Supporting Information for

Host-sensitized borate phosphors $ZnGdB_5O_{10}:Mn^{2+}/Dy^{3+}/Sm^{3+}$

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Table S1. Cell lattice parameters (a, b, c, β, V) for $Zn_{1-x}Mn_xGdB_5O_{10}$ ($0.005 \leq x \leq 0.07$) obtained from Le Bail fitting on the powder XRD (space group: $P2_1/n$)

$Zn_{1-x}Mn_xGdB_5O_{10}$	a (Å)	b (Å)	c (Å)	β (°)	V (Å^3)
0.005	8.5987(2)	7.6031(2)	9.4000(2)	93.394(1)	613.46(2)
0.01	8.5985(1)	7.6039(1)	9.4005(2)	93.395(1)	613.55(2)
0.03	8.5983(2)	7.6061(2)	9.4012(2)	93.378(1)	613.76(2)
0.05	8.5987(2)	7.6082(1)	9.4018(2)	93.365(1)	614.01(2)
0.07	8.5991(2)	7.6103(2)	9.4028(2)	93.351(1)	614.28(2)

Table S2. Cell lattice parameters (a, b, c, β, V) for $ZnGd_{1-y}Dy_yB_5O_{10}$ ($0.01 \leq y \leq 0.09$) obtained from Le Bail fitting on the powder XRD (space group: $P2_1/n$)

$ZnGd_{1-y}Dy_yB_5O_{10}$	a (Å)	b (Å)	c (Å)	β (°)	V (Å^3)
0.01	8.5987(2)	7.6038(2)	9.4012(2)	93.404(1)	613.59(2)
0.03	8.5985(2)	7.6031(2)	9.3997(2)	93.405(1)	613.43(2)
0.05	8.5970(2)	7.6032(2)	9.3988(2)	93.404(1)	613.27(2)
0.07	8.5959(3)	7.6030(3)	9.3984(3)	93.416(2)	613.14(4)
0.09	8.5945(2)	7.6029(2)	9.3973(2)	93.418(1)	612.96(3)

Table S3. Cell lattice parameters (a, b, c, β, V) for $ZnGd_{1-z}Sm_zB_5O_{10}$ ($0.01 \leq z \leq 0.09$) obtained from Le Bail fitting on the powder XRD (space group: $P2_1/n$)

$ZnGd_{1-z}Sm_zB_5O_{10}$	a (Å)	b (Å)	c (Å)	β (°)	V (Å^3)
0.01	8.5988(2)	7.6024(1)	9.3999(2)	93.397(1)	613.41(2)
0.03	8.5999(4)	7.6029(4)	9.4007(5)	93.397(2)	613.57(5)
0.05	8.6008(2)	7.6036(2)	9.4007(2)	93.385(1)	613.71(2)
0.07	8.6018(2)	7.6035(2)	9.4020(1)	93.389(1)	613.85(2)
0.09	8.6033(3)	7.6035(2)	9.4028(3)	93.382(2)	614.01(3)

Table S4. Enhancement of integrated emission intensity for $ZnGd_{1-y}Dy_yB_5O_{10}$ ($0.01 \leq y \leq 0.09$) by host-sensitization effect

y	Integrated intensity (a.u.) (450-600 nm)		Enhancement factor
	λ_{ex} = 343 nm	λ_{ex} = 273 nm	
0.01	4251	70853	16.67
0.03	8236	76528	9.29
0.05	8477	65947	7.78
0.07	7839	52541	6.70
0.09	6373	38122	5.98

Table S5. Enhancement of the Dy^{3+} emission by Gd^{3+}-to-Dy^{3+} energy transfer in different hosts

Activator	Host	Dy^{3+} content	Enhancement factor	Ref.
Dy^{3+}	$ZnGdB_5O_{10}$	0.03	9.29	This work
	$(Lu_{0.4}Gd_{0.6})_3Al_5O_{12}$	0.025	6.36	Ref. S1
	$Mg_2Gd_8(SiO_4)_6O_2$	0.1	4.3	Ref. S2
	$Gd_2O_2SO_4$	0.025	2.8	Ref. S3
	$Y_{1.2}Gd_{0.8}WO_6$	0.025	2.7	Ref. S4
	Gd_2O_3	0.02	1.13	Ref. S5

