Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Adjustable ultraviolet and white light dual emission phosphor $Y_2Sr(Ga_{1-y}Al_y)_4SiO_{12}:xPr^{3+}$ for health lighting

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Table S1. The fitting index information of $Y_2SrGa_4SiO_{12}$:1%Pr^{3+}

Fitting index	Chemical formula		Y2SrGa4SiO12
	Phase content		100
Rwp= 9.64%	Card ID		PDF#00-043-0512
	Space group		I a -3 d
Rp= 7.04%	Cell parameter	a (Å)	12.28376(40)
		b(Å)	12.28376(40)
GOF=1.61		c(Å)	12.28376(40)
		α(°)	90
X2=GOF^2		β(°)	90
		γ(°)	90
		Volume(Å^3)	1853.51(18)

Table S2. The refined XRD Atomic parameters of $Y_2SrGa_4SiO_{12}$:1%Pr^{3+}

Atomic parameters						
Atom	Wyck	Site	S.O.F	x/a	y/b	z/c
Y	24c	2.22	0.617	1/8	0	1/4
Sr	24c	2.22	0.333	1/8	0	1/4
Ga	16a	-3		0	0	0
Ga1	24d	-4	0.667	3/8	0	1/4
Si	24d	-4	0.333	3/8	0	1/4
O	96h	1		0.304(51)	0.494(60)	0.656(92)
Pr	24c	2.22	0.05	1/8	0	1/4

Table S3. The crystal structure data and refinement parameters for samples

Formula	X=0	X=0.4%	X=0.6%	X=1%	X=1.5%
Crystal system	Cubic	Cubic	Cubic	Cubic	Cubic
Space group	Ia-3d	Ia-3d	Ia-3d	Ia-3d	Ia-3d
a (Å)	12.28263	12.28376	12.28395	12.28455	12.28479
V (Å^3)	1852.99	1853.51	1853.59	1853.86	1853.97
χ^2(%)	2.63	2.59	3.29	2.70	2.77
R_{wp} (%)	9.70	9.46	12.01	9.88	10.10
R_p (%)	7.14	7.04	8.94	7.35	7.52

