Support information

An advanced color tunable persistent luminescent

$NaCa_2GeO_4F:Tb^{3+}$phosphor for multicolor anti-counterfeiting

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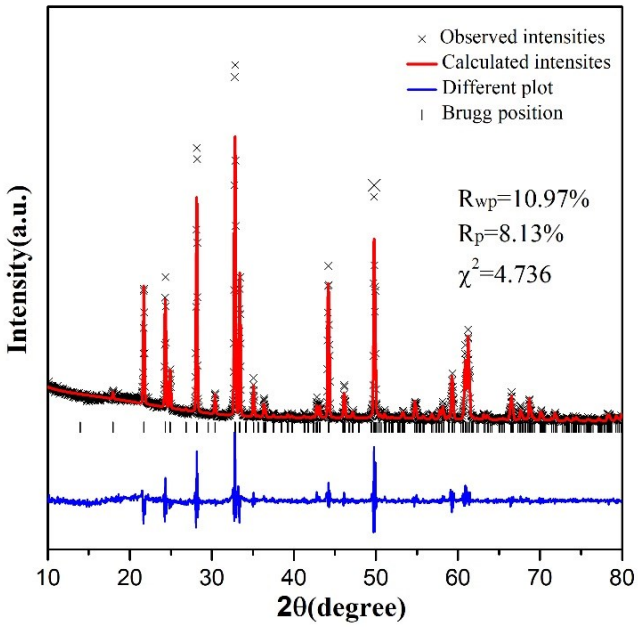