Table S6. Enhancement of integrated emission intensity for $ZnGd_{1-z}Sm_zB_5O_{10}$ ($0.01 \leq z \leq 0.09$) by host-sensitization effect

z	Integrated intensity (a.u.) (540-730 nm)		Enhancement factor
	λ_{ex} = 400 nm	λ_{ex} = 273 nm	
0.01	23982	59470	2.48
0.03	29693	62406	2.10
0.05	25866	57265	2.21
0.07	21555	44743	2.08
0.09	20351	44039	2.16

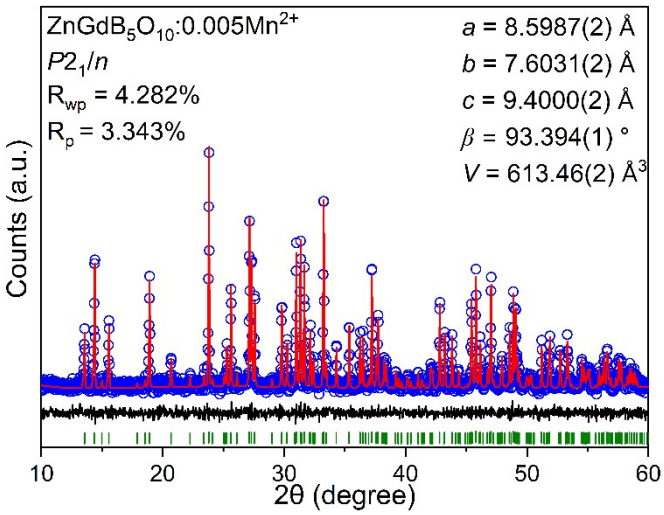

Figure S1. Final Le Bail fitting for $Zn_{0.995}Mn_{0.005}GdB_5O_{10}$. Blue circles, red and black lines represent the observed, calculated data, and the difference between them, respectively. The expected Bragg peaks positions are given as green bars at the bottom of the patterns.

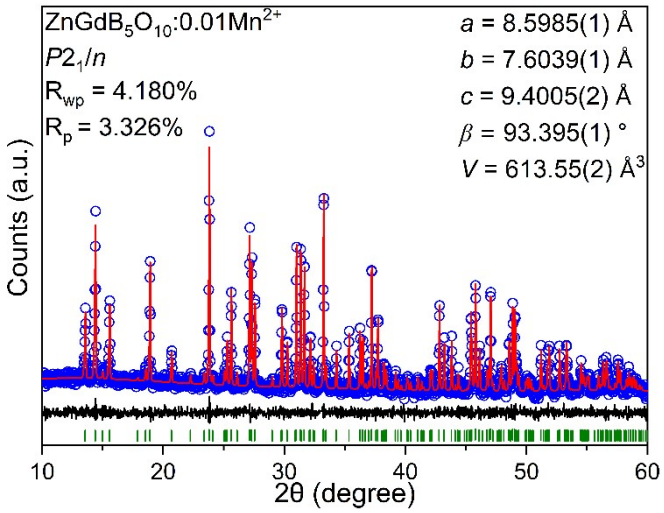

Figure S2. Final Le Bail fitting for $Zn_{0.99}Mn_{0.01}GdB_5O_{10}$.

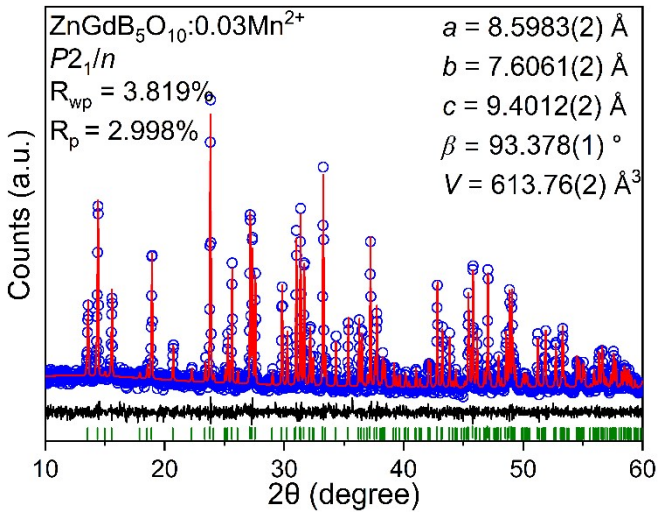

Figure S3. Final Le Bail fitting for $Zn_{0.97}Mn_{0.03}GdB_5O_{10}$.