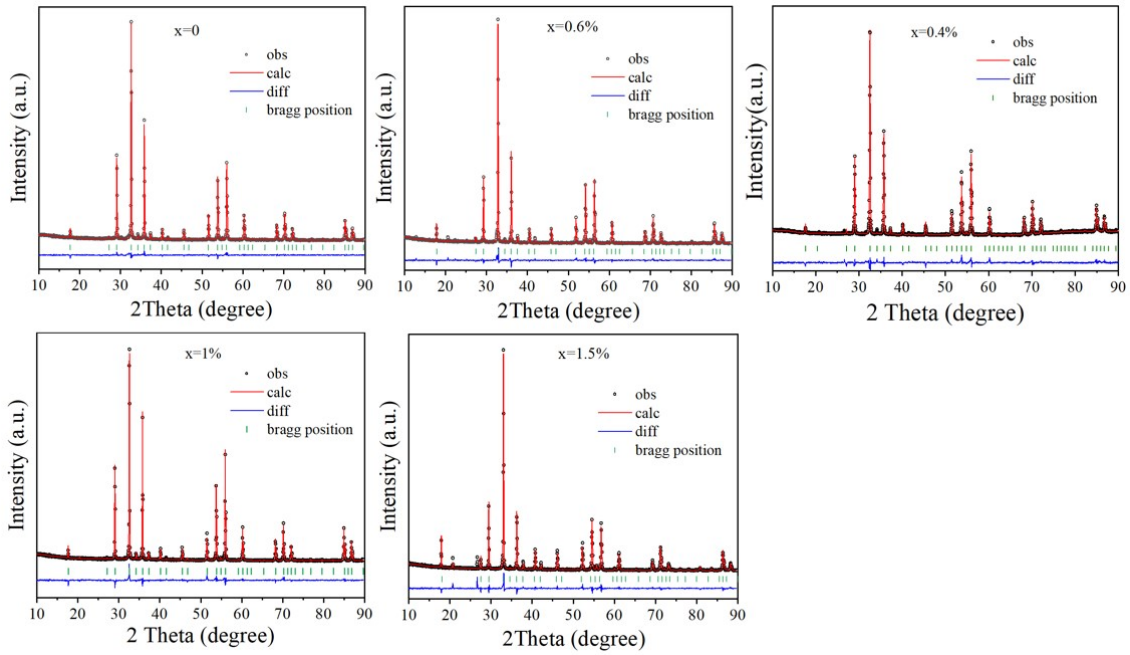


Fig S1. Rietveld refinement and crystal structure of YSGS:xPr^{3+}(x = 0–1.5%).

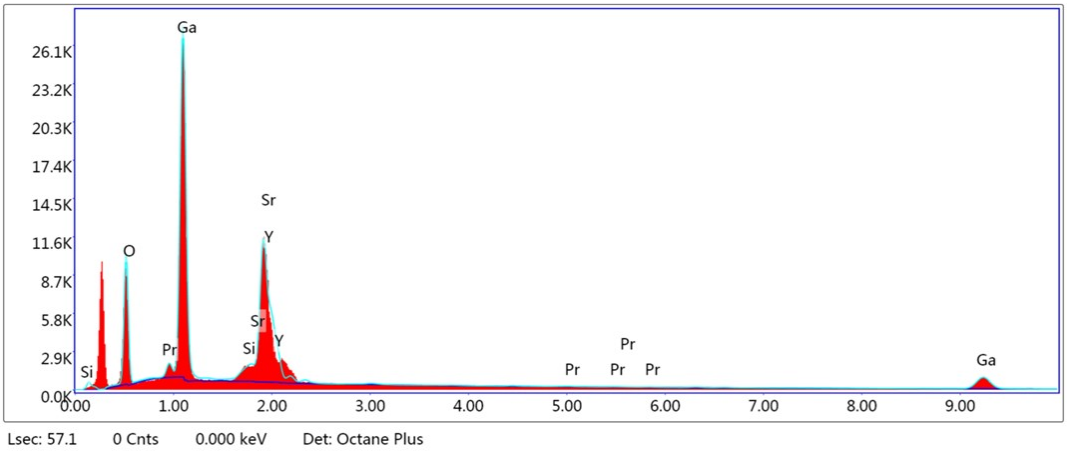
Table S4. The ICP-OES test results of sample Y_2SG_4S: 1%Pr

m_0 (g)	V_0 (ml)	element	C_0 (mg/L)	f	C_1 (mg/L)	C_x (mg/kg)	W (%)
0.1151	100	Sr	12.1001	10	121.001	105126.8462	10.5127%
0.1151	100	Ga	49.2893	10	492.893	428230.2346	42.8230%
0.1151	100	Pr	0.3804	10	3.804	3304.9522	0.3305%
0.1151	100	Y	23.8519	10	238.519	207227.6281	20.7228%

$$C_X(mg/kg) = \frac{C_0(mg/L) * f * V_0(mL) * 10^{-3}}{m_0(g) * 10^{-3}} = \frac{C_1(mg/L) * V_0(mL) * 10^{-3}}{m_0(g) * 10^{-3}}$$

