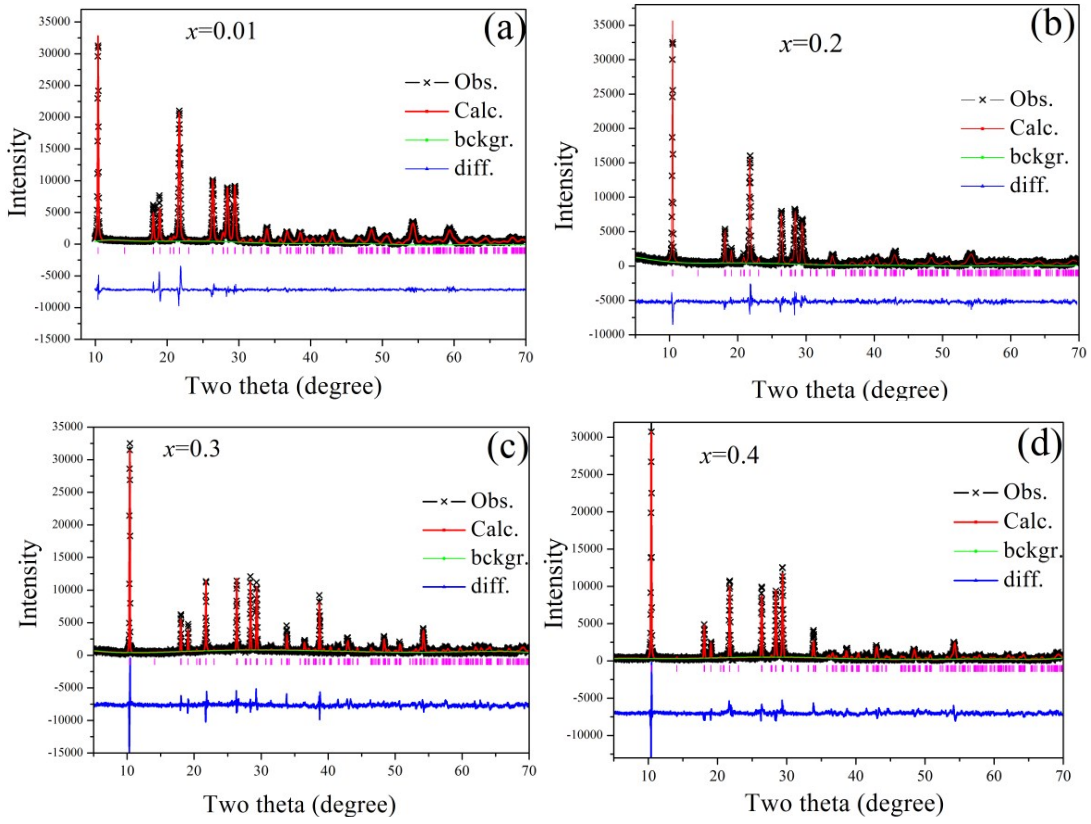

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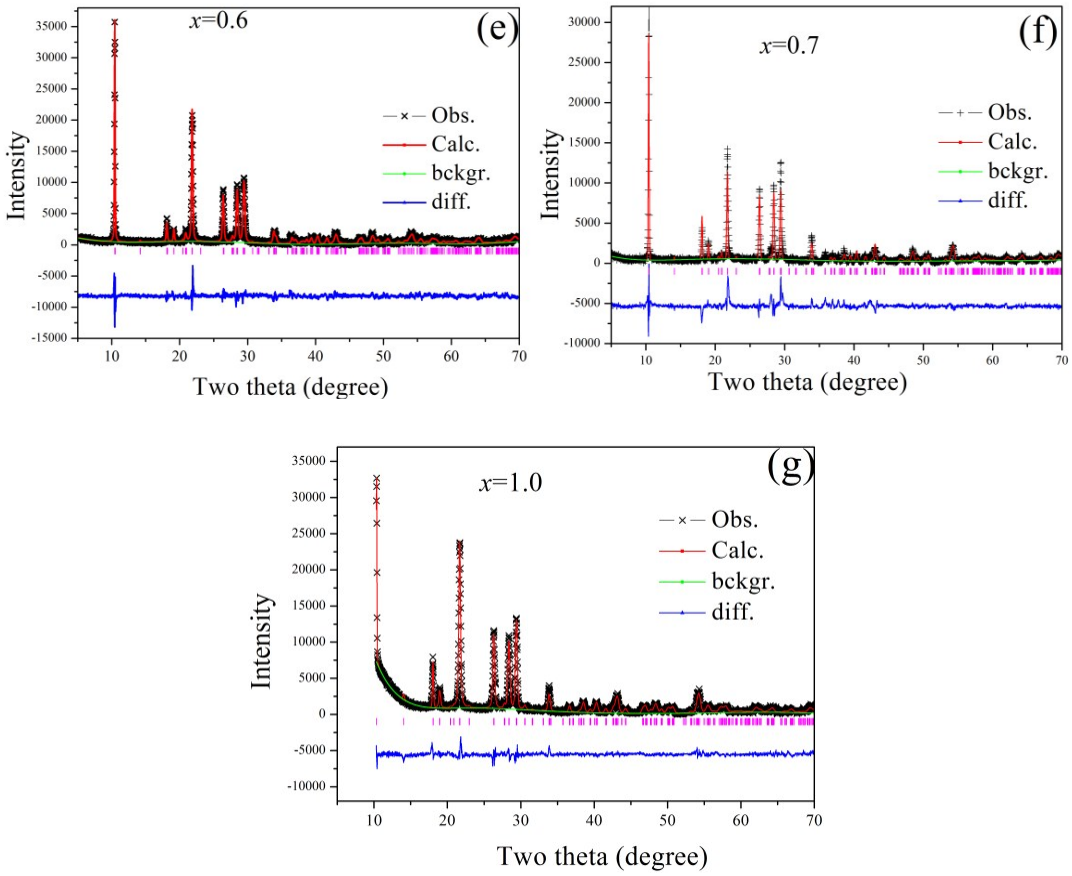

Figure-S1 the Rietveld refinements of $Mg_{2-2x}Mn_{2x}Al_4Si_5O_{18}$ with x=0.01 (a), 0.2 (b), 0.3 (c), 0.4 (d), 0.6 (e), 0.7 (f), 1.0 (g).