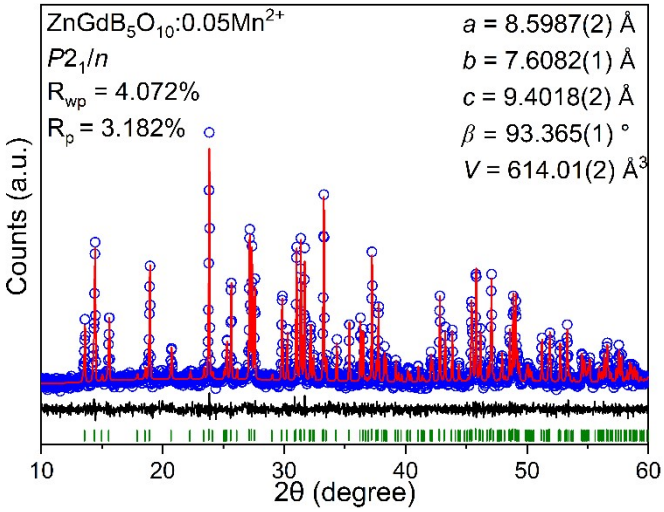

Figure S4. Final Le Bail fitting for $Zn_{0.95}Mn_{0.05}GdB_5O_{10}$.

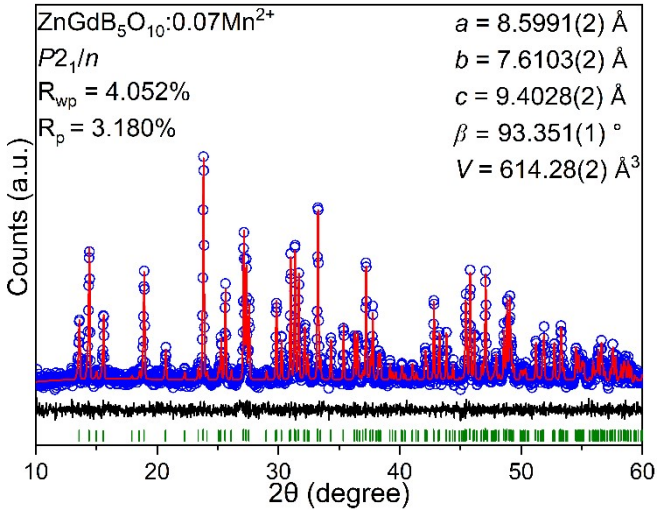

Figure S5. Final Le Bail fitting for $Zn_{0.93}Mn_{0.07}GdB_5O_{10}$.

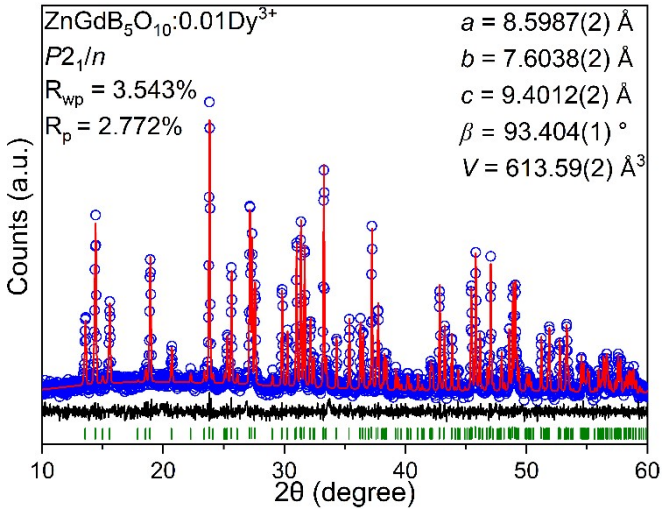

Figure S6. Final Le Bail fitting for $ZnGd_{0.99}Dy_{0.01}B_5O_{10}$.