Fig. S1 the Rietveld XRD refinement of NCGOF: 0.1%Tb^{3+} phosphor

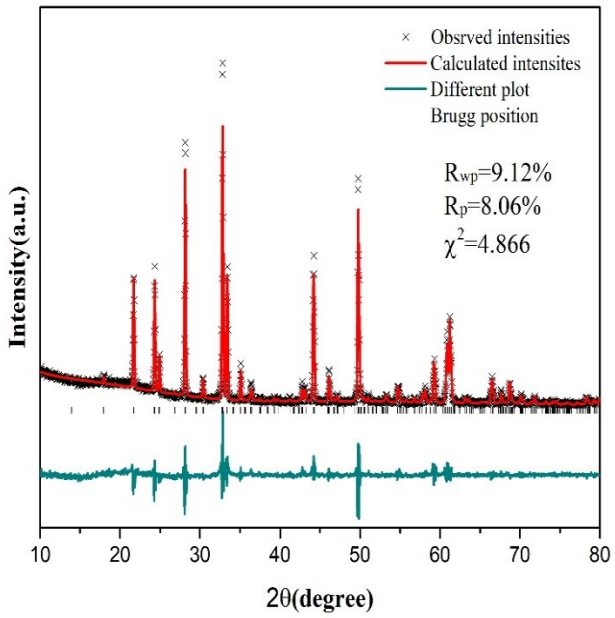

Fig. S2 the Rietveld XRD refinement of NCGOF: 0.4%Tb^{3+} phosphor

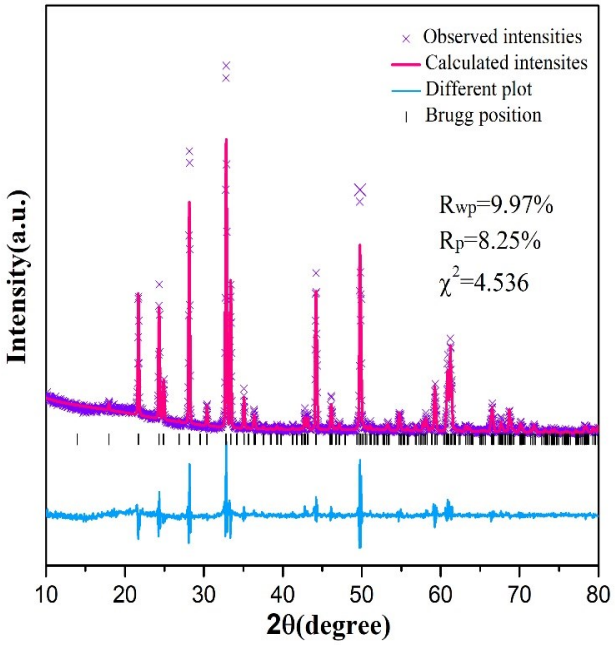

Fig. S3 the Rietveld XRD refinement of NCGOF: 0.8%Tb^{3+} phosphor

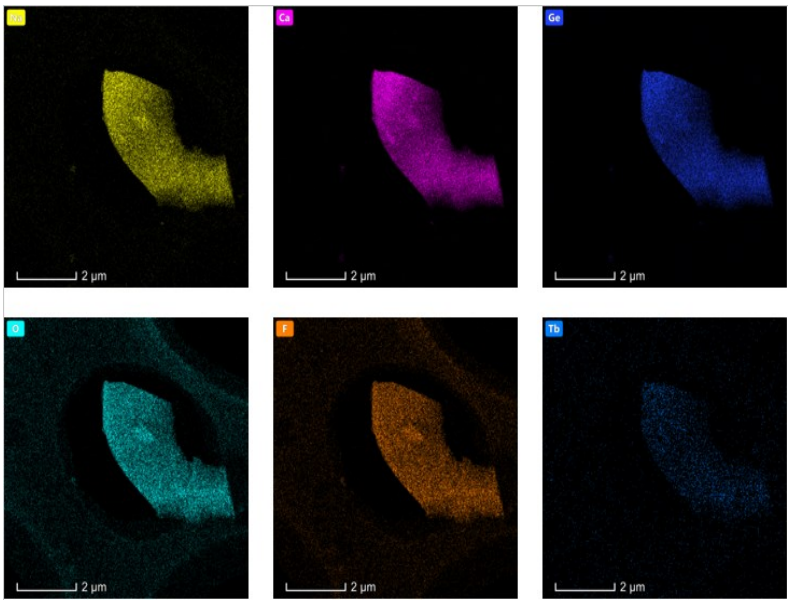

Fig. S4. Element distribution of $NaCa_2GeO_4F$: 0.4% Tb^{3+} material.

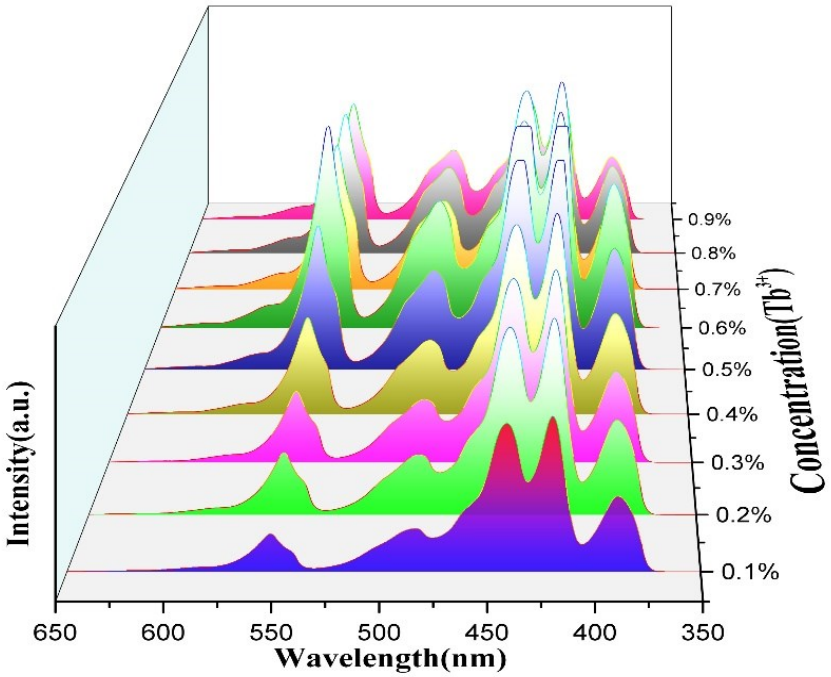

Fig. S5 the PL spectra of the NCGOF: xTb^{3+} phosphors (x=0.1% - 0.8%).

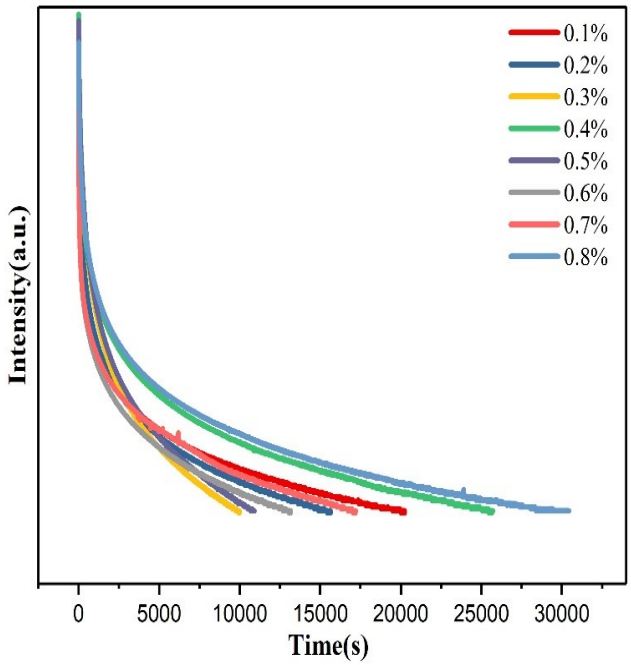

Fig. S6 the PersL decay curves of NCGOF: xTb^{3+} phosphors (x=0.1% - 0.8%)