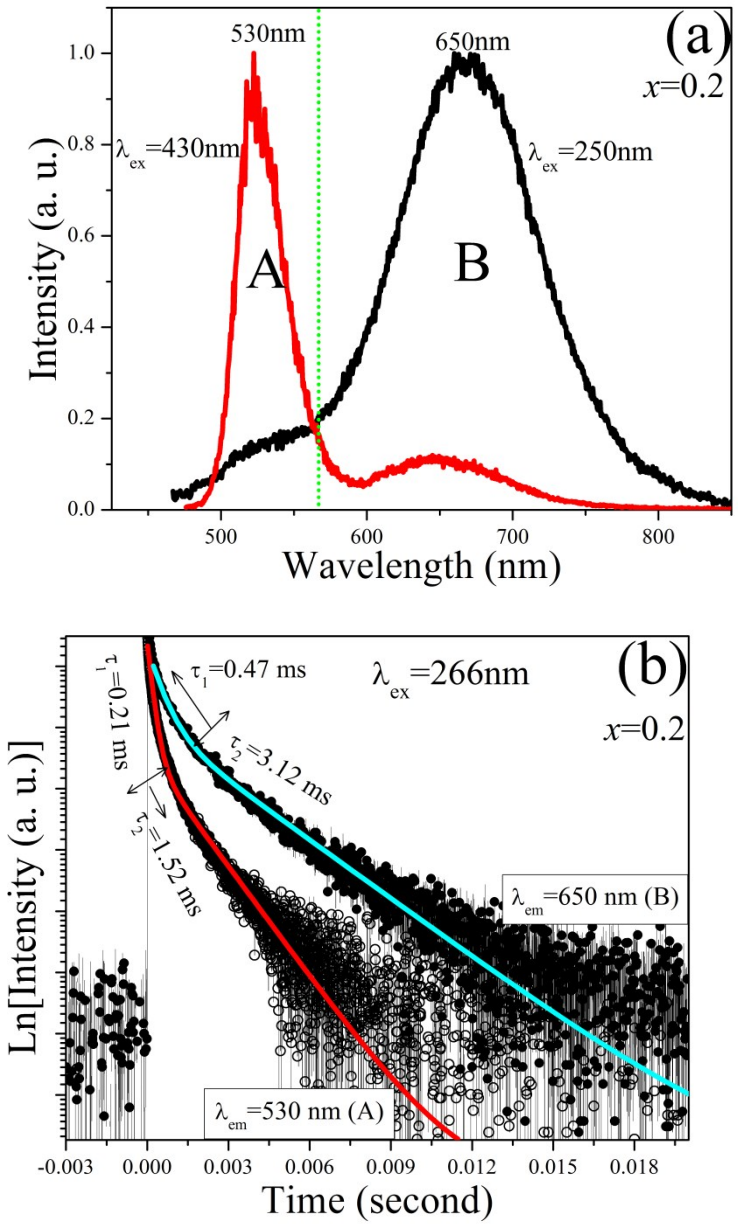

Figure-S2 the normalized emission spectra (λ_{ex}=430, 250 nm) (a), and decay curves (λ_{em}=530, 650 nm) (b) for $(Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ (x=0.2) at 300 K.

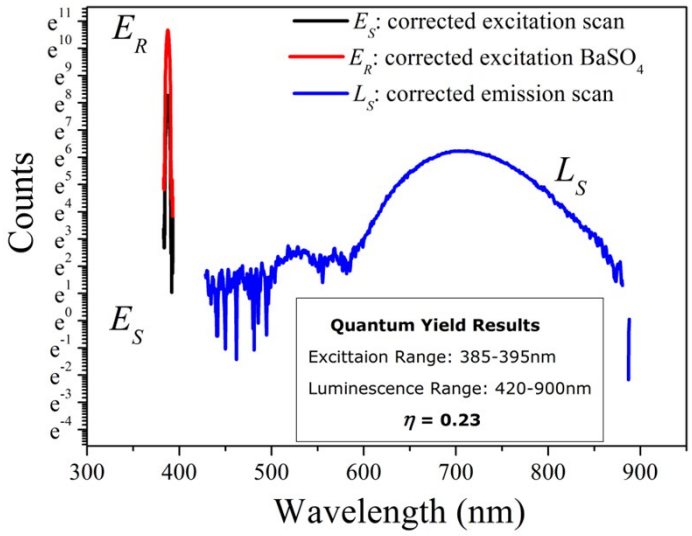

Figure-S3 the quantum efficiency measurements for $(Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ (x=0.7) by using an integrating sphere at 300 K.

