Supplementary information for:

Multimode Responsive Luminescence of Robust $Sr_2Ga_2SiO_7$: Zn/Er/Pr for Visualized/Dynamic Anticounterfeiting and Temperature/Stress Sensing

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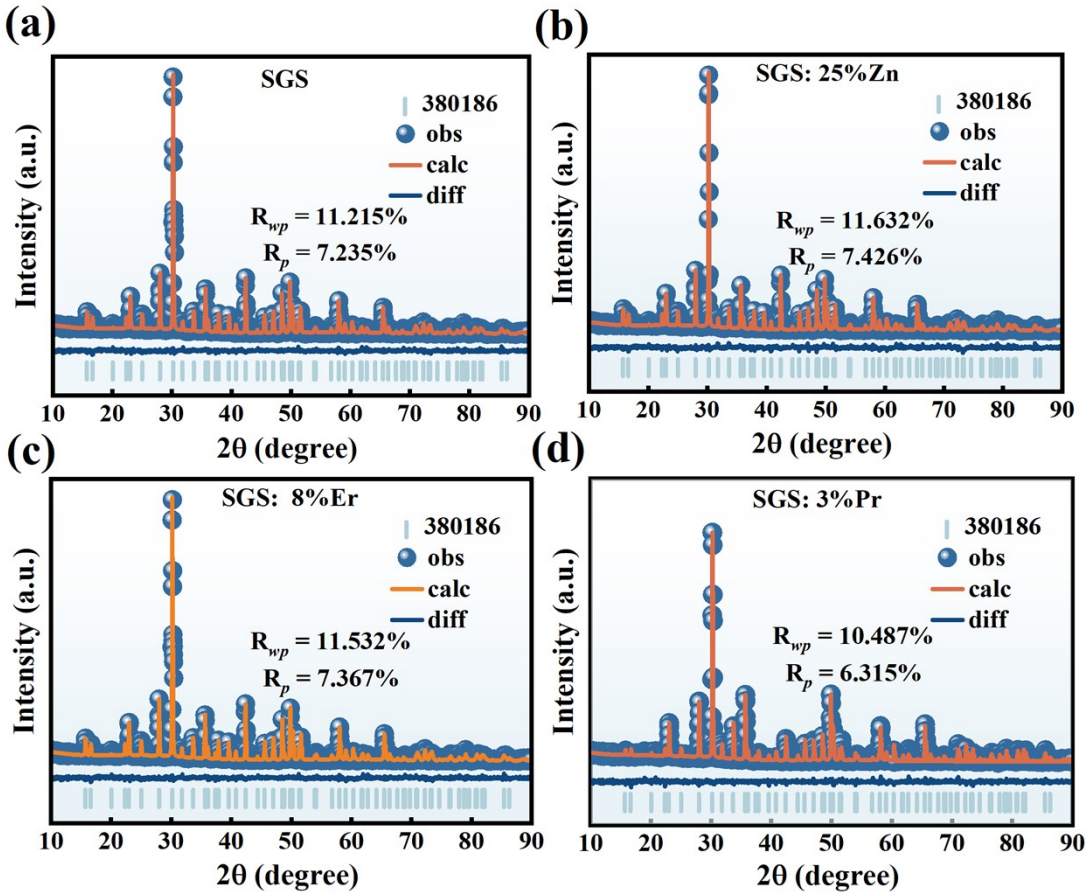

Fig.S1 Representative XRD Rietveld refinements for the a) the host SGS, b) SGS: 25%Zn, c) SGS: 8%Er, and d) SGS: 3%Pr.

Table S1 Comparison of ionic radius and the calculated D_r[a]

Doping ion \ Host ion	Sr^{2+} (CN = 8) 1.26 Å	Ga^{3+} (CN = 4) 0.47 Å	Si^{4+} (CN = 4) 0.26 Å
Zn^{2+} (CN = 4) 0.60 Å	-	27.6%	-56%
Zn^{2+} (CN = 8) 0.90 Å	28.5%	-	-
Er^{3+} (CN = 8) 1.004 Å	20.3%	-	-
Pr^{3+} (CN = 8) 1.126 Å	10.63%	-	-

[a] D_r is calculated *via* $D_r = \left|\frac{R_h(CN) - R_d(CN)}{R_h(CN)}\right| \times 100\%$, where $R_h(CN)$ and the $R_d(CN)$ are the ionic radii of host cation and doped ion, respectively. An acceptance value of the D_r typically must not excess about 30%.

