Supporting Information

Ultrabroadband Red Luminescence of Mn^{4+} in $MgAl_2O_4$ Peaking at 651 nm

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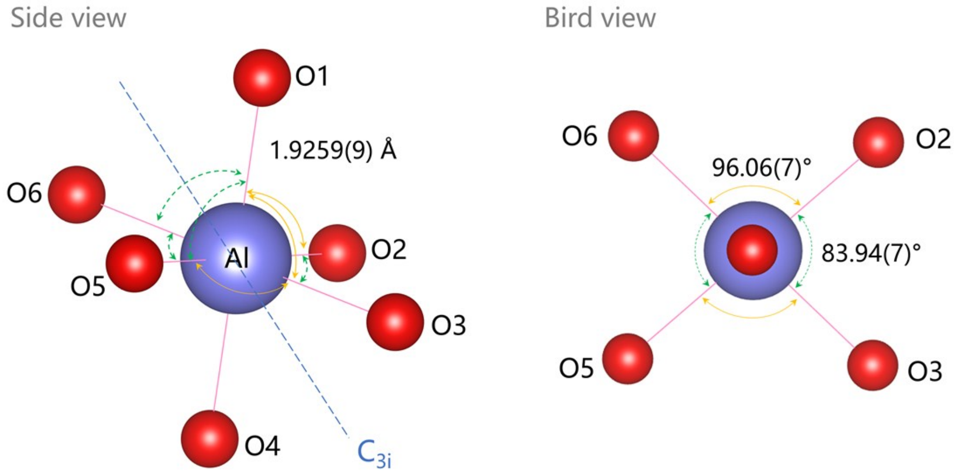

Figure S1 Al^{3+} octahedral coordination in $MgAl_2O_4$ (ICSD 31373) showing the interatomic distances and angles between the chemical bonds. $d_{Al\text{-}O1} = d_{Al\text{-}O2} = d_{Al\text{-}O3} = d_{Al\text{-}O4} = d_{Al\text{-}O5} = d_{Al\text{-}O6} =$ 1.9259(9) Å; ∠O1-Al-O2 = ∠O1-Al-O3 = ∠O2-Al-O6 = ∠O3-Al-O5 = ∠O2-Al-O4 = ∠O3-Al-O4 = ∠O4-Al-O5 = ∠O4-Al-O6 =96.06(7)°, ∠O1-Al-O5 = ∠O1-Al-O6 = ∠O2-Al-O3 =∠O5-Al-O6 = 83.94(7)°.

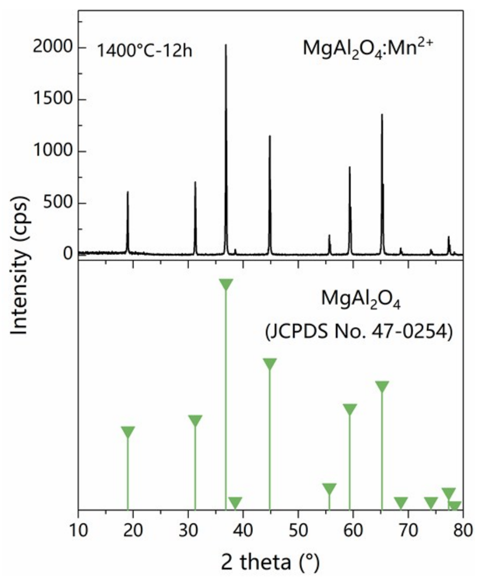

Figure S2 XRD pattern of the spinel phosphor calcined at 1400 °C for 12 h. The standard pattern for $MgAl_2O_4$ (JCPDS card no. 47-0254) was provided as reference.