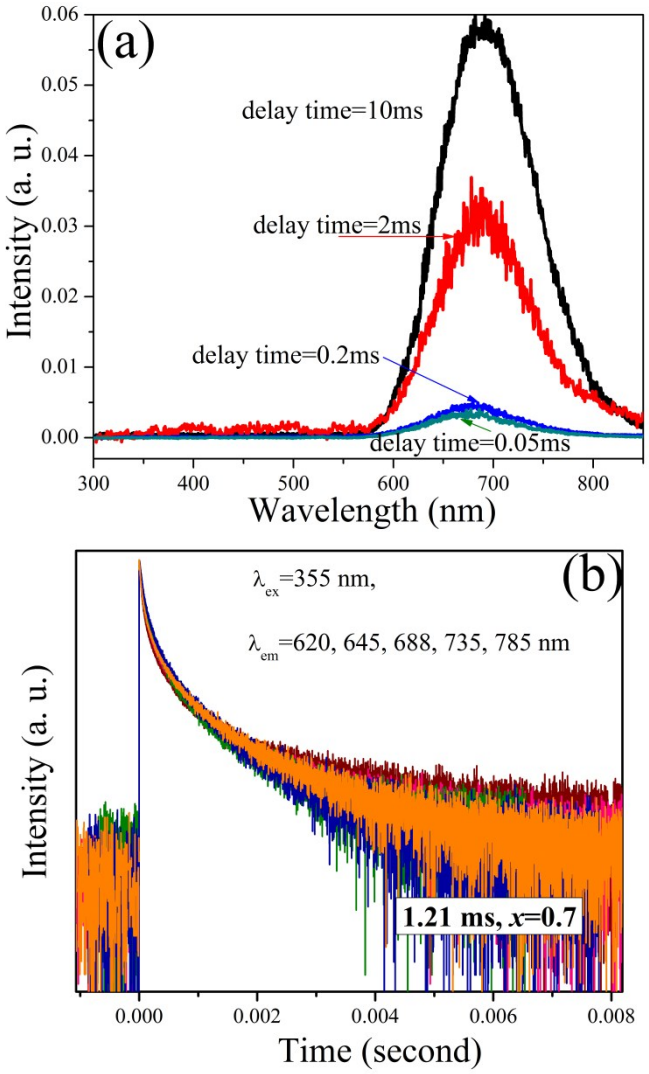

Figure-S4 Time resolved spectra of $(Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ (x=0.7) with different pulsed delay times after the laser excitation (a), and decay curves by monitoring different wavelength positions on the spectra (b) under excitation of 355 nm of a pulsed Nd:YAG laser.