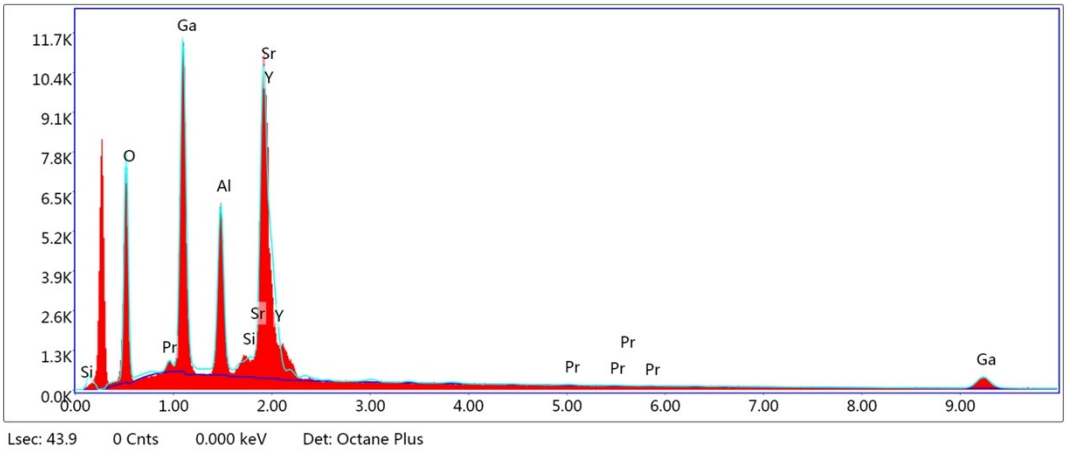
$$W(\%) = \frac{C_x(mg/kg)}{10^6} * 100\%$$

In the above formula, m_0 is the mass of the sample, V_0 is the volume of the constant volume of the sample after digestion, f is the dilution multiple, C_0 is the concentration of elements in the test solution, C_1 is the concentration of elements in the stock solution of the sample digestion solution, C_x is the test result of the measured element, and W is the final test result of the measured element.



Element	Weight %	Atomic %	Net Int.	Error %	Kratio	Z	A	F
O K	13.71	41.76	920.20	6.13	0.0638	0.8240	0.5643	1.0000
GaL	42.89	29.19	2632.40	3.30	0.3501	0.5829	1.1775	0.9999
SiK	2.88	5.56	301.60	8.76	0.0049	0.7390	0.8096	1.0037
SrL	13.81	8.92	599.21	4.83	0.0150	0.5565	0.9607	1.0005
Y L	26.26	14.41	1142.90	2.07	0.1699	0.5621	0.9689	0.9999
PrL	0.45	0.16	6.80	55.36	0.0026	0.5559	1.0400	1.0166

Fig. S2. The EDS spectrum of YSGS:1%Pr^{3+} phosphor. The quantitative data of each element.



Element	Weight %	Atomic %	Net Int.	Error %	Kratio	Z	A	F
O K	10.08	30.84	941.80	6.55	0.0703	0.8106	0.5364	1.0000
GaL	26.44	18.52	1266.10	3.57	0.2014	0.5751	1.1813	1.0001
AlK	8.19	16.23	989.70	4.23	0.0541	0.7124	0.8027	1.0029
SiK	3.29	5.38	207.40	21.90	0.0022	0.7300	0.8437	1.0049
SrL	16.20	10.01	882.20	7.73	0.0089	0.5499	0.9976	1.0009
Y L	35.32	18.86	1354.84	1.86	0.2357	0.5554	1.0027	0.9998
PrL	0.48	0.15	6.60	56.75	0.0028	0.5472	1.0389	1.0094

Fig. S3. The EDS spectrum of $YSG_{2.4}A_{1.6}S{:}1\%Pr^{3+}$ phosphor. The quantitative data of each element.

