Supplementary Information

Crystallization and architecture engineering of $ZnWO_4$ for enhanced photoluminescence

Meiting Li[a,b,c], Xuejiao Wang[d], Qi Zhu[a,b], Ji-Guang Li[*c], and Byung-Nam Kim[c]

[a] Key Laboratory for Anisotropy and Texture of Materials (Ministry of Education), School of Materials Science and Engineering, Northeastern University, Shenyang, Liaoning 110819, China

[b] Research Center for Advanced Ceramic Materials, School of Materials Science and Engineering, Northeastern University, Shenyang, Liaoning 110819, China

[c] Research Center for Functional Materials, National Institute for Materials Science, Tsukuba, Ibaraki 305-0044, Japan

[d] College of New Energy, Bohai University, Jinzhou, Liaoning 121007, China

*Corresponding author

Dr. Ji-Guang Li

National Institute for Materials Science

Tel: +81-29-860-4394

E-mail: LI.Jiguang@nims.go.jp

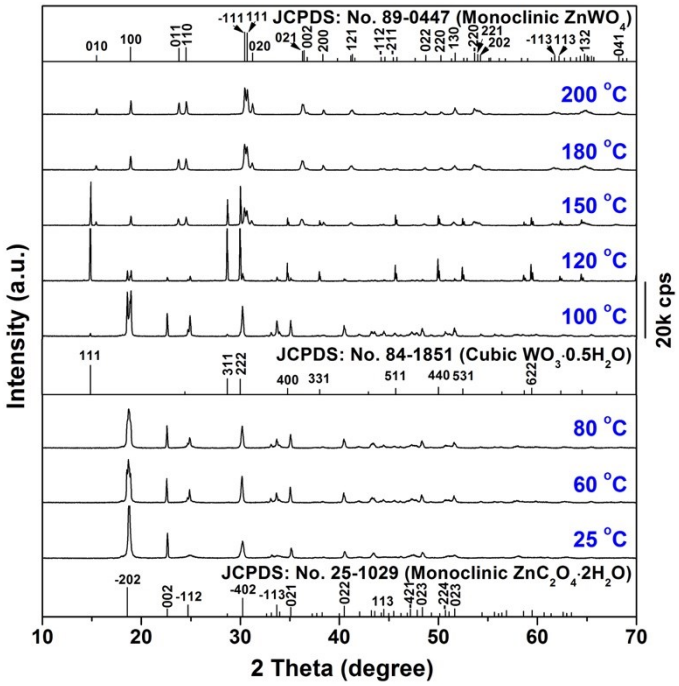

Fig. S1 XRD profiles showing temperature-dependent phase evolution of the R=1/R'=3 sample. The standard diffractions of monoclinic $ZnC_2O_4 \cdot 2H_2O$ and cubic $WO_3 \cdot 0.5H_2O$ were included as bars for comparison.

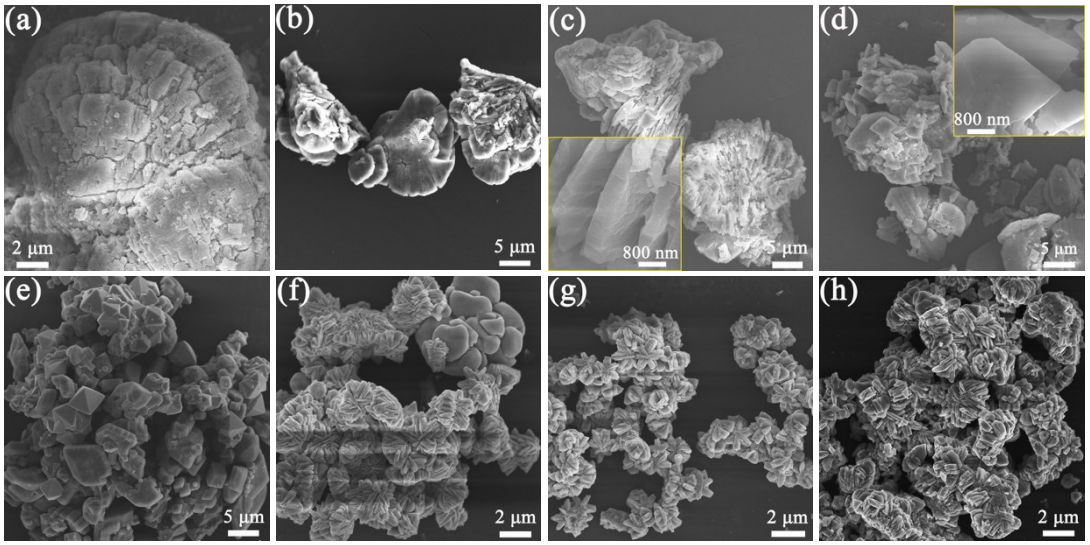

Fig. S2 FE-SEM micrographs showing temperature-dependent morphology evolution of the R=1/R'=3 sample, with the hydrothermal temperature being 25 ºC (a), 60 ºC (b), 80 ºC (c), 100 ºC (d), 120 ºC (e), 150 ºC (f), 180 ºC (g), and 200 ºC (h). The insets in (c) and (d) are magnified views of the products.