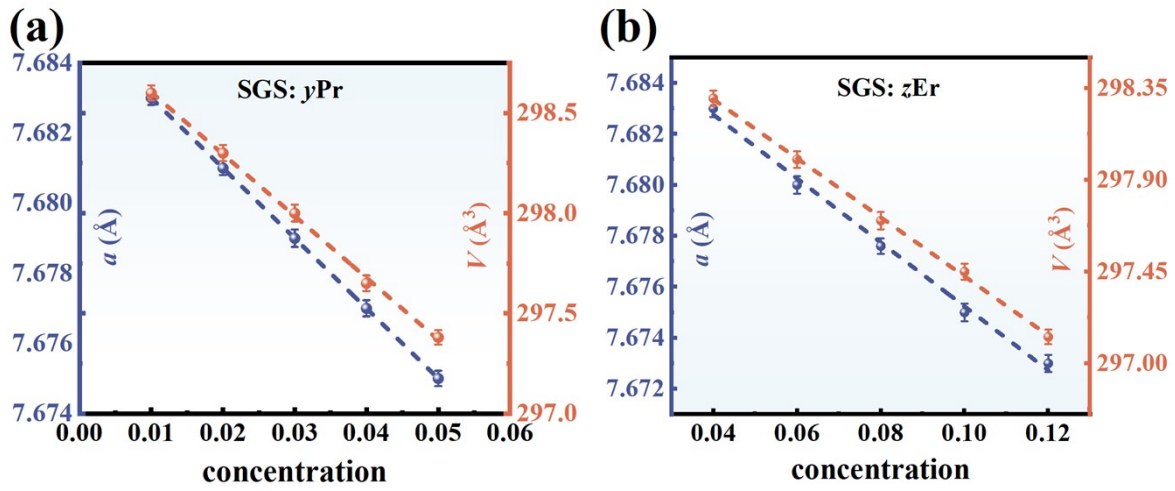

Fig.S2 Variations of the cell parameters of a and V in a) SGS: yPr and b) SGS: zEr.

Table S2 The calculated weight and atomic percentages of the SGS: 25%Zn, 8%Er, 3%Pr via the EDS elemental mapping

Elements	Line type	Weight (%)	Atomic (%)
Sr	L	39.07	20.96
Ga	L	4.98	3.36
Si	K	7.53	12.60
O	K	17.14	50.36
Zn	L	6.84	4.92
Pr	L	17.71	5.91
Er	L	6.73	1.89
Total	-	100	100

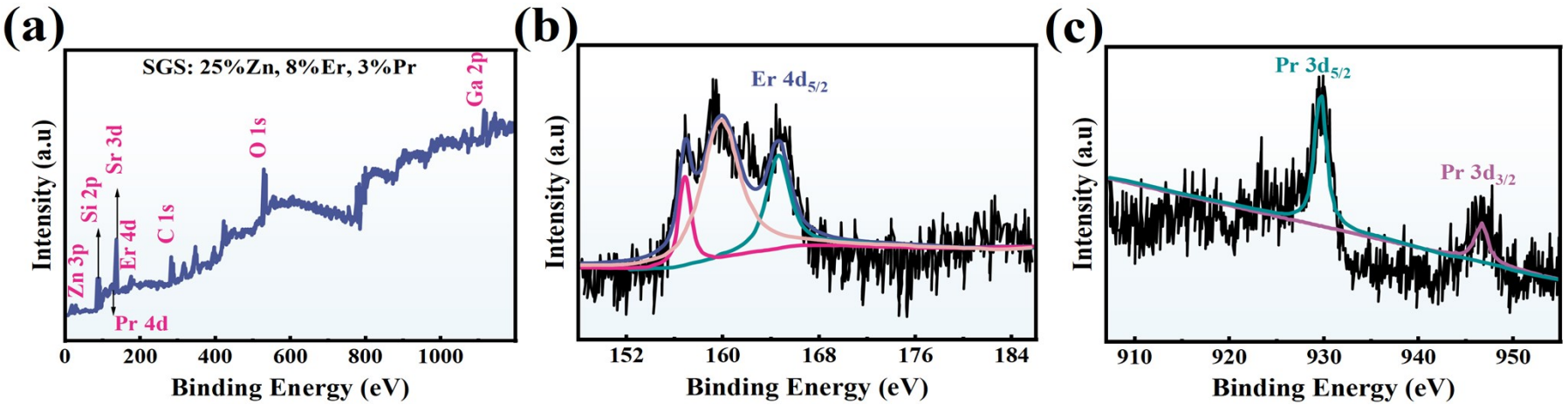

Fig.S3 a) The survey XPS spectra of the SGS: 25%Zn, 8%Er, 3%Pr, b) and c) Decomposition XPS peaks for the Er and Pr, respectively.

