Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

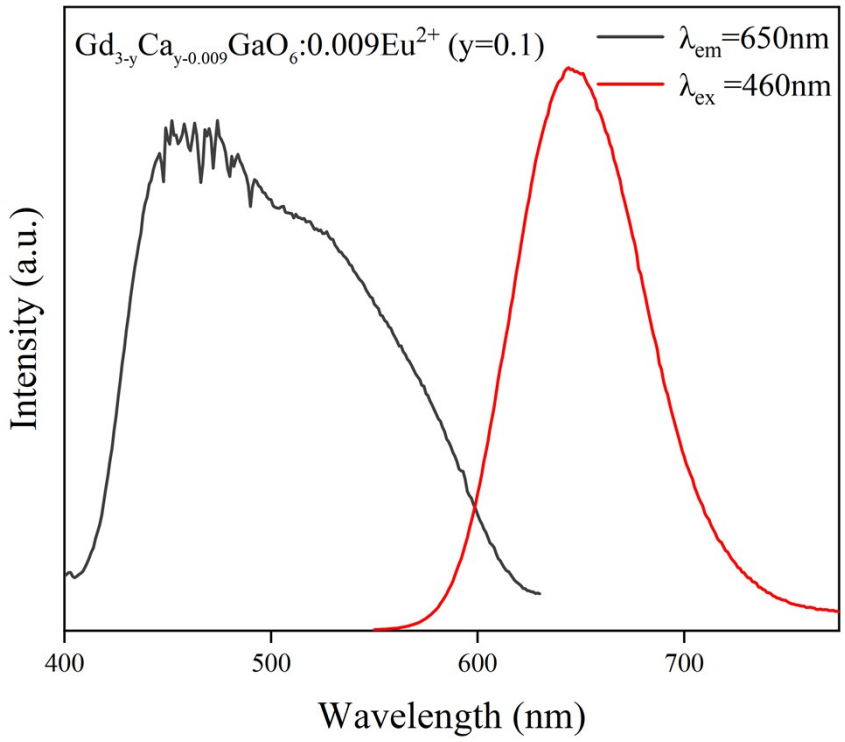

Fig. S1 PL and PLE spectra of $Gd_{3-y}Ca_{y-0.009}GaO_6$:0.009$Eu^{2+}$ (y=0.1).

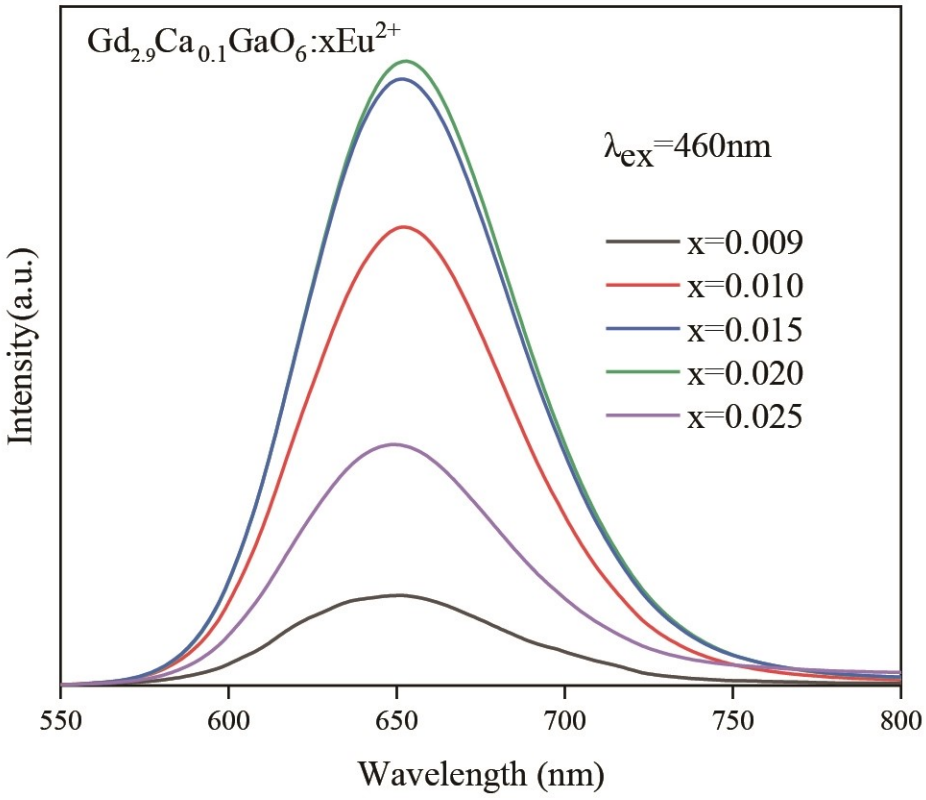

Fig. S2 PL spectra of $Gd_{2.9}Ca_{0.1}GaO_6$:xEu^{2+} (x = 0.009-0.025).