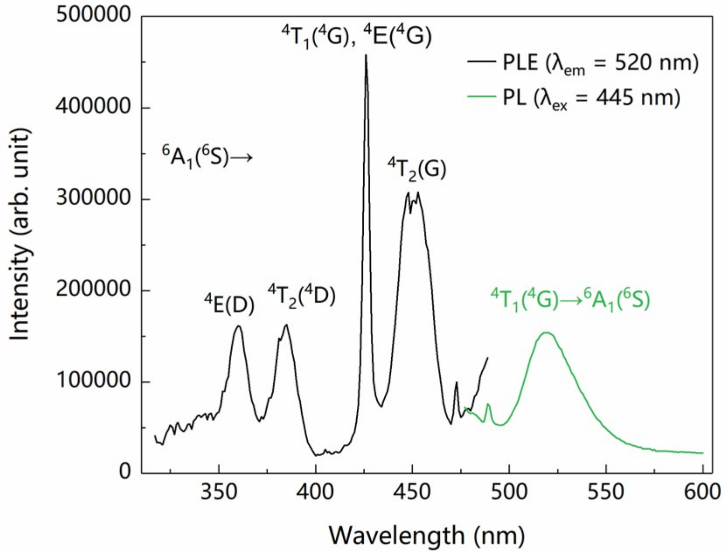

Figure S3 Photoluminescence spectra of the $MgAl_2O_4:Mn^{2+}$ phosphor calcined at 1400 °C for 12 h. The corresponding energy transitions were assigned based on Ref. [1].

[1] E. H. Song, Y. Y. Zhou, Y. Wei, X. X. Han, Z. R. Tao, R. L. Qiu, Z. G. Xia and Q. Y. Zhang. A thermally stable narrow-band green-emitting phosphor $MgAl_2O_4:Mn^{2+}$ for wide color gamut backlight display application. *J. Mater. Chem. C*, 2019, 7, 8192-8198.

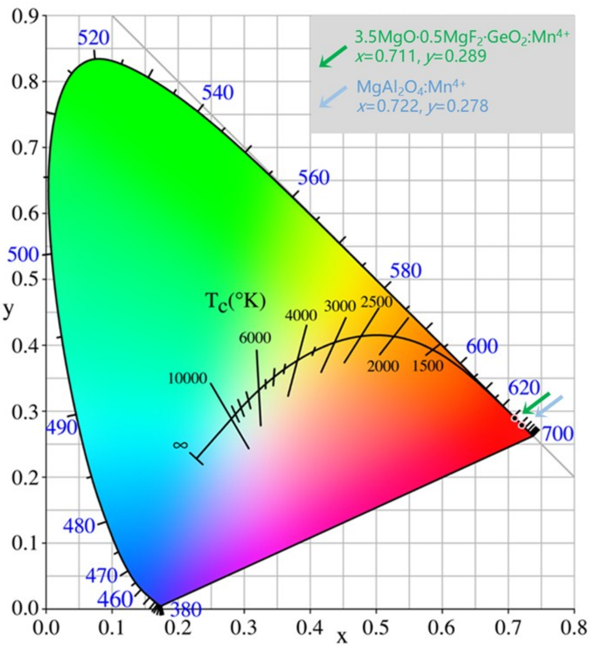

Figure S4 Chromaticity coordinate (λ_{ex} = 440 nm) of $MgAl_2O_4:Mn^{4+}$ in CIE 1931 diagram. The chromaticity of the commercial $3.5MgO{\cdot}0.5MgF_2{\cdot}GeO_2:Mn^{4+}$ was also given.

Preparation of $MgAl_2O_4:Mn^{4+}$ by the molten salt method:

MgO (A.R., Sinopharm, China) and Al_2O_3 (99.99%, γ-phase, ≤20 nm, Aladdin, China) were used as the raw chemicals. $MnCO_3$ (A.R., Sinopharm, China) and $LiCl \cdot H_2O$ (A.R., Sinopharm, China) were used as the dopant source and the salt. MgO, Al_2O_3, and $MnCO_3$ were weighed according to the formula of $MgAl_{1.998}Mn_{0.002}O_4$ and then mixed with $LiCl \cdot H_2O$ in a weight ratio of 1:5. The mixture was then transferred to corundum crucibles covered with a lid and heated at 950 °C for 3 h. After cooling to room temperature, the product was washed with hot deionized water for 5 times to remove the salt, concentrated by centrifugation, and then dried in an oven at 100 °C for 12 h.