Tables

Table S1 Crystallographic refinement parameters of $Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ with *x*=0.01, 0.1, 0.2, 0.3, 0.4, 0.6, 0.7, 0.8, 1.0**.**

formula	0.01	0.1	0.2	0.3	0.4	0.6	0.7	0.8	1.0
radiation	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka	Cu-Ka
2θ/°	10-100	10-100	10-100	10-100	10-100	10-100	10-100	10-100	10-100
symmetry	orthorhombic	orthorhombic	orthorhombic	hexagonal	hexagonal	hexagonal	hexagonal	hexagonal	orthorhombic
space group	Cccm (66)	Cccm (66)	Cccm (66)	P_6/mcc (192)	P_6/mcc (192)	P_6/mcc (192)	P_6/mcc (192)	P_6/mcc (192)	Cccm (66)
a/Å	9.7212	9.7329	9.7489	9.7932	9.7963	9.8024	9.8082	9.8127	9.9159
b/Å	17.2682	17.2774	17.3022	9.7932	9.7963	9.8024	9.8082	9.8127	17.315
c/Å	9.4384	9.4556	9.4753	9.3452	9.3465	9.3525	9.3573	9.3601	9.9996
Z	4	4	4	2	2	2	2	2	4
R_p	0.04378	0.0676	0.03978	0.04218	0.03852	0.05102	0.0933	0.0854	0.1032
R_{wp}	0.05249	0.07356	0.06249	0.07522	0.04569	0.07214	0.0825	0.0755	0.09215
X^2	3.21	5.231	3.1513	3.2153	4.2525	4.1802	4.2551	5.1251	4.3563
V/ $Å^3$	801.12	805.52	810.45	770.60	772.17	773.52	778.14	780.25	826.54

Table S2 elemental contents of $(Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ with x=0.2, 0.4, 0.6, 0.7, 0.9, 0.95 obtained in the EDS measurements by face-scanning.

x=0.2 ($Mg_{1.6}Mn_{0.4}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	12.22	19.93	10.66
Mg K	11.11	11.89	6.99
Mn K	6.21	2.90	5.58
Al K	30.61	29.59	7.69
Si K	40.13	35.68	6.19

x=0.4 ($Mg_{1.2}Mn_{0.8}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	23.61	36.04	12.66
Mg K	6.91	6.95	7.46
Mn K	10.41	4.63	4.85
Al K	26.12	23.64	6.37
Si K	33.03	28.72	7.05

x=0.6 ($Mg_{0.8}Mn_{1.2}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	16.83	27.63	8.95
Mg K	4.83	5.22	5.65
Mn K	16.41	7.85	4.23
Al K	27.11	26.4	7.52
Si K	35.15	32.89	4.25

x=0.7 ($Mg_{0.6}Mn_{1.4}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	15.32	25.98	11.25
Mg K	3.62	4.04	6.41
Mn K	19.11	9.44	6.05
Al K	26.81	26.97	6.74
Si K	34.73	33.56	5.69

x=0.9 ($Mg_{0.2}Mn_{1.82}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	23.43	37.91	13.81
Mg K	1.06	1.13	3.85
Mn K	21.26	10.02	4.71
Al K	23.55	22.59	5.62
Si K	30.75	28.34	6.01

x=0.95 ($Mg_{0.1}Mn_{1.9}Al_4Si_5O_{18}$)

Element	Weight %	Atomic %	Error %
O K	19.07	32.26	11.85
Mg K	0.55	0.61	5.12
Mn K	24.05	11.85	4.21
Al K	24.61	24.69	7.84
Si K	31.73	30.58	5.01

Table S3 The experimental quantum efficiencies of $Mg_{1-x}Mn_x)_2Al_4Si_5O_{18}$ (*x*=0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0**.)**

Samples (x)	Excitation wavelength (nm)	QE	PL range (nm)
0.1	365	0.065	420-900
0.2	365	0.102	420-900
0.3	365	0.133	420-900
0.4	365	0.154	420-900
0.5	365	0.208	420-900
0.6	365	0.215	420-900
0.7	365	0.228	420-900
0.8	365	0.16	420-900
0.9	365	0.07	420-900
1.0	365	0.04	420-900