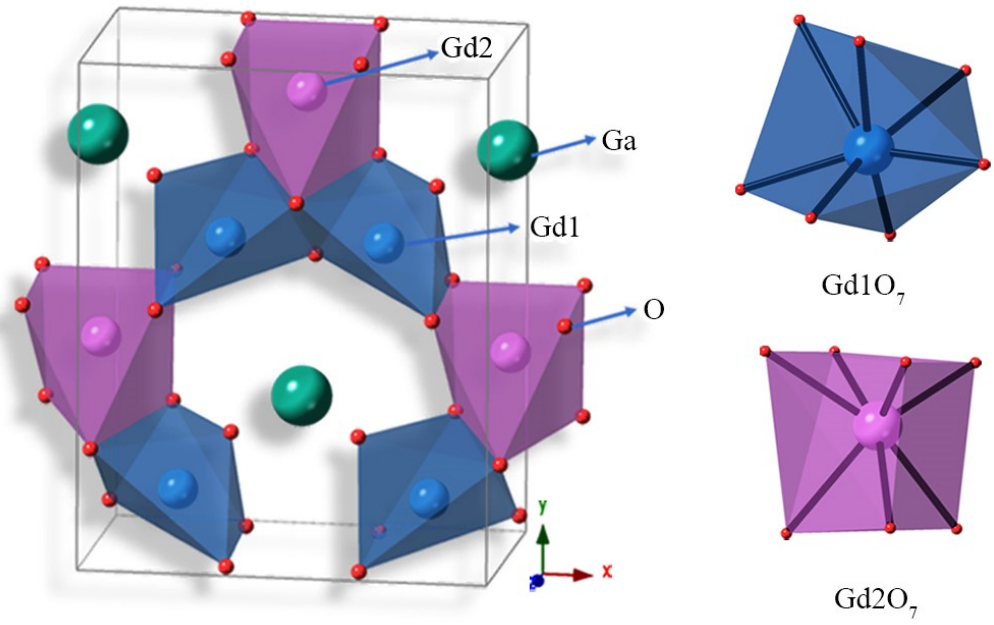

Fig. S3 Crystal structure of Gd_3GaO_6.

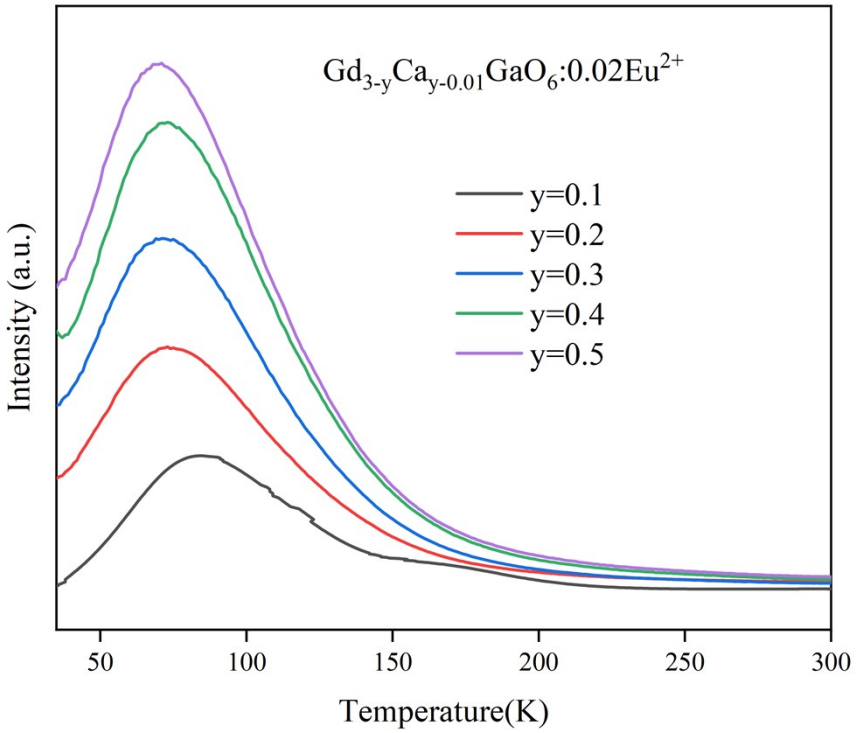

Fig. S4 TL spectra of $Gd_{3-y}Ca_{y-0.02}GaO_6:0.02Eu^{2+}$ (y = 0.1-0.5).