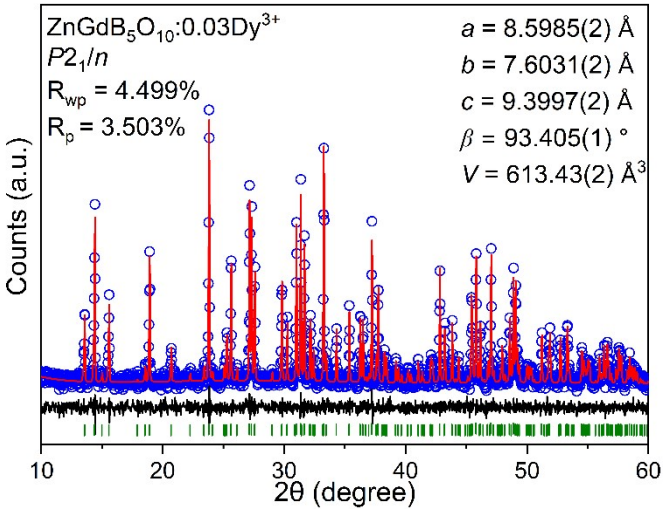

Figure S7. Final Le Bail fitting for $ZnGd_{0.97}Dy_{0.03}B_5O_{10}$.

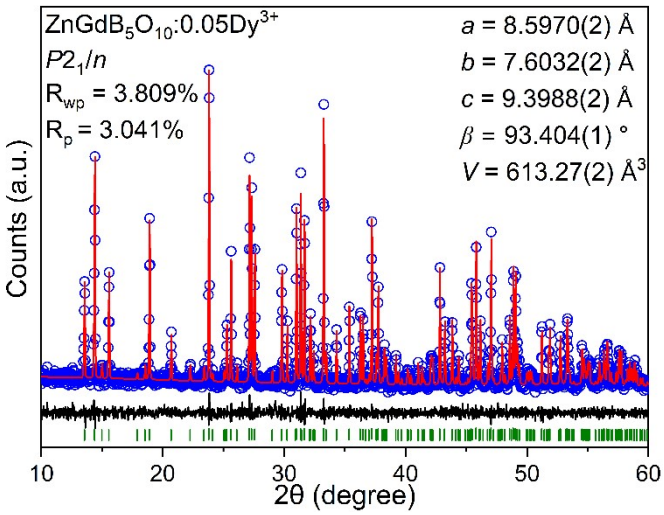

Figure S8. Final Le Bail fitting for $ZnGd_{0.95}Dy_{0.05}B_5O_{10}$.

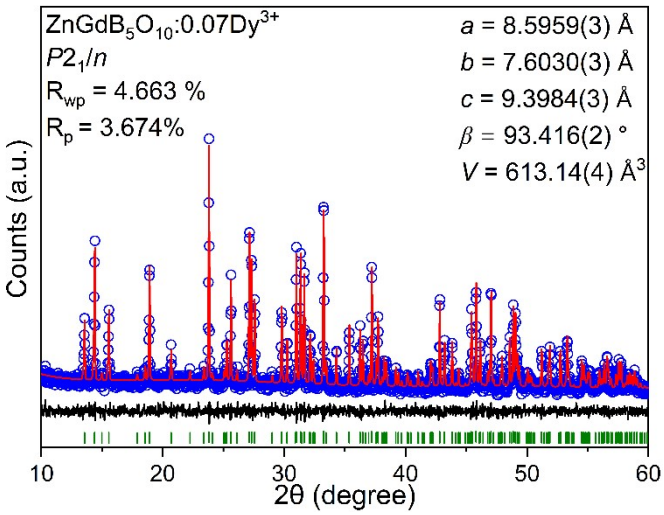

Figure S9. Final Le Bail fitting for $ZnGd_{0.93}Dy_{0.07}B_5O_{10}$.

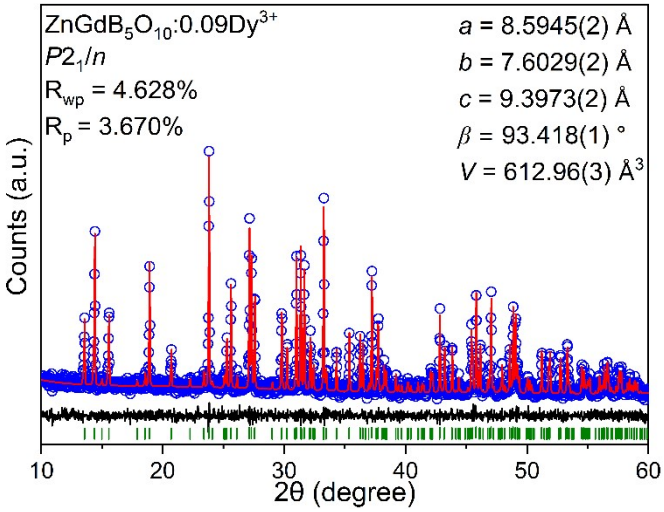

Figure S10. Final Le Bail fitting for $ZnGd_{0.91}Dy_{0.09}B_5O_{10}$.