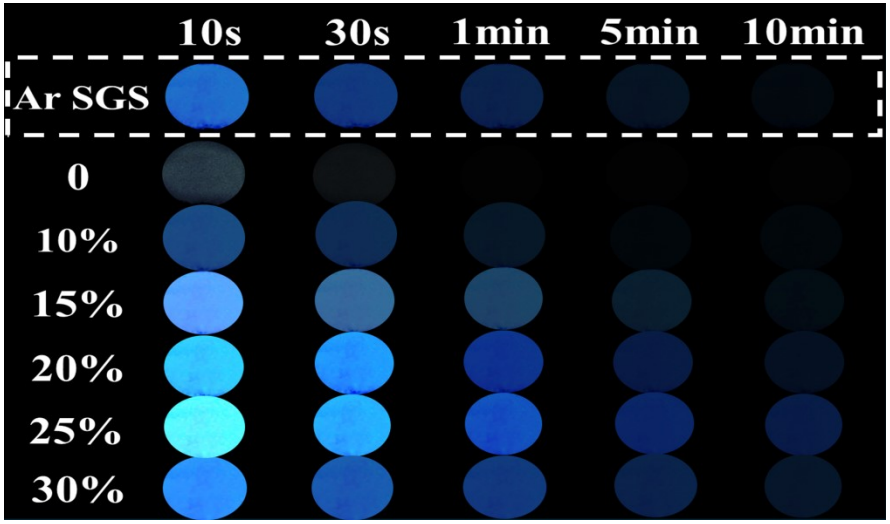

Fig.S4 The LPL evolutions of the digital images for the distinct phosphors

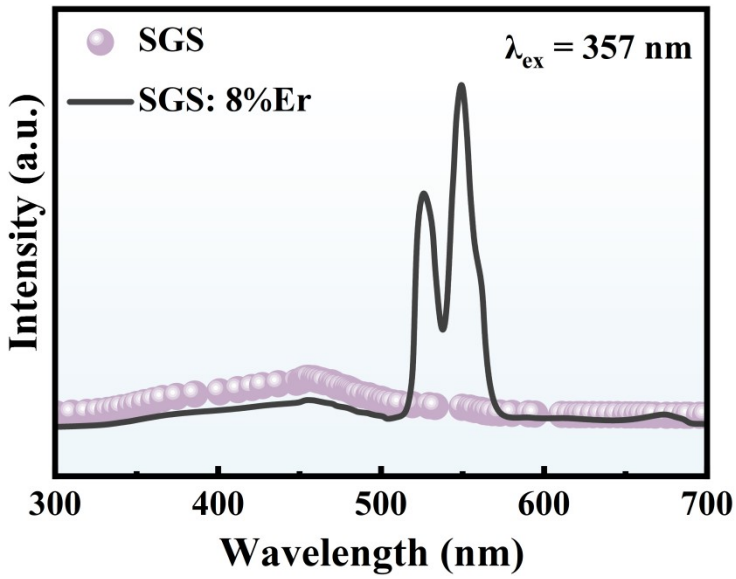

Fig.S5 Comparison of the PL spectra for the host and SGS: 8%Er under air condition

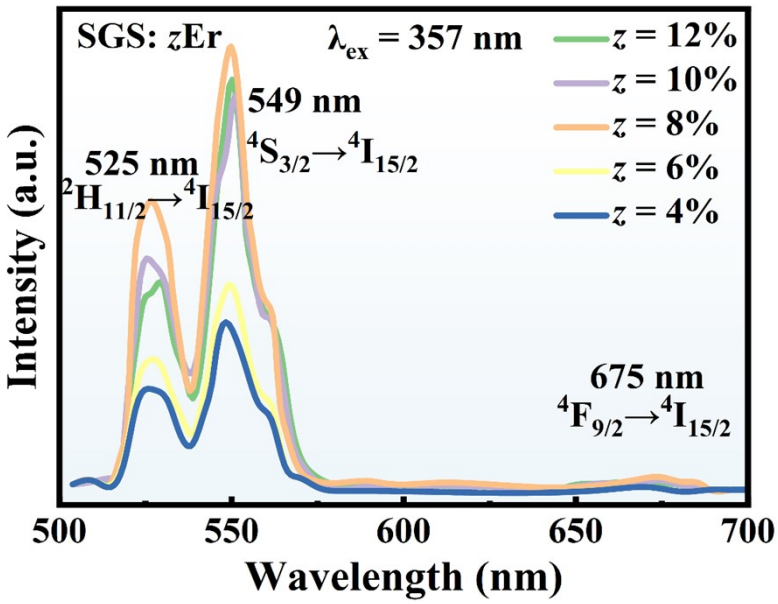

Fig.S6 Variations of PL intensity of SGS: zEr

Table S3 CIE coordinates of the phosphors SGS: zEr

Concentration of Er^{3+}	CIE coordinates (x, y)
4%	(0.2550, 0.5912)
6%	(0.2580, 0.6012)
8%	(0.2577, 0.6120)
10%	(0.2534, 0.6023)
12%	(0.2561, 0.5893)