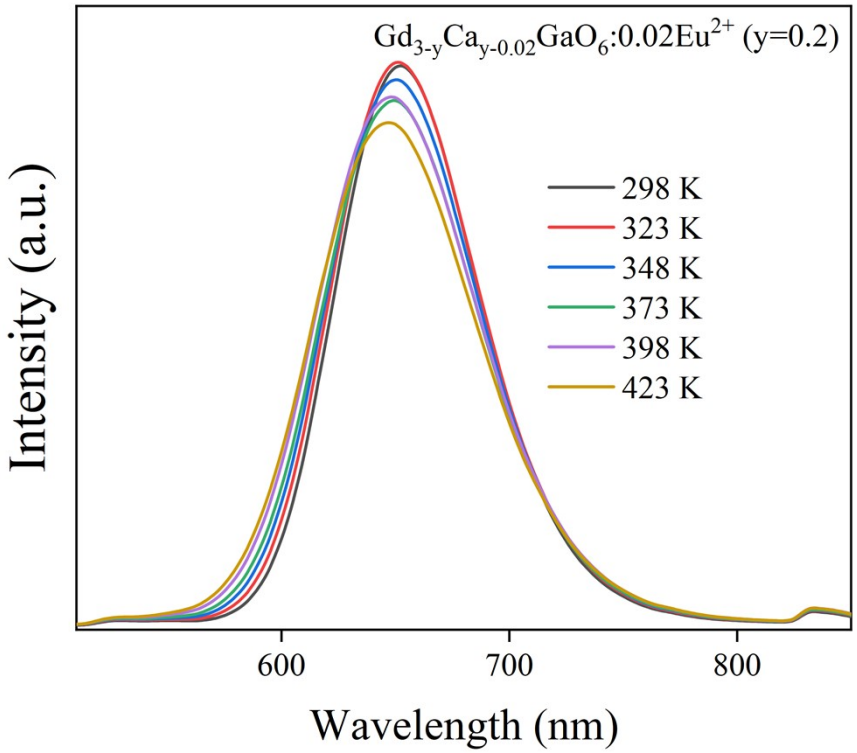

Fig. S5 Temperature-dependent PL spectra of $Gd_{3-y}Ca_{y-0.02}GaO_6$:0.02Eu^{2+} (y=0.2).