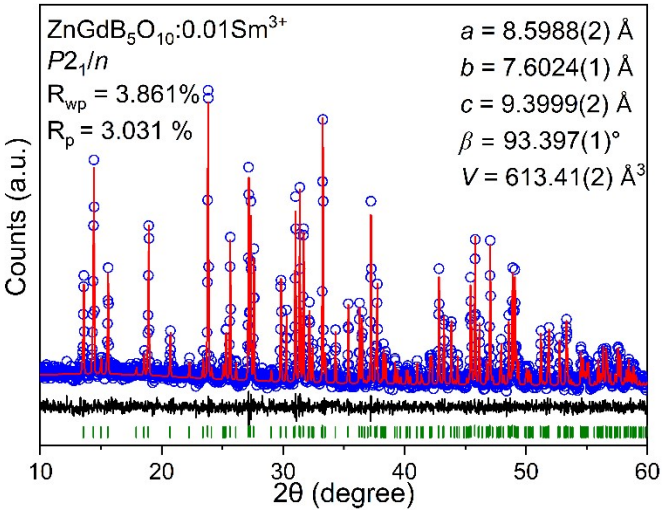

Figure S11. Final Le Bail fitting for $ZnGd_{0.99}Sm_{0.01}B_5O_{10}$.

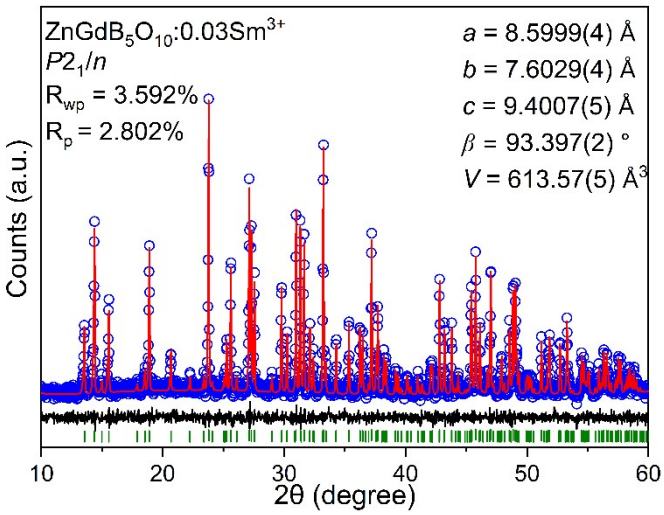

Figure S12. Final Le Bail fitting for $ZnGd_{0.97}Sm_{0.03}B_5O_{10}$.

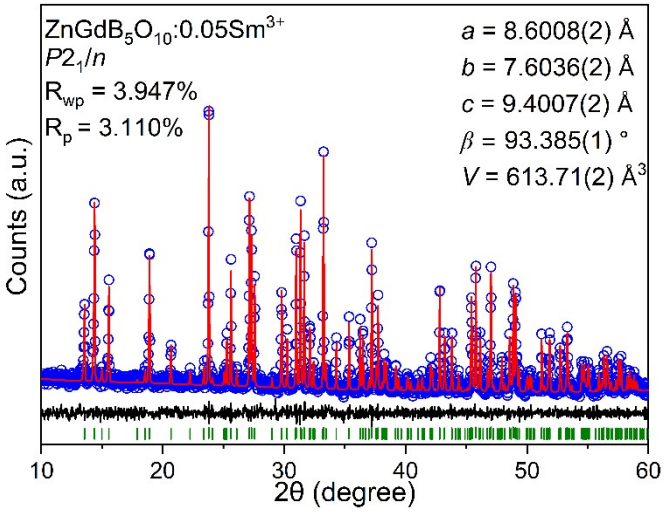

Figure S13. Final Le Bail fitting for $ZnGd_{0.95}Sm_{0.05}B_5O_{10}$.