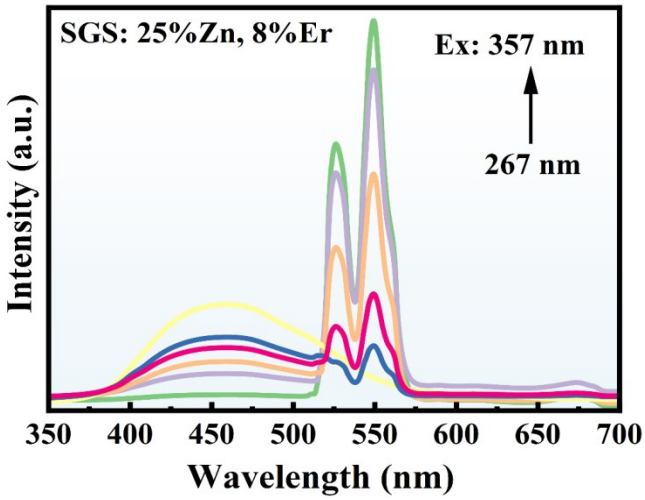

Fig.S7 Variation of PL contour under distinct excitations from 267 to 357 nm for the phosphor SGS: 25%Zn, 8%Er.

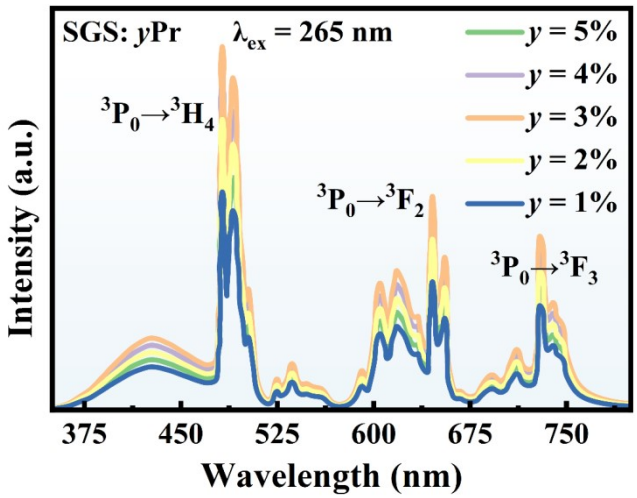

Fig.S8 PL intensity evolution with the increase of Pr content in the SGS.

Table S4 The calculated average decay lifetimes with the relevant fitting parameters

SGS: y%Pr	A_1	τ_1 (ms)	A_2	τ_2 (ms)	τ_{av} (ms)	R^2
$y = 1$	6293.45	21374.53	351.82	39429.69	0.93	99.91
$y = 2$	6871.32	18647.25	287.50	30957.97	0.81	99.88
$y = 3$	7025.14	15332.48	312.59	25324.44	0.72	99.93
$y = 4$	7324.10	16454.17	394.73	26708.67	0.56	99.87
$y = 5$	7553.56	17263.92	326.10	28588.46	0.47	99.90

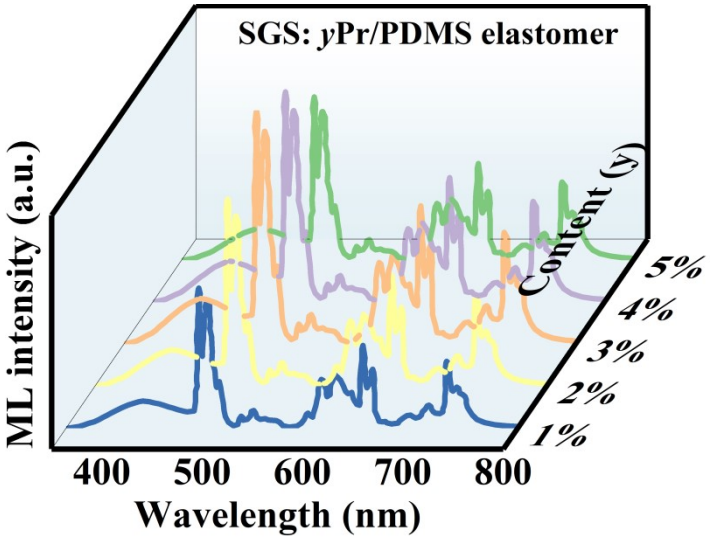

Fig.S9 Variation of the ML intensity with the distinct Pr content in the SGS: yPr elastomer.