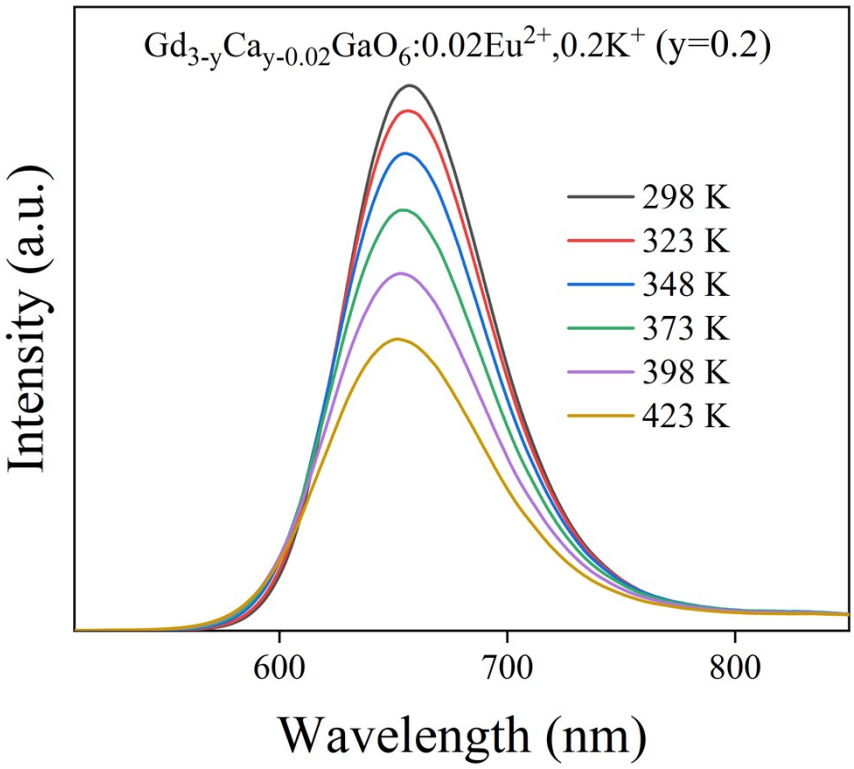

Fig. S6 Temperature-dependent PL spectra of $Gd_{3-y}Ca_{y-0.02}GaO_6$:0.02Eu^{2+}, 0.2K^+

(y=0.2).

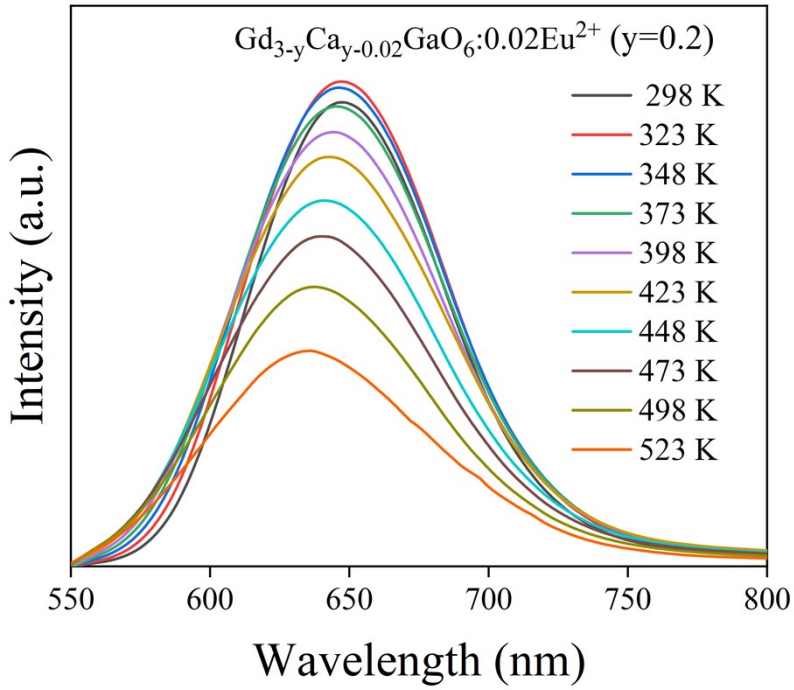

Fig. S7 Temperature-dependent PL spectra of $Gd_{3-y}Ca_{y-0.02}GaO_6:0.02Eu^{2+}$ (y=0.2).

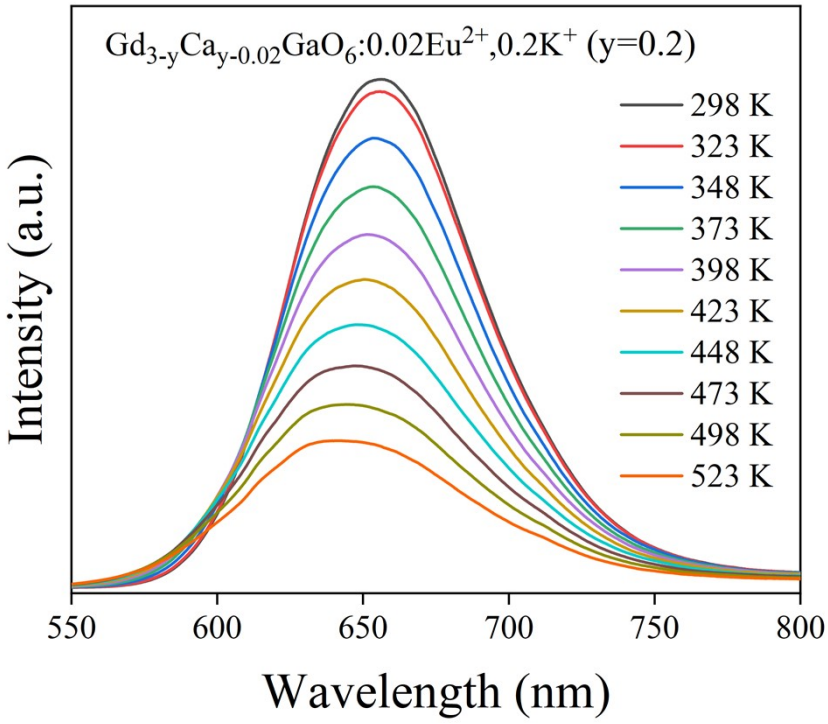

Fig. S8 Temperature-dependent PL spectra of $Gd_{3-y}Ca_{y-0.02}GaO_6:0.02Eu^{2+}$, $0.2K^{+}$

(y=0.2).