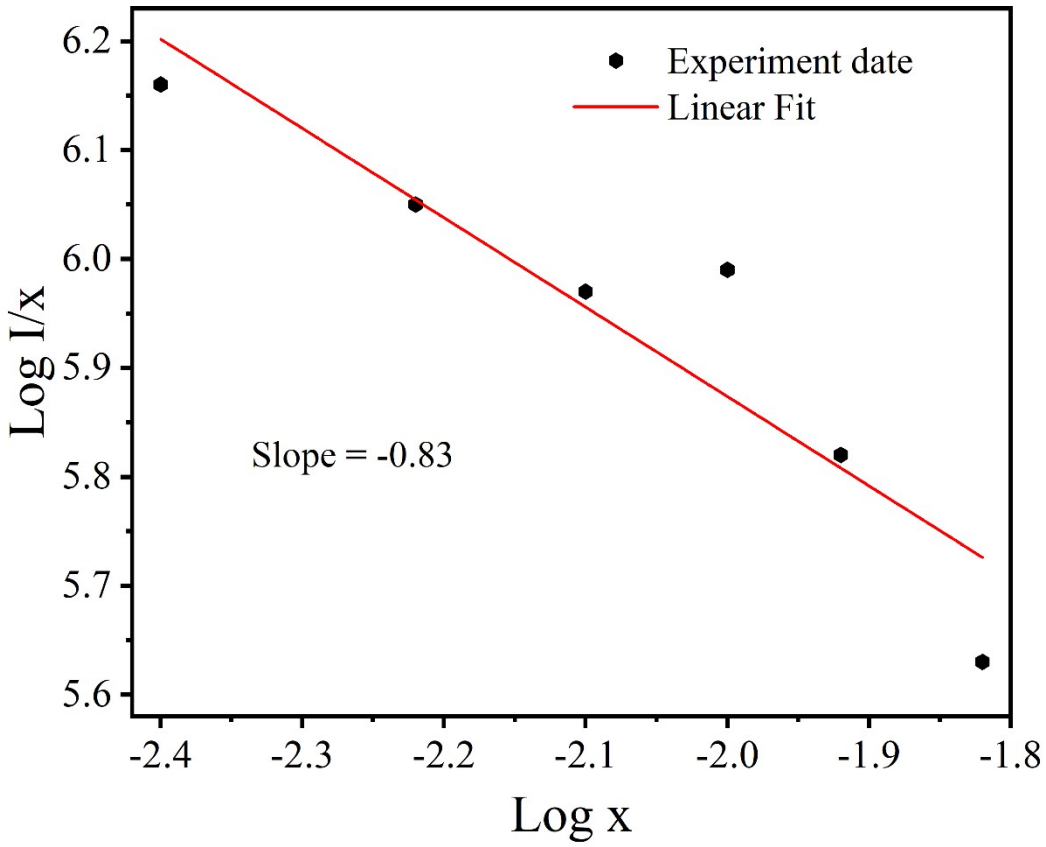


Fig. S4. the lg(I/x) − lg(x) plot and linear fitting

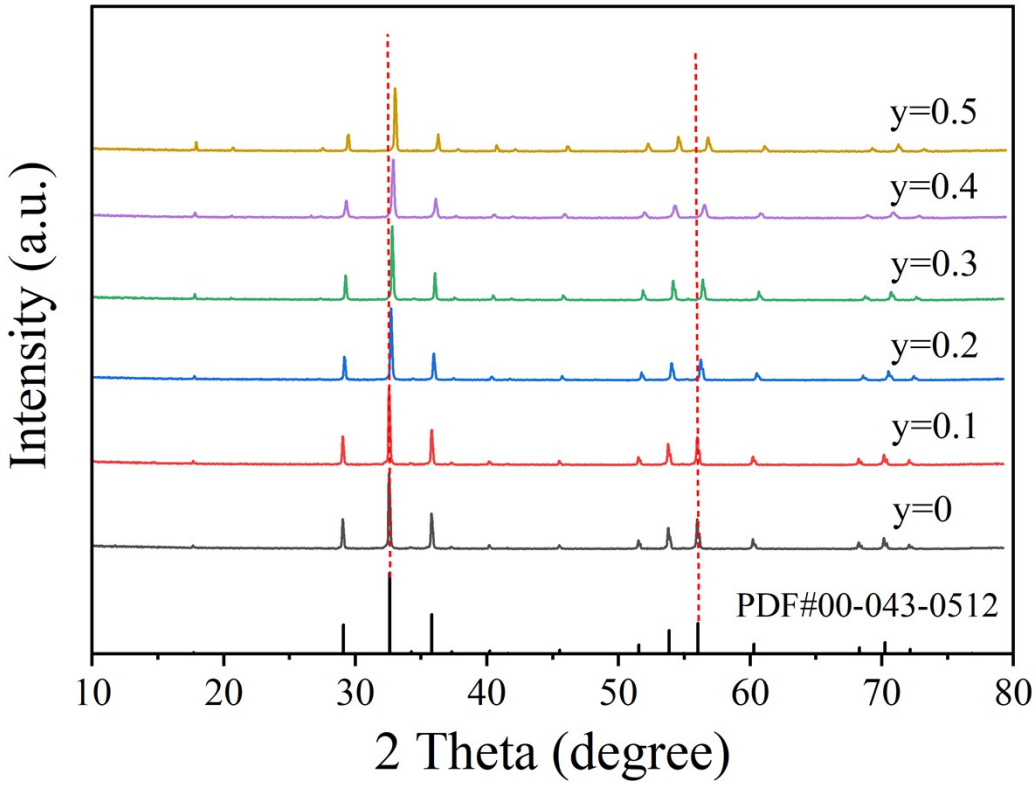


Fig. S5. XRD patterns of $Y_2Sr(Ga_{1-y}Al_y)_4SiO_{12}$:0.01$Pr^{3+}$ (y=0–0.5), bars