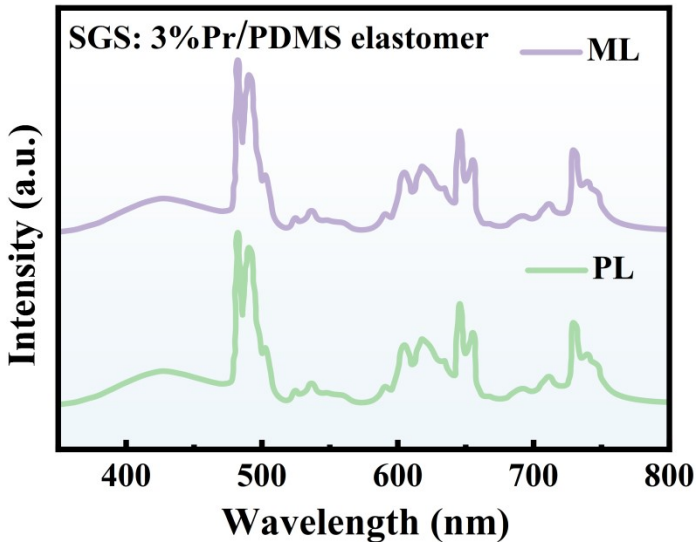

Fig.S10 Comparison of the emissions from the ML and PL for the SGS: 3%Pr/PDMS and SGS: 3%Pr.

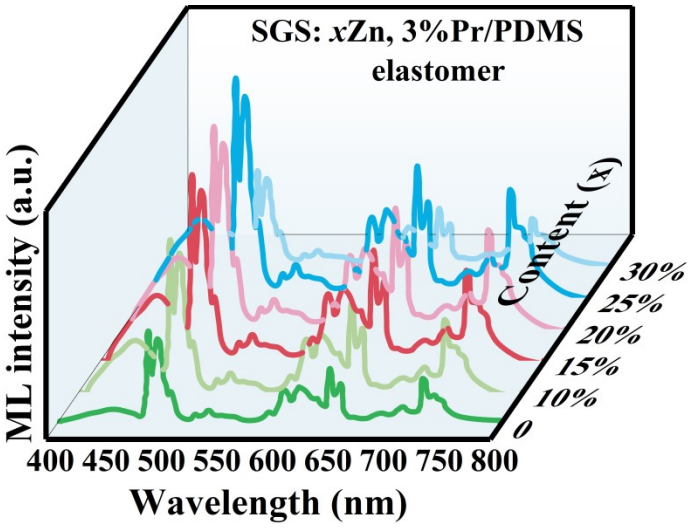

Fig.S11 ML spectra of SGS: *x*Zn, 3%Pr/PDMS elastomer

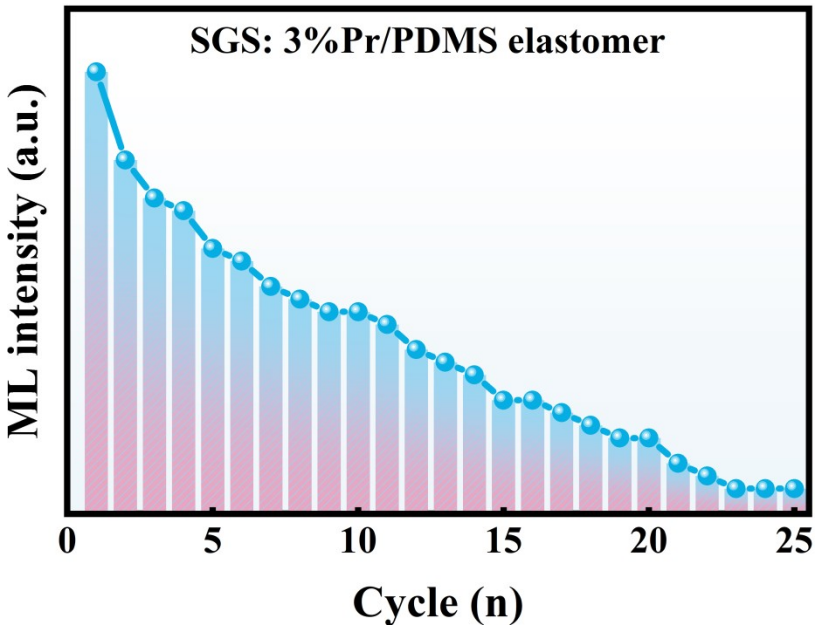

Fig.S12 ML intensity evolution experience different cycle periods of the SGS: 3%Pr/PDMS elastomer.