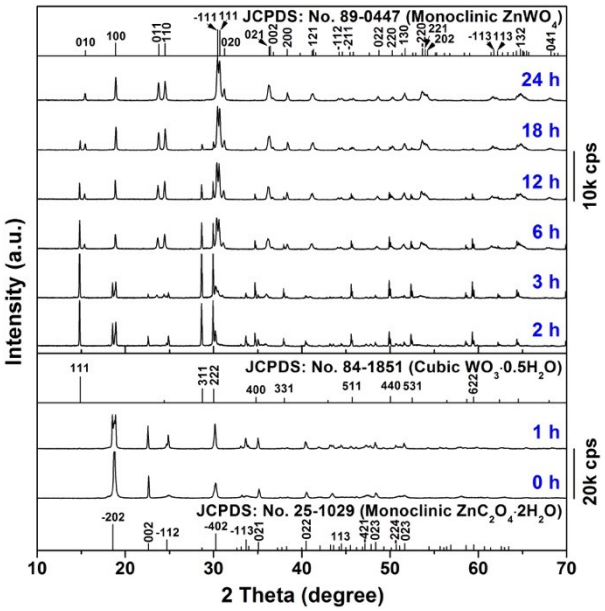

Fig. S3 XRD patterns showing time-course phase evolution of the R=1/R'=3 sample.

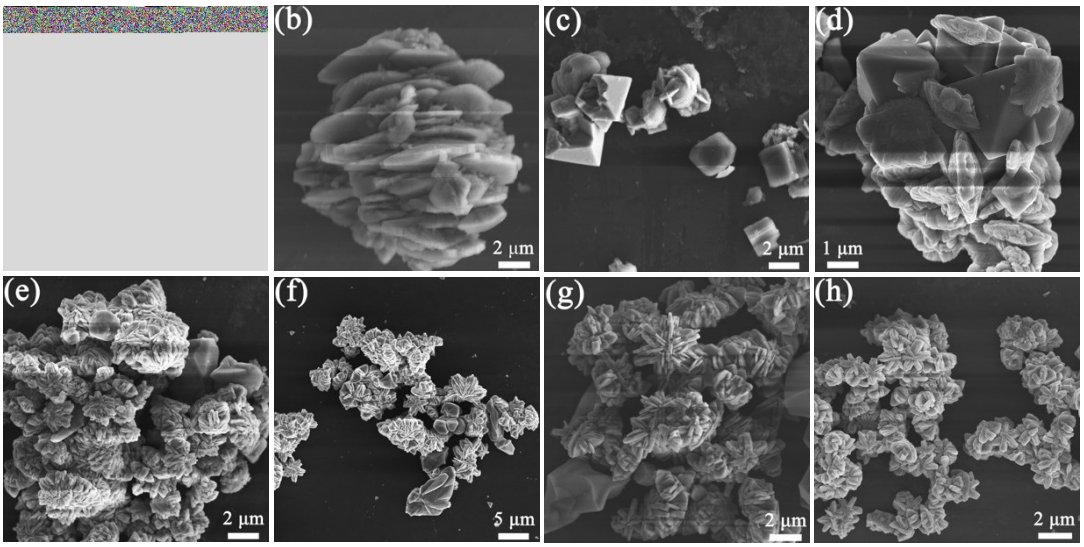

Fig. S4 FE-SEM micrographs showing time-course morphology evolution of the R=1/R'=3 sample, with the reaction duration being 0 h (a), 1 h (b), 2 h (c), 3 h (d), 6 h (e), 12 h (f), 18 h (g), and 24 h (h).