at button present the standard data of $Y_3Ga_5O_{12}$ (PDF 00-043-0152).

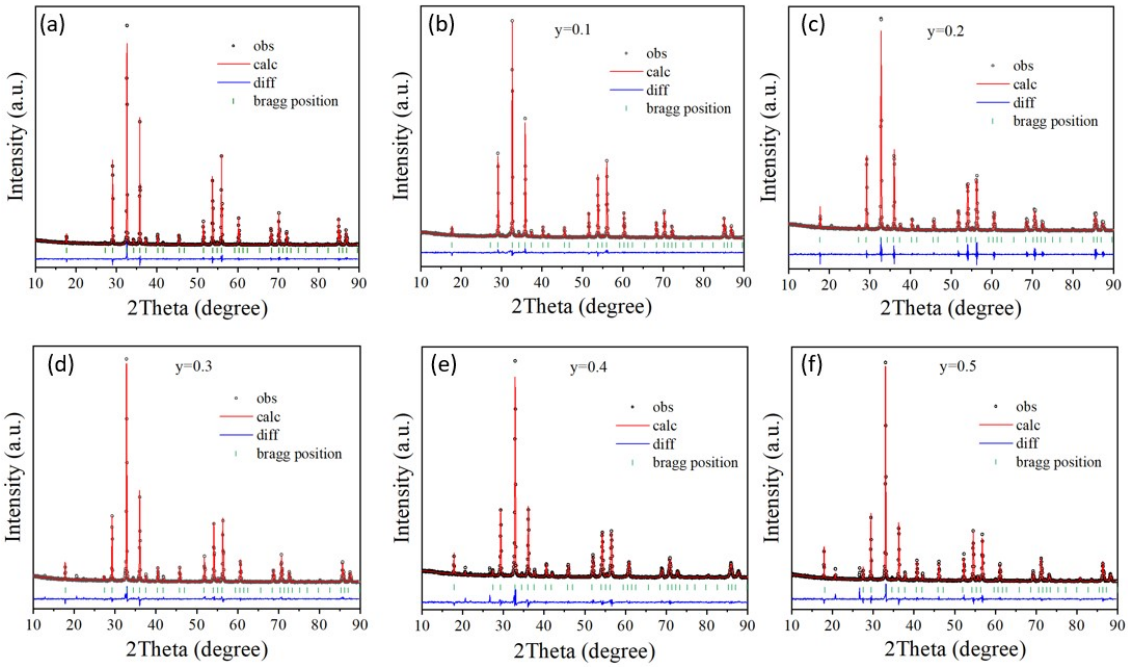


Fig. S6. Rietveld refinement and crystal structure of $YSG_{1-y}A_yS:1\%Pr^{3+}$(y = 0–0.5).