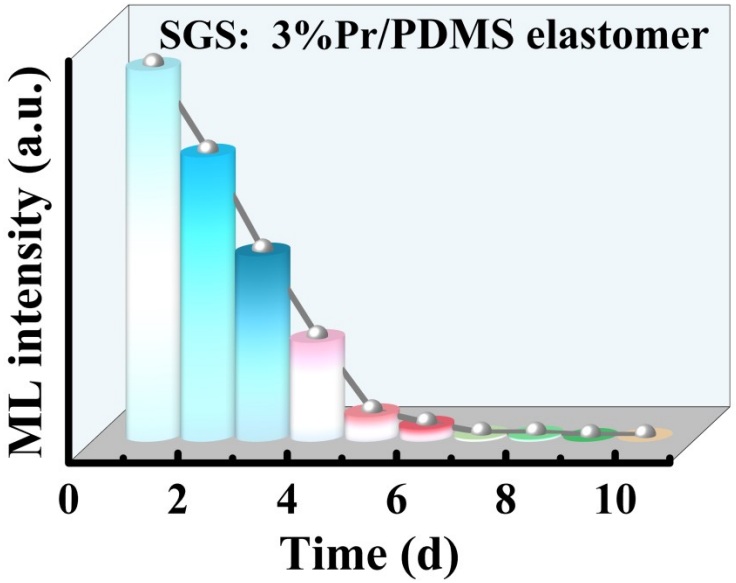

Fig.S13 ML intensity evolution with different standing time for the sample SGS: 3%Pr/PDMS elastomer.