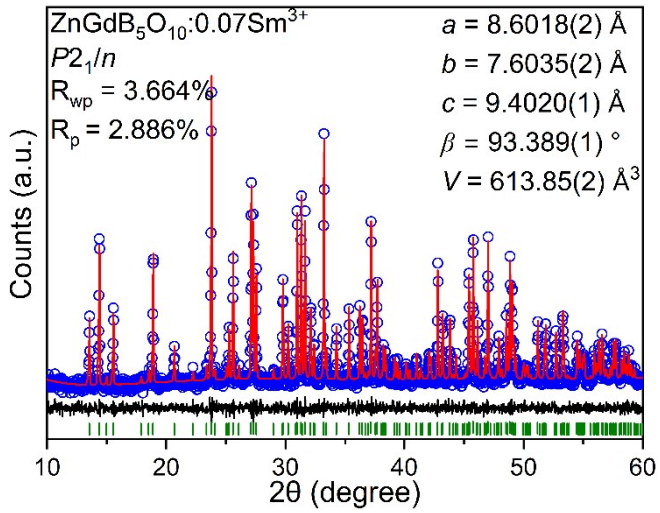

Figure S14. Final Le Bail fitting for $ZnGd_{0.93}Sm_{0.07}B_5O_{10}$.

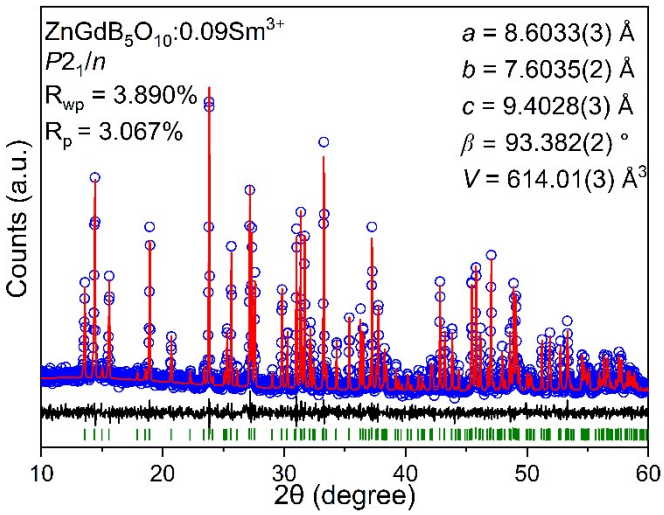

Figure S15. Final Le Bail fitting for $ZnGd_{0.91}Sm_{0.09}B_5O_{10}$.