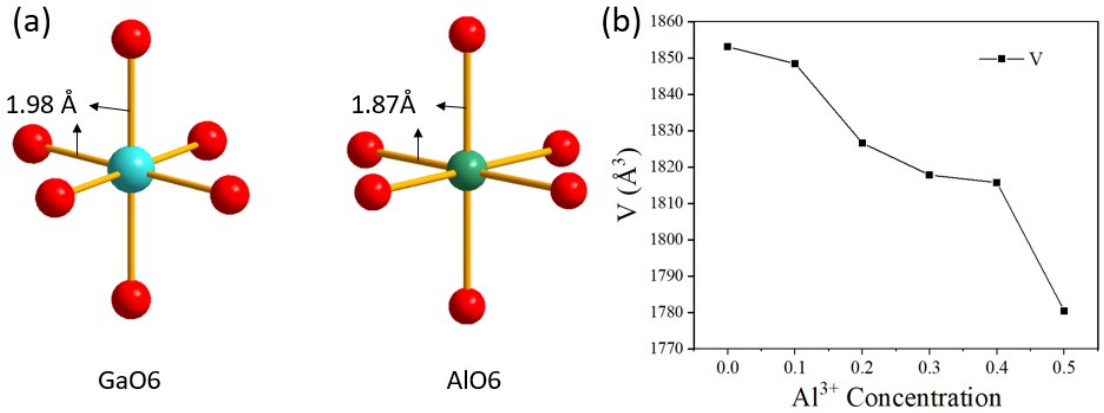


Fig. S7. (a) The average bond length of Ga-O and Al-O. (b) The change trend of the unit cell volume.