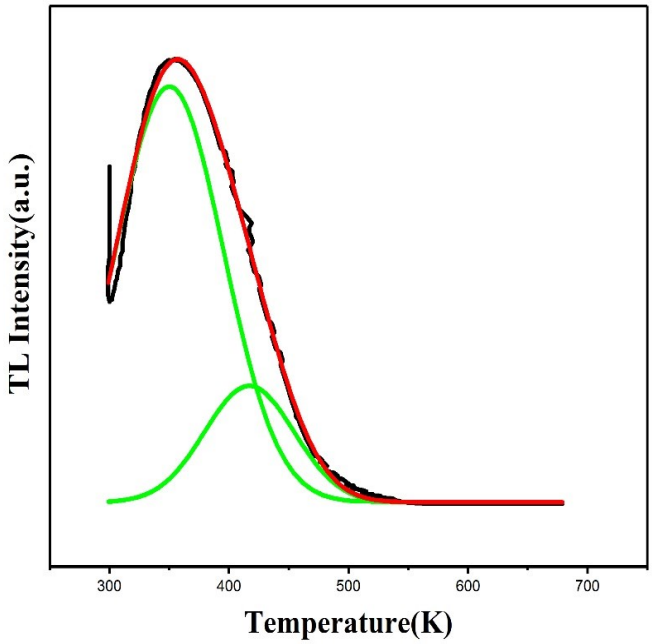

Fig. S7 TL glow curve of the NCGOF: 0.1%Tb^{3+} phosphor

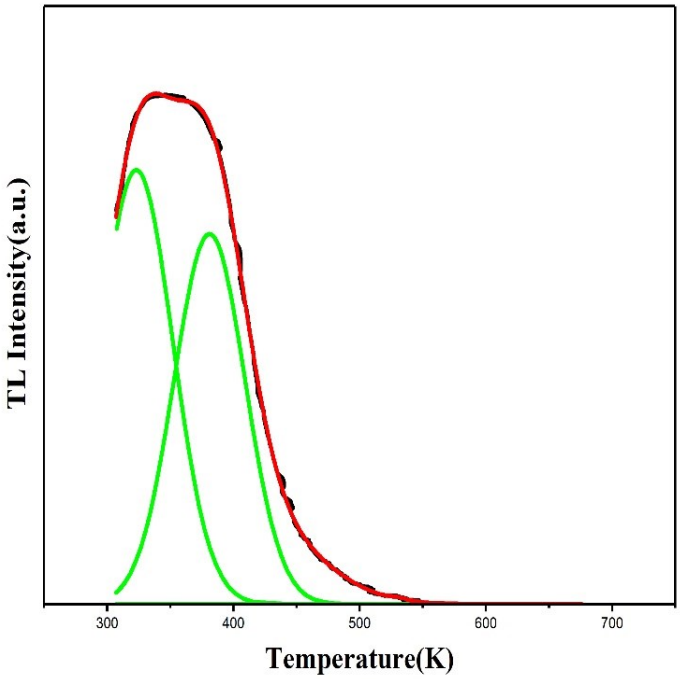

Fig. S8 TL glow curve of the NCGOF: 0.8%Tb^{3+} phosphor

Formula	Host			0.1%Tb^{3+}			0.4%Tb^{3+}			0.8%Tb^{3+}		
Crystal system	Pnma (no.62)			Pnma (no.62)			Pnma (no.62)			Pnma (no.62)		
Lattice	a	b	c	a	b	c	a	b	c	a	b	c
parameters	5.365	7.326	12.662	5.371	7.321	12.689	5.364	7.327	12.691	5.368	7.317	12.663
Cell volume(Å^3)	497.735			498.456			498.684			498.765		
Density(gm/cm^3)	3.483			3.476			3.483			3.482		

Table S1 Rietveld refinement data of NCGOF: xTb^{3+} (x=0.1%,0.4%, 0.8%) samples

	CIE X	CIE Y	Peak	CCT
0.1%	0.1763	0.1143	420	3177
0.2%	0.1814	0.1334	420	4159
0.3%	0.1851	0.1473	420	4255
0.4%	0.1932	0.1753	420	4452
0.5%	0.2003	0.2005	420	6212
0.6%	0.2034	0.2103	420	4809
0.7%	0.2116	0.2396	420	4607
0.8%	0.2196	0.2624	554	7709

Table S2 the CIE chromaticity coordinate as well as the correlate color temperature (CCT) values of the $NaCa_2GeO_4F$: xTb^{3+} (x=0.1%-0.8%).

Formula	$NaCa_2GeO_4F$:x%Tb^{3+}			$Sr_2Ga_2GeO_7$: x%Pr^{3+}		
x%	1%	4%	8%	0.2%	1%	3%
Color (PersL)	blue	cyan	Bright green	red	pink	blue
afterglow	5.62h	8.52h	7.14h	23min	＜15min	2min
Synthesis conditions	850℃ 8h			1300℃ 6h		

Table S3 the performance comparison between $NaCa_2GeO_4F$:x%Tb^{3+} and $Sr_2Ga_2GeO_7$: x%Pr^{3+}.