Supporting Information

Synthesis, crystal structure and luminescence characteristic of a novel red phosphor Ca₁₉Mg₂(PO₄)₁₄:Eu³⁺ for light emitting devices and field emission displays

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Figure S1 TG-DTA curves of as-prepared (a) $Ca_{19}Zn_2(PO_4)_{14}$ and (b) $Ca_{19}Mn_2(PO_4)_{14}$ samples.



Figure S2 FTIR spectra of (a) $Ca_{19}Zn_2(PO_4)_{14}$ and (b) $Ca_{19}Mn_2(PO_4)_{14}$ samples.



Figure S3 A series of XRD patterns of Eu^{3+} doped $Ca_{19}Mg_2(PO_4)_{14}$ phosphors with different doping contents .



Figure S4 The emission spectra of $Ca_{19}Mg_2(PO_4)_{14}$: 0.06Eu³⁺ at 394 nm excitation. The emission spectra of the commercial red phosphor Y_2O_3 : Eu³⁺ (Topstar, TXC-RIA) is also measured for comparison.



Figure 5 The temperature dependent emission spectra of $Ca_{19}Mg_2(PO_4)_{14}$:0.02Eu³⁺ phosphor.

Atom	Wyck.	x/a	y/b	z/c	Occupancy	U [Å2]
Ca1	18b	0.73299	0.85588	0.42999	1.0000	0.01191
Ca2	18b	0.61867	0.81794	0.21124	1.0000	0.01691
Ca3	18b	0.20354	0.38806	0.33671	1.0000	0.05505
Ca4	6a	0	0	0.18028	0.5000	0.07844
Zn1	6a	0	0	-0.00412	1.0000	0.0369
P1	ба	0	0	0.26363	1.0000	0.04205
P2	18b	0.68286	0.86013	0.13433	1.0000	0.05277
P3	18b	0.65699	0.84185	0.02873	1.0000	0.00377
01	ба	0	0	0.31176	1.0000	0.04317
02	18b	-0.01520	0.85708	0.24330	1.0000	0.05098
03	18b	0.74970	0.89697	0.18187	1.0000	0.17574
04	18b	0.75551	0.80003	0.11653	1.0000	0.00242
05	18b	0.73708	0.03326	0.11684	1.0000	0.00467
06	18b	0.53674	0.77650	0.12567	1.0000	0.00760
07	18b	0.60359	0.92409	0.05394	1.0000	0.00367
08	18b	0.53072	0.65097	0.03457	1.0000	0.14869
09	18b	0.82027	0.91547	0.03429	1.0000	0.00273
O10	18b	0.61430	0.84249	0.98586	1.0000	0.0006

Table S1 The detailed atomic coordinates of $Ca_{19}M_2(PO_4)_{14}$ (M=Zn, Mn)

Atom	Wyck.	x/a	y/b	z/c	Occupancy	U [Ų]
Ca1	18b	0.71831	0.85920	0.43120	1.0000	0.02758
Ca2	18b	0.61067	0.82276	0.23098	1.0000	0.00896
Ca3	18b	0.20343	0.39478	0.33653	1.0000	0.04098
Ca4	ба	0	0	0.19389	0.5000	0.03102
Mn1	ба	0	0	-0.0030	1.0000	0.02926
P1	ба	0	0	0.23643	1.0000	0.09680
P2	18b	0.71738	0.87750	0.16742	1.0000	0.12111
Р3	18b	0.65294	0.84180	0.03023	1.0000	0.01040
01	ба	0	0	0.31826	1.0000	0.01319
02	18b	0.01866	0.86479	0.25296	1.0000	0.02722
03	18b	0.68715	0.86407	0.13061	1.0000	0.03108
04	18b	0.76063	0.78932	0.11986	1.0000	0.03301
05	18b	0.72777	-0.0022	0.11137	1.0000	0.00714
O6	18b	0.51352	0.74981	0.12780	1.0000	0.00779
07	18b	0.80495	0.92203	0.03547	1.0000	0.05332
08	18b	0.57100	0.70891	0.04749	1.0000	0.03072
09	18b	0.37558	0.42340	0.04148	1.0000	0.05955
O10	18b	0.57689	0.82448	0.97893	1.0000	0.20111