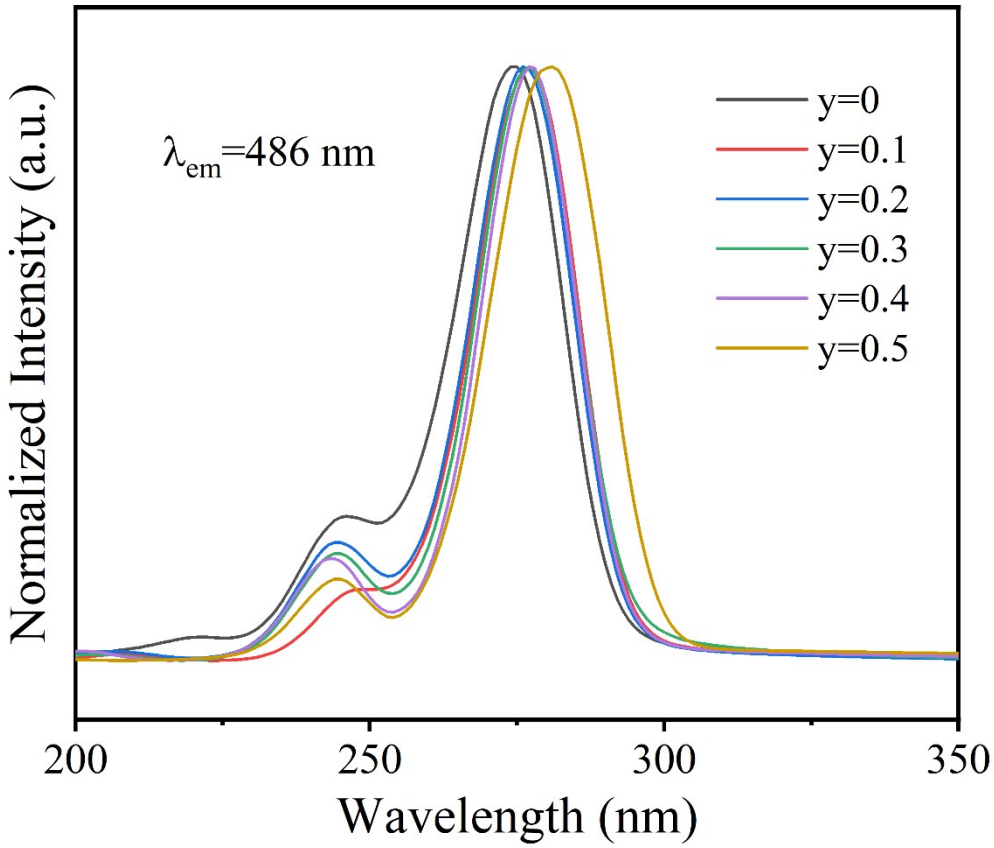


Fig. S8. Normalized excitation spectra of $Y_2Sr(Ga_{1-y}Al_y)_4SiO_{12}:0.01Pr^{3+}$ (y=0.0.1,0.2,0.3,0.4,0.5) monitored at 486 nm

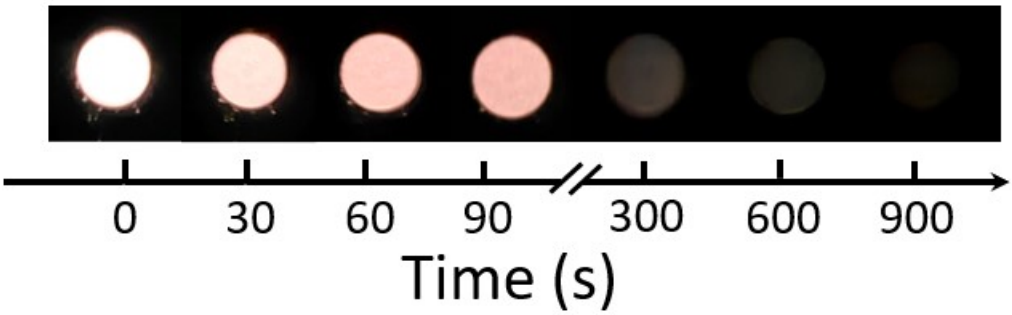


Fig. S9. Continuous luminescence of the sample under 275 nm excitation for 10 minutes.

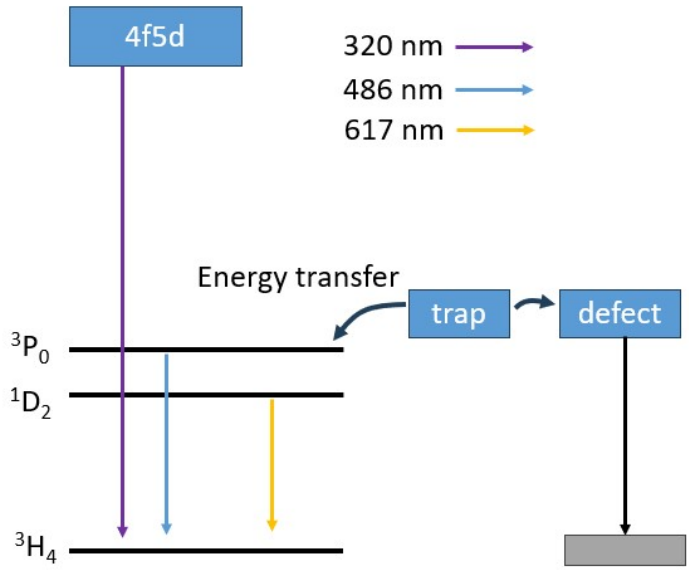


Fig. S10. Energy transfer diagram of trap energy level