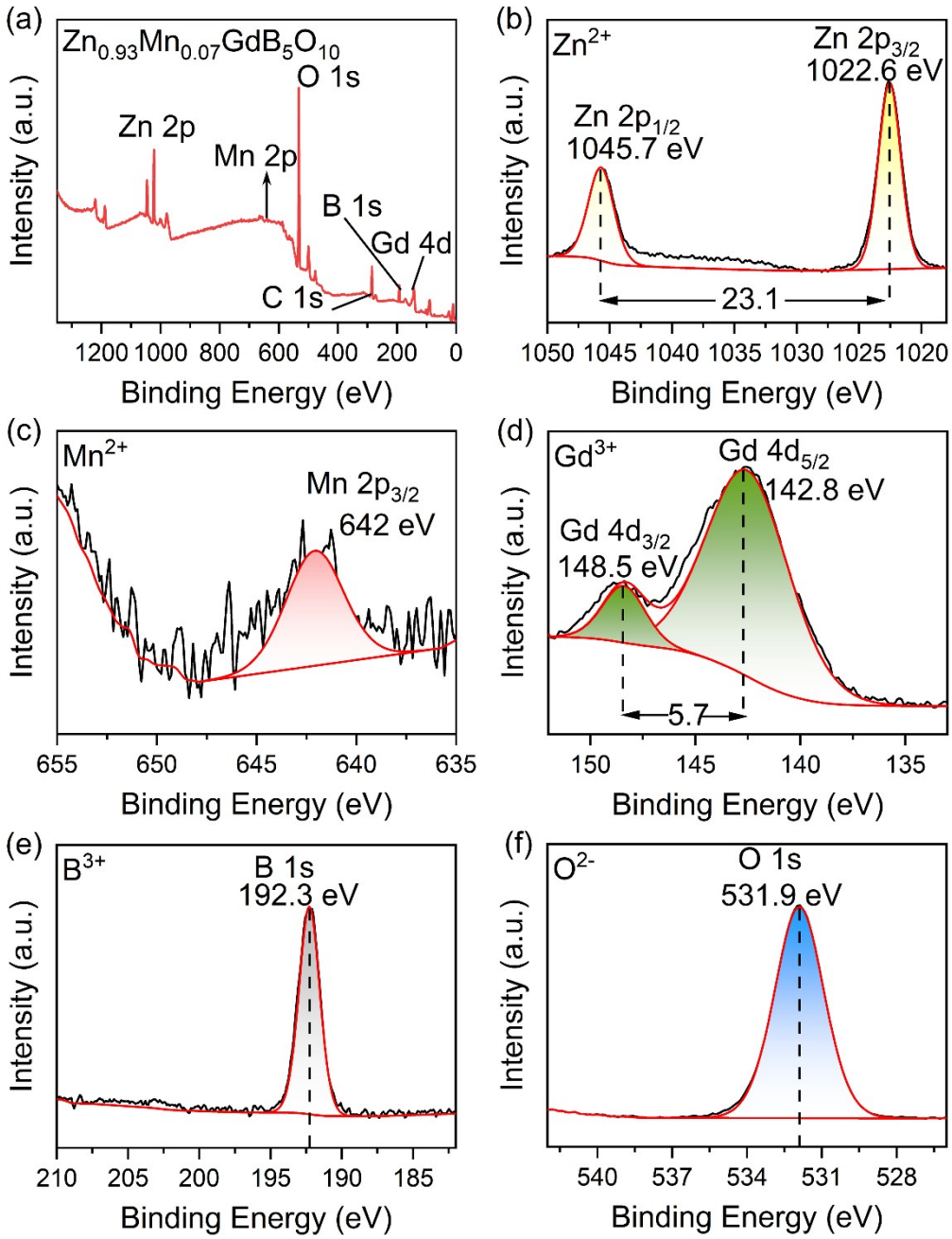

Figure S16. (a) XPS survey scan of $Zn_{0.93}Mn_{0.07}GdB_5O_{10}$ and (b-f) respective spectra for each element.

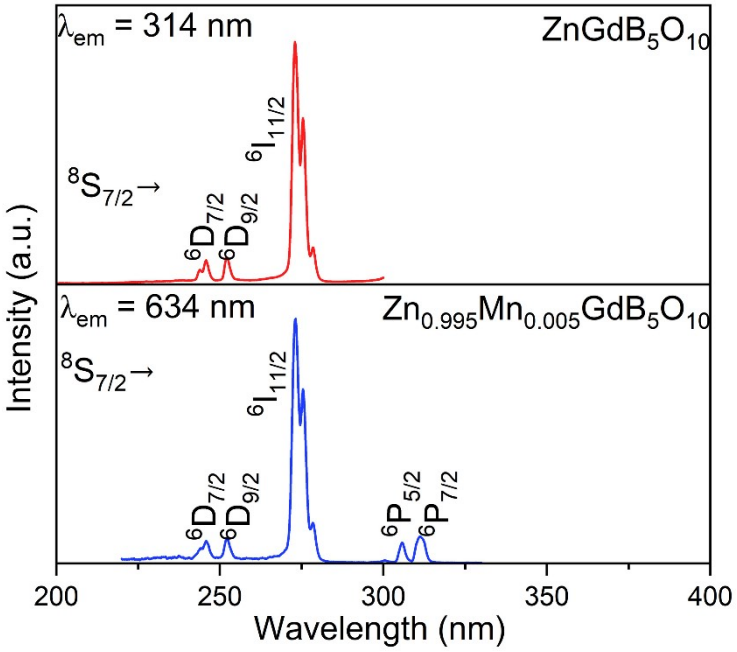

Figure S17. Comparison of the excitation spectra between $ZnGdB_5O_{10}$ and $Zn_{0.95}Mn_{0.05}GdB_5O_{10}$ by monitoring the emission at 314 nm (Gd^{3+}) and 634 nm (Mn^{2+}), respectively.