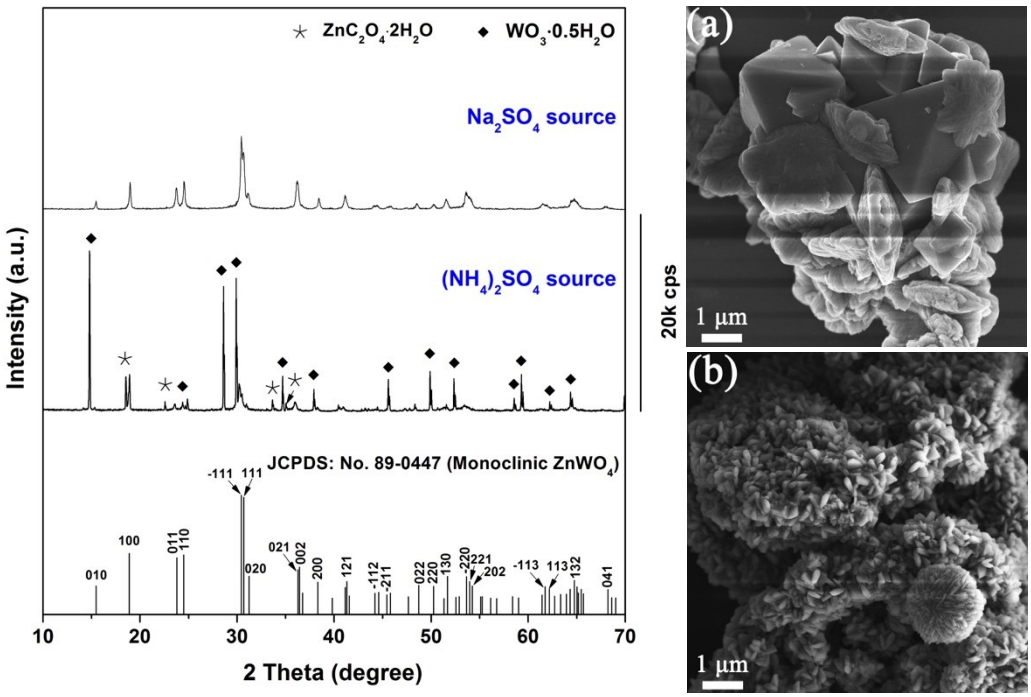

Fig. S5 XRD patterns and SEM morphologies for the 3 h hydrothermal products synthesized under R=1/R'=3 with $(NH_4)_2SO_4$ (a) and Na_2SO_4 (b) as sulfate sources.

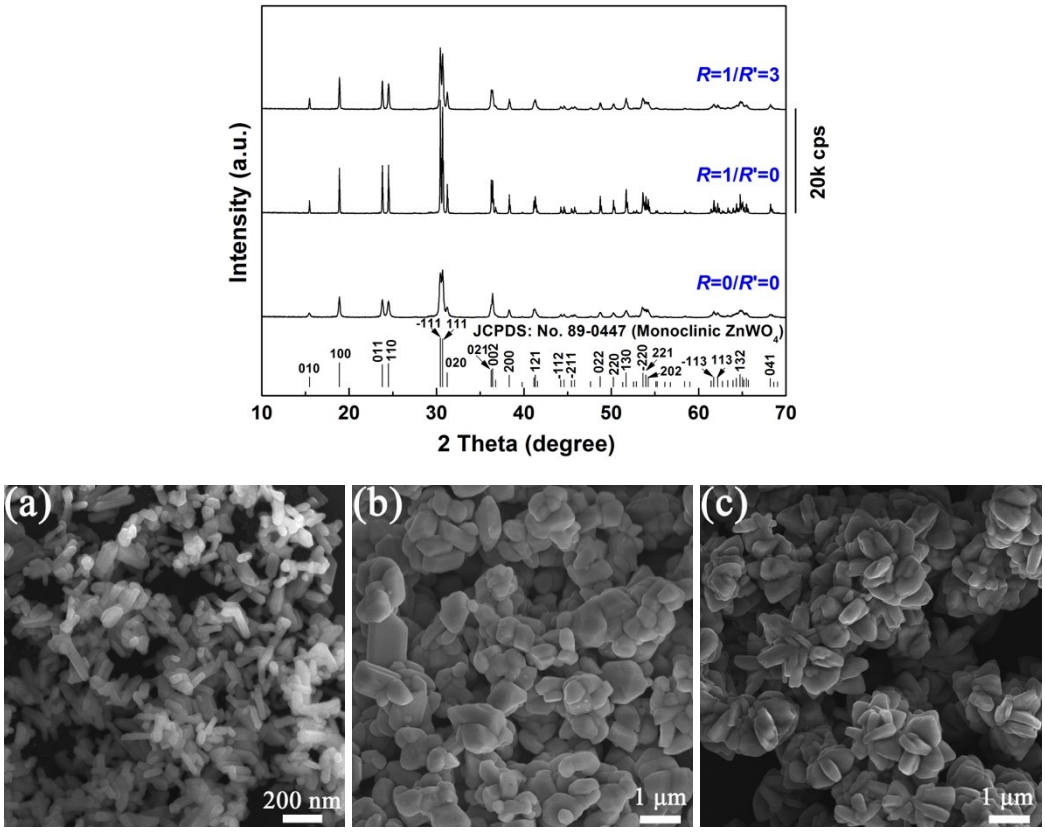

Fig. S6 XRD patterns and SEM morphologies for the R=0/R'=0 (a), R=1/R'=0 (b) and R=1/R'=3 (c) hydrothermal products after calcination at 700 ºC for 2 h.

