Supporting Information

Mixing valence control of Eu^{2+}/Eu^{3+} and energy transfer construction of Eu^{2+}/Mn^{2+} in solid solution $(1\text{-}x)Ca_3(PO_4)_2\text{-}xCa_9Y(PO_4)_7$ for multichannel photoluminescence tuning

Peipei Dang,[a,b] Dongjie Liu,[a,b] Guogang Li,*[,c] Sisi Liang,[a,b] Hongzhou Lian,[a] Mengmeng Shang,[d] and Jun Lin*[,a,b,e]

[a] *State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, University of Science and Technology of China, Changchun 130022, P. R. China.* E-mail: jlin@ciac.ac.cn

[b] *University of Science and Technology of China, Hefei, 230026, China*

[c] *Engineering Research Center of Nano-Geomaterials of Ministry of Education, Faculty of Materials Science and Chemistry, China University of Geosciences, 388 Lumo Road, Wuhan 430074, P. R. China.* E-mail: ggli@cug.edu.cn

[d] *School of Chemistry and Chemical Engineering, Qingdao University, 308 Ningxia Road, Qingdao, 266071, P. R. China*

[e] *School of Applied Physics and Materials, Wuyi University, Jiangmen, Guangdong, 529020, P. R. China*

Table S1. Main refinement parameters of the (1-x)CPO-xCYPO:Eu^{2+} (x = 0-1.0) samples.

Space group: R3c (161)			
x	Cell parameters, Å	Cell volume, $Å^3$	R_{wp}, R_p, %, χ^2
x = 0	$a = b$ = 10.4434 c = 37.3465 $\alpha = \beta$ =90º γ= 120°	3527.46	5.30, 4.08, 1.573
x = 0.1	$a = b$ = 10.4464 c = 37.3581 $\alpha = \beta$ = 90º γ= 120°	3530.62	4.21, 3.18, 2.432
x = 0.2	$a = b$ = 10.4449 c = 37.3633 $\alpha = \beta$ = 90º γ= 120°	3530.07	4.29, 3.17, 2.732
x = 0.3	$a = b$ = 10.4458 c = 37.3636 $\alpha = \beta$ = 90º γ= 120°	3530.77	4.63, 3.50, 2.753
x = 0.4	$a = b$ = 10.4434 c = 37.3640 $\alpha = \beta$ = 90º γ= 120°	3529.16	3.75, 2.79, 1.902
x = 0.5	$a = b$ = 10.4435 c = 37.3597 $\alpha = \beta$ = 90º γ= 120°	3528.79	3.30, 2.54, 1.696
x =0.6	$a = b$ = 10.4449 c = 37.3682 $\alpha = \beta$ = 90º γ= 120°	3530.57	3.73, 2.83, 1.812
x = 0.7	$a = b$ = 10.4465 c = 37.3768 $\alpha = \beta$ = 90º γ= 120°	3532.45	4.94, 3.81, 1.412
x = 0.8	$a = b$ = 10.4432 c = 37.3828 $\alpha = \beta$ = 90º γ= 120°	3530.82	5.48,4.24, 1.154

$x = 0.9$	$a = b = 10.4405$ $c = 37.3916$ $\alpha = \beta = 90°$ $\gamma = 120°$	3529.80	7.34, 5.37, 2.779
$x = 1.0$	$a = b = 10.4410$ $c = 37.3779$ $\alpha = \beta = 90°$ $\gamma = 120°$	3528.81	4.81, 3.55, 2.891

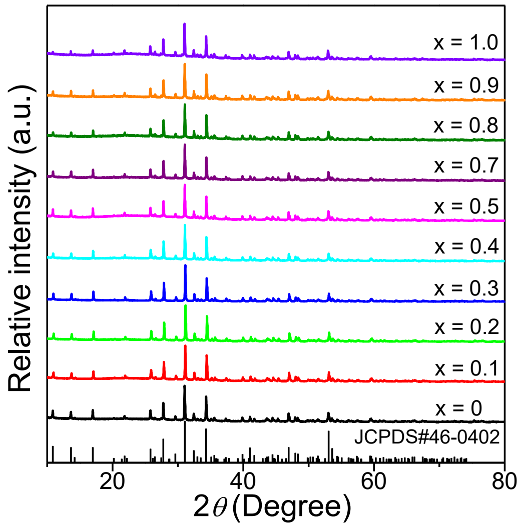

Fig. S1. The XRD patterns of as-prepared (1-x)CPO-xCYPO:Eu^{2+} (x = 0-1.0) samples.

Table S2. The internal quantum yields (IQYs) and absorption of (1-x)CPO-xCYPO:0.03Eu^{2+} (x = 0-1.0) samples

Samples (x)	IQYs (%)	Abs (%)
0	74.7	53.8
0.1	81.2	53.5
0.2	84.3	48.9
0.3	86.4	50.5
0.4	87.1	33.4
0.5	91.8	23.4
0.6	82.2	33.8
0.7	93.9	38.1
0.8	93.8	31.3
0.9	80.9	38.2
1.0	89.8	22.4

Table S3. The average lifetimes of (1-x)CPO-xCYPO:$y$$Eu^{2+}$,$z$$Mn^{2+}$ samples, respectively.

z	x = 0.2, y = 0.01	x = 0.5, y = 0.03	x = 0.7, y = 0.05	x = 0.9, y = 0.07
0	606.70 ns	671.53 ns	638.87 ns	892.79 ns
0.05	514.24 ns			
0.10	366.60 ns	486.60 ns	592.33 ns	779.98 ns
0.20	227.62 ns	357.10 ns	444.22 ns	652.40 ns
0.30	121.94 ns	295.53 ns	292.53 ns	396.25 ns
0.35	44.49 ns	152.62 ns	170.63 ns	178.64 ns

Table S4. The long-decay (τ_1) and short-decay (τ_2) components and fraction in the total emission intensity assigned to each component of 0.5CPO-0.5CYPO:Eu^{2+}/Eu^{3+} sample.

T (K)	I_1	τ_1	I_2	τ_2	f_1	f_2
140	3040.255	1091.55	4938.228	114.0029	0.8549	0.1450
200	3068.15	1070.71	5578.56	105.87	0.8476	0.1524
300	2647.03	984.83	6897.07	100.96	0.7892	0.2108
350	2439.9	859.43	9760.12	83.89	0.7192	0.2808