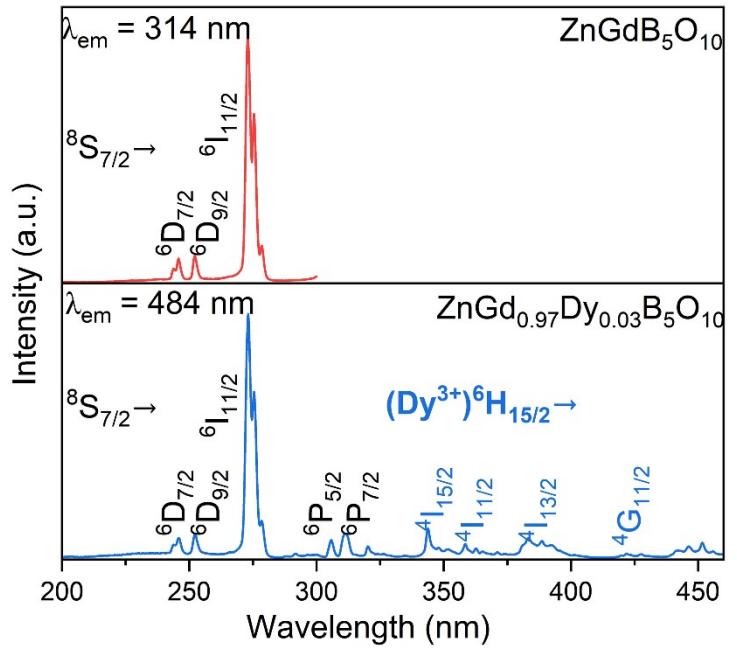

Figure S18. Comparison of the excitation spectra between $ZnGdB_5O_{10}$ and $ZnGd_{0.97}Dy_{0.03}B_5O_{10}$ by monitoring the emission at 314 nm (Gd^{3+}) and 484 nm (Dy^{3+}), respectively.

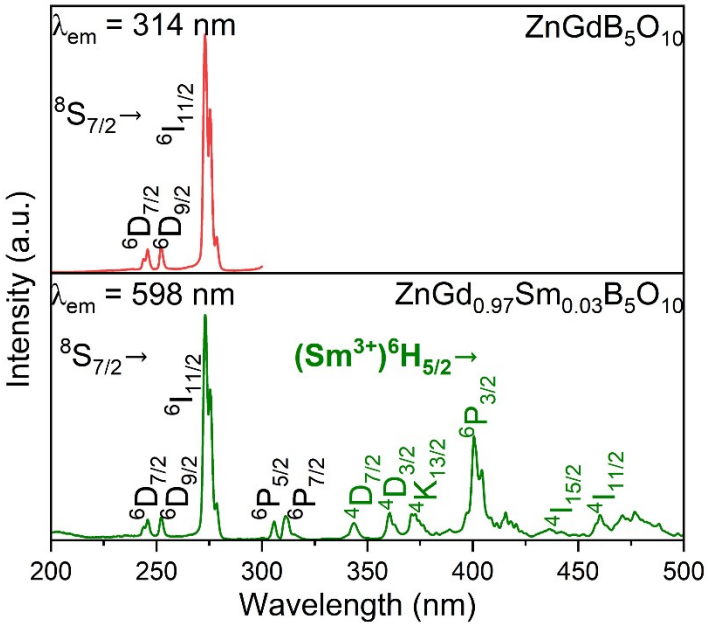

Figure S19. Comparison of the excitation spectra between $ZnGdB_5O_{10}$ and $ZnGd_{0.97}Sm_{0.03}B_5O_{10}$ by monitoring the emission at 314 nm (Gd^{3+}) and 598 nm (Sm^{3+}), respectively.

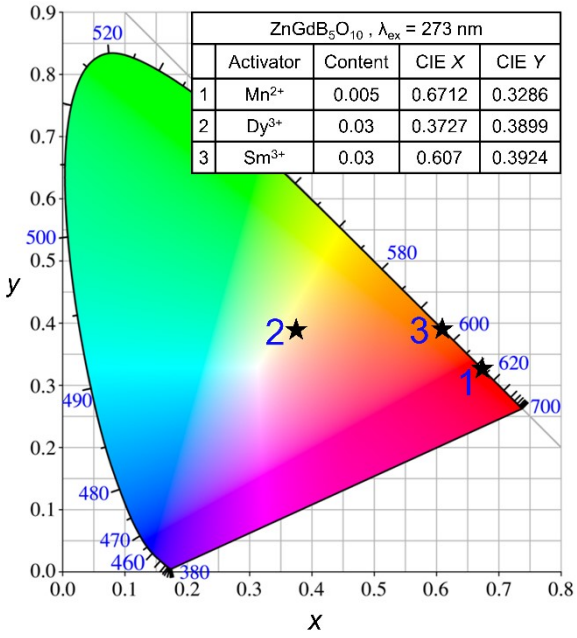

Figure S20. Calculated CIE chromaticity coordinate under the excitation at 273 nm.

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