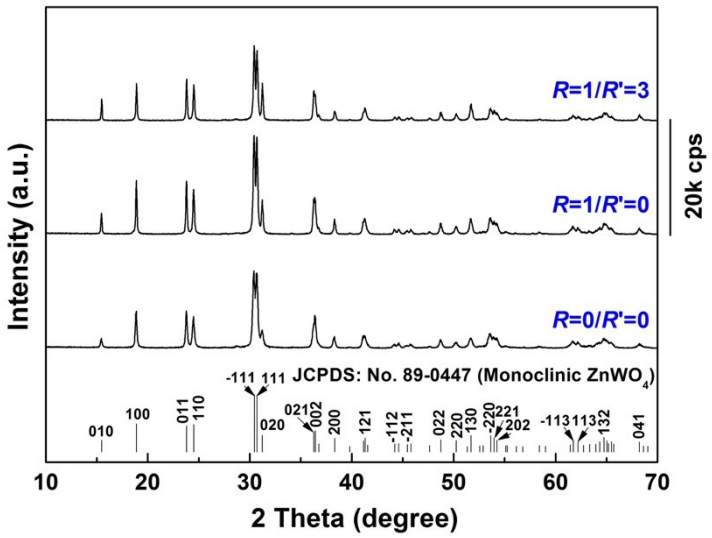

Fig. S7 XRD profiles for the R=0/R'=0, R=1/R'=0 and R=1/R'=3 $(Zn_{0.98}Eu_{0.02})WO_4$ phosphors after calcination at 700 ºC for 2 h.

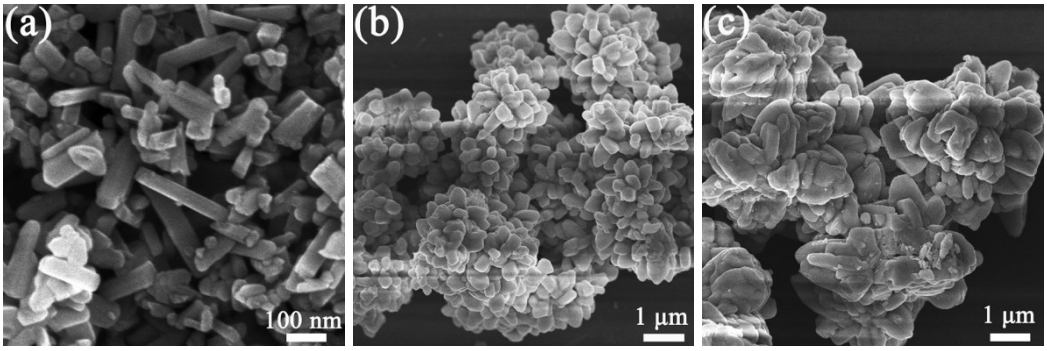

Fig. S8 FE-SEM micrographs for the R=0/R'=0 (a), R=1/R'=0 (b) and R=1/R'=3 (c) $(Zn_{0.98}Eu_{0.02})WO_4$ phosphors after calcination at 700 ºC for 2 h.

Table S1 A summary of fitting parameters for $[WO_6]^{6-}$ emissions in the $ZnWO_4$ and $(Zn_{0.98}Eu_{0.02})WO_4$ phosphors

Samples		A_1	τ_1 (μs)	A_2	τ_2 (μs)	A	τ (μs)
$ZnWO_4$	R=0/R'=0	8.336×10^5	18.56	2.544×10^4	50.40	-	-
	R=1/R'=0	-	-	-	-	2.681×10^5	28.39
	R=1/R'=3	-	-	-	-	5.188×10^5	23.89
$(Zn_{0.98}Eu_{0.02})WO_4$	R=0/R'=0	1.546×10^5	26.31	2.328×10^{10}	6.93	-	-
	R=1/R'=0	-	-	-	-	2.018×10^6	18.38
	R=1/R'=3	-	-	-	-	1.680×10^6	19.55