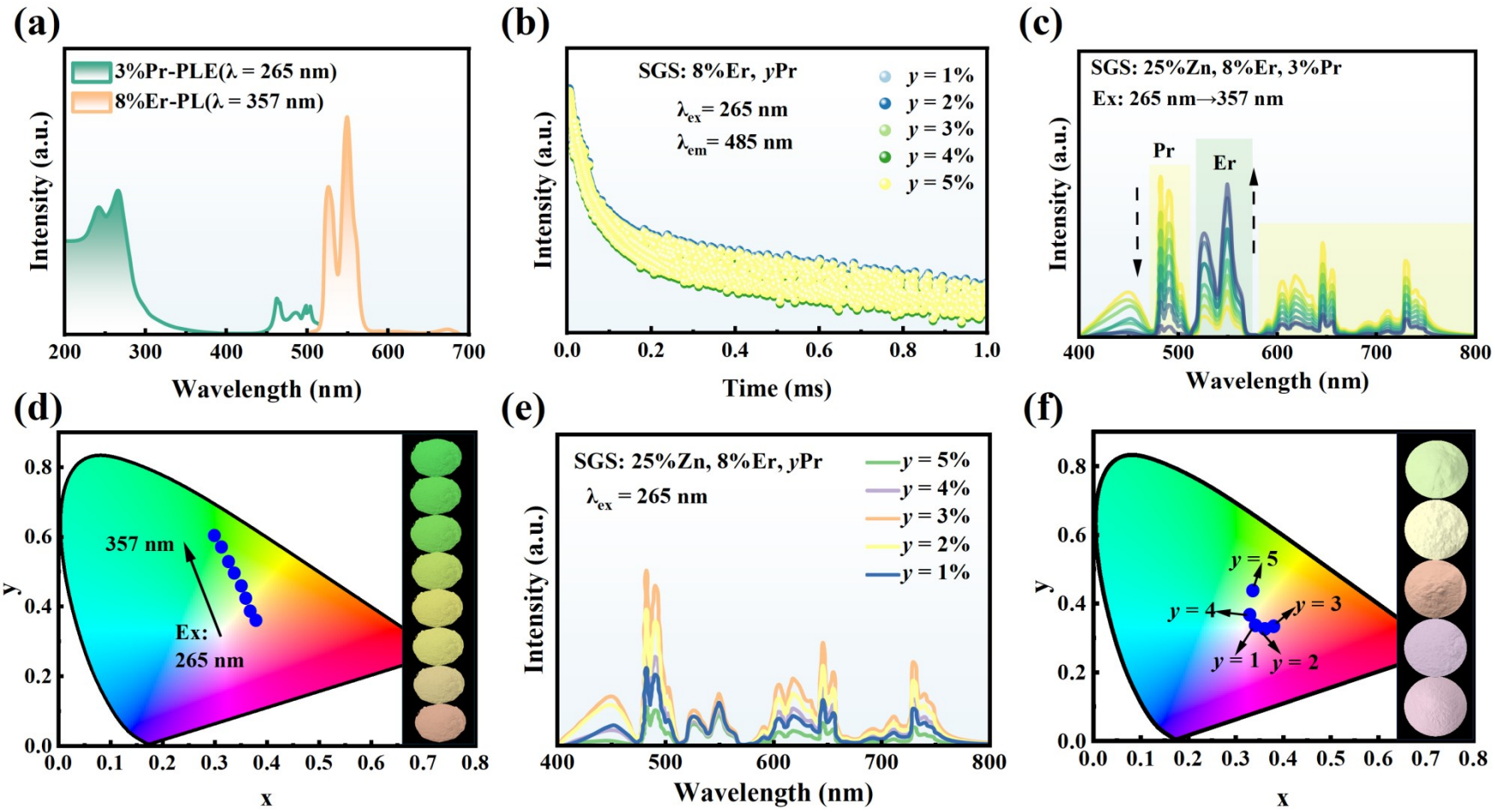

Fig.S14 a) PLE and PL spectra of the SGS: 3%Pr and SGS: 8%Er, b) the nearly unchanged PL decay lifetimes of Er in SGS: 8%Er, yPr, c) and d) PL spectra and CIE coordinates with digital images under different excitations, e) and f) PL spectra and CIE coordinates with digital images with different doping content of Pr in the SGS: 25%Zn, 8%Er, yPr.