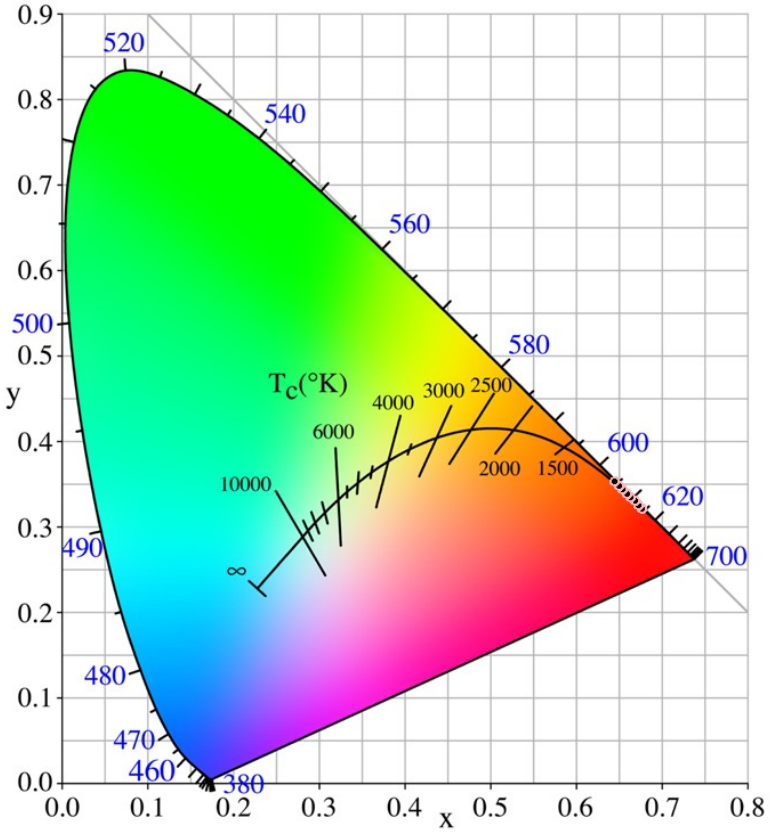

Fig. S9 Variation of color coordinates with temperature of $Gd_{2.8}Ca_{0.2}GaO_6$:0.02Eu^{2+}.

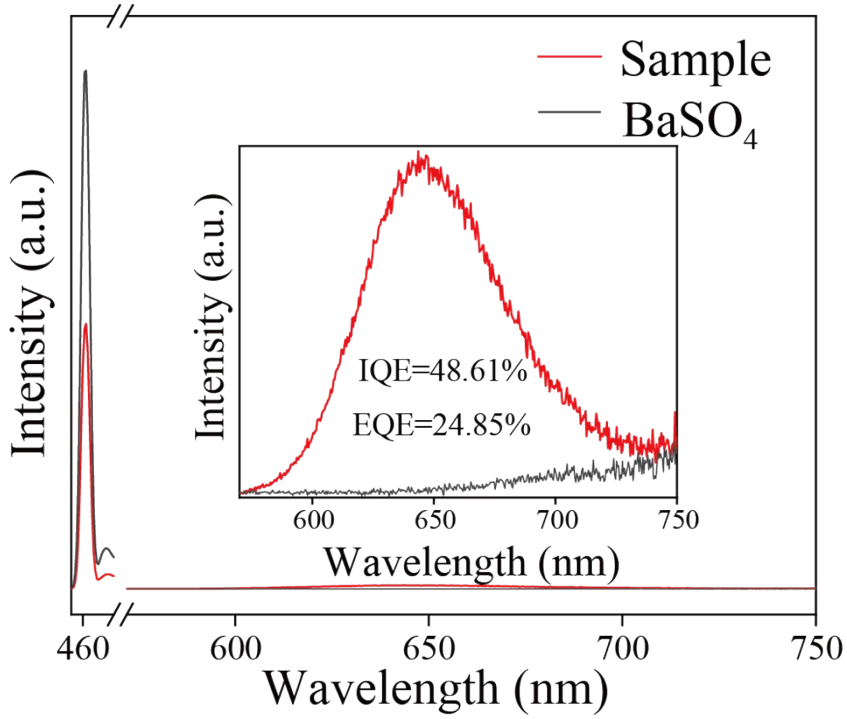

Fig. S10 Quantum efficiency.