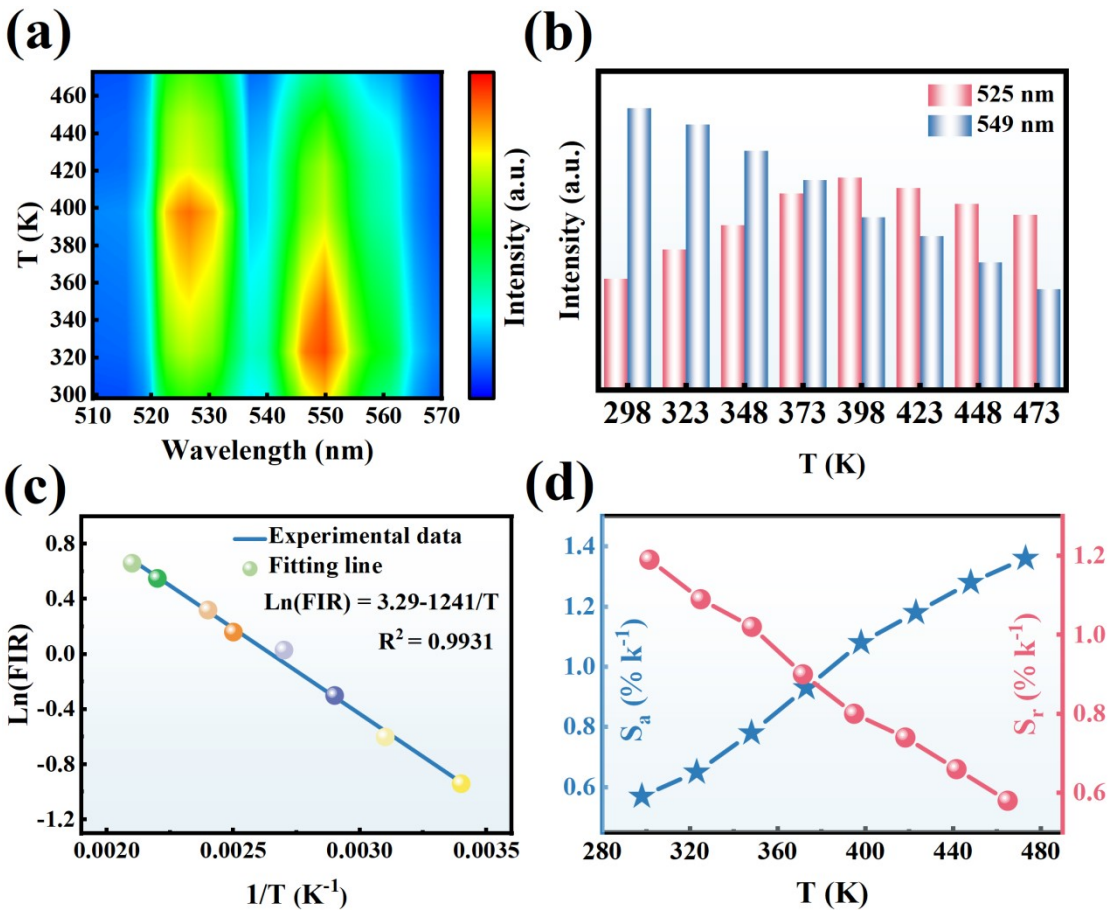

Fig.S15 a) Temperature-dependent emission spectra upon 357 nm excitation for the SGS: 25%Zn, 8%Er, 3%Pr, b) Variation of integral intensities of the TCLs under different temperature, c) Plot of ln(FIR) vs. 1/T (K^{-1}) for 357 nm excitation, d) Calculated sensing sensitives for the phosphor upon 357 nm excitation.

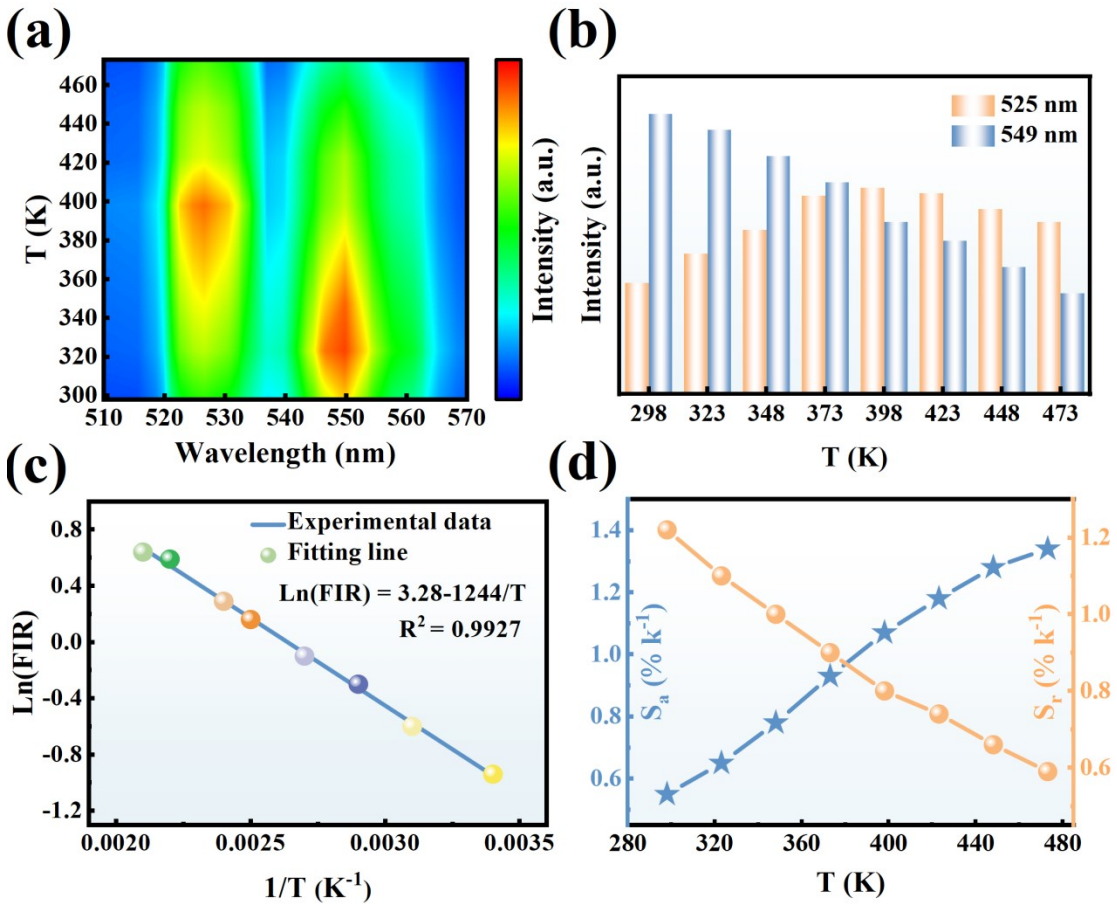

Fig.S16 a) Temperature-dependent emission spectra upon 357 nm excitation for the SGS: 8%Er, b) Variation of integral intensities of the TCLs under different temperature, c) Plot of ln(FIR) vs. 1/T (K^{-1}) for 357 nm excitation, d) Calculated sensing sensitives for the phosphor upon 357 nm excitation.