$$I(t) = I_0 + A_1 \exp\left(-\frac{t}{\tau_1}\right) + A_2 \exp\left(-\frac{t}{\tau_2}\right) \quad \text{(S1)}$$

where I and I_0 are the emission intensities at the time of τ and 0, respectively, A_1 and A_2 represent constants; t is the time, t_1 and t_2 are the first and the second values represent the life of the exponential fitting, respectively.

$$\tau = (A_1\tau_1^2 + A_2\tau_2^2) / (A_1\tau_1 + A_2\tau_2) \quad \text{(S2)}$$

where t is time and $I(t)$ is the intensity at time t.

Table S1 The crystal structure data and refinement parameters for samples $Gd_{3-y}Ca_{y-0.02}GaO_6$:$0.02Eu^{2+}$.

Formula	y=0	y=0.05	y=0.1	y= 0.15	y= 0.2	y= 0.25
Crystal system	Orthorhombic					
Space group	Cmc21					
a(Å)	8.9802	8.9910	8.9946	8.9963	8.9981	9.0073
b(Å)	11.2651	11.2755	11.2808	11.2812	11.2875	11.2881
c(Å)	5.4741	5.4780	5.4799	5.4820	5.4830	5.4868
2theta interval	10-80	10-80	10-80	10-80	10-80	10-80
χ^2	2.959	2.796	6.763	2.792	2.799	3.599
R_{wp}	6.27%	7.17%	8.29%	7.17%	7.41%	7.47%
R_p	4.6%	5.41%	5.28%	5.14%	5.36%	5.30%

Table S2 Variation of crystal cell with doping concentration of Ca^{2+} ($Å^3$).

y	$Gd1O_7$	$Gd2O_7$	GaO_4
0	19.424	19.817	5.861
0.05	19.456	19.851	3.006
0.10	19.481	19.876	3.010
0.15	19.490	19.886	3.011
0.20	19.509	19.904	3.014
0.25	19.523	19.919	3.016

Table S3 Variation of bond length with doping concentration of Ca^{2+} (Å).

	y=0	y=0.05	y=0.1	y=0.15	y=0.2	y=0.25
Gd_1-O1	2.0843	2.0863	2.087	2.0946	2.0883	2.0896
Gd_1-O2	2.2076	2.2093	2.2103	2.1943	2.2116	2.2123
Gd_1-O3	2.3563	2.3590	2.3600	2.3370	2.3613	2.3626
Gd_1-O4	2.3900	2.3923	2.3933	2.3990	2.3946	2.3960
Gd_1-O5	2.4016	2.4040	2.4050	2.4490	2.4060	2.4080
Gd_1-O6	2.4730	2.4753	2.4763	2.5513	2.4776	2.4790
Gd_1-O7	2.7420	2.7443	2.7456	2.7413	2.7473	0.7486
Gd_2-O1	2.2073	2.2096	2.2106	2.2056	2.2116	2.2130
Gd_2-O2	2.2073	2.2096	2.2106	2.2056	2.2116	2.2130
Gd_2-O3	2.4576	2.4600	2.4610	2.4253	2.4623	2.4636
Gd_2-O4	2.4576	2.4600	2.4610	2.4680	2.4623	0.4636
Gd_2-O5	2.4830	2.4853	2.4863	2.4850	2.4876	2.4893
Gd_2-O6	2.4830	2.4853	2.4863	2.5613	2.4876	2.4893
Gd_2-O7	2.6006	2.6030	2.6040	2.6393	2.6053	2.6060

Table S4 CIE coordinates at different temperatures.

Temperature (°C)	CIE
25	(0.6773,0.3218)
50	(0.6733,0.3257)
75	(0.6689,0.3301)
100	(0.6646,0.3344)
125	(0.6600,0.3390)
150	(0.6553,0.3436)
175	（0.6506,0.3483）
200	（0.6458,0.3531）