Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supplementary information

Realizing luminescent and dielectric abilities via lattice-disturbance with Eu^{3+}/Ti^{4+} co-substitutions in $Ba_2NaNb_5O_{15}$ ceramics

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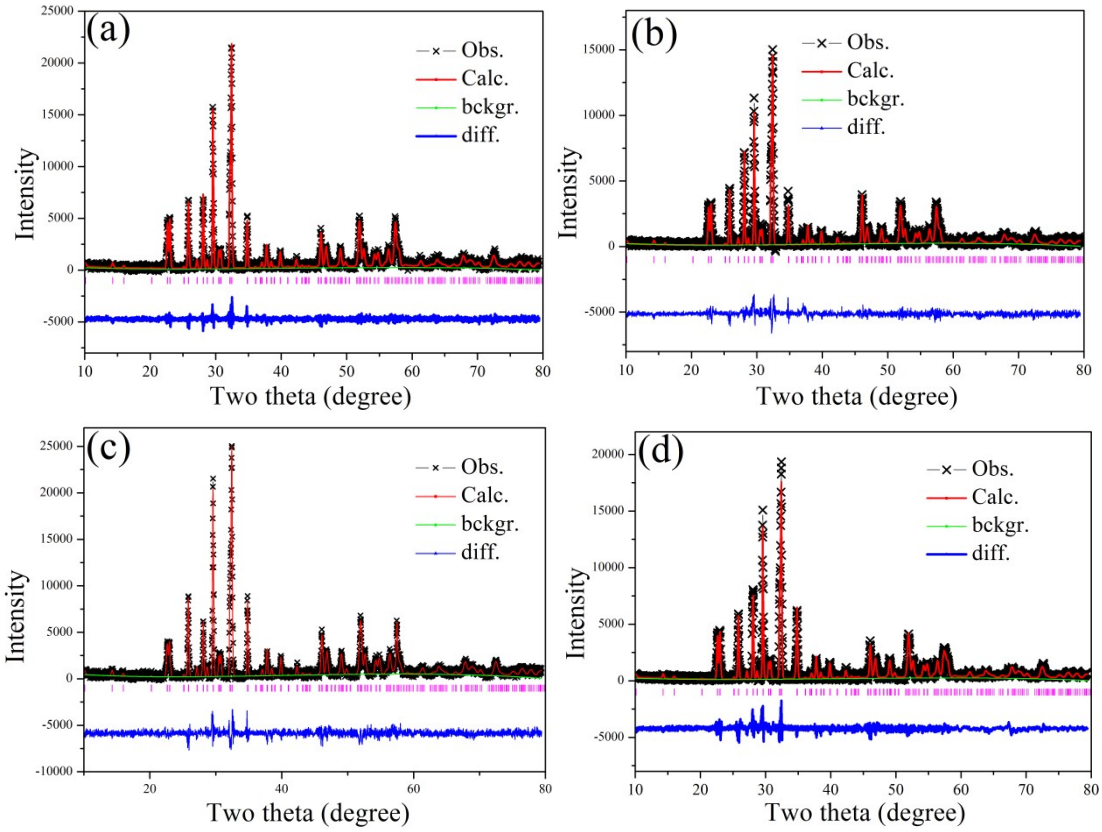

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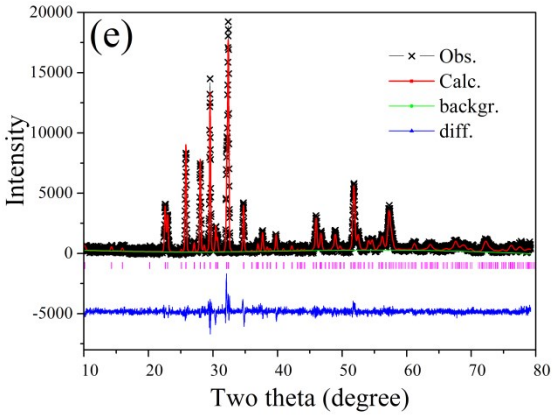

Figure-S1 the representative structural Rietveld refinement of $Ba_{2-x}Eu_xNaNb_5O_{15}$ (*x*=0.01) (a), $Ba_{2-x}Eu_xNaNb_5O_{15}$ (*x*=0.1) (b), $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.1) (c), and $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.3) (d), f $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.2) (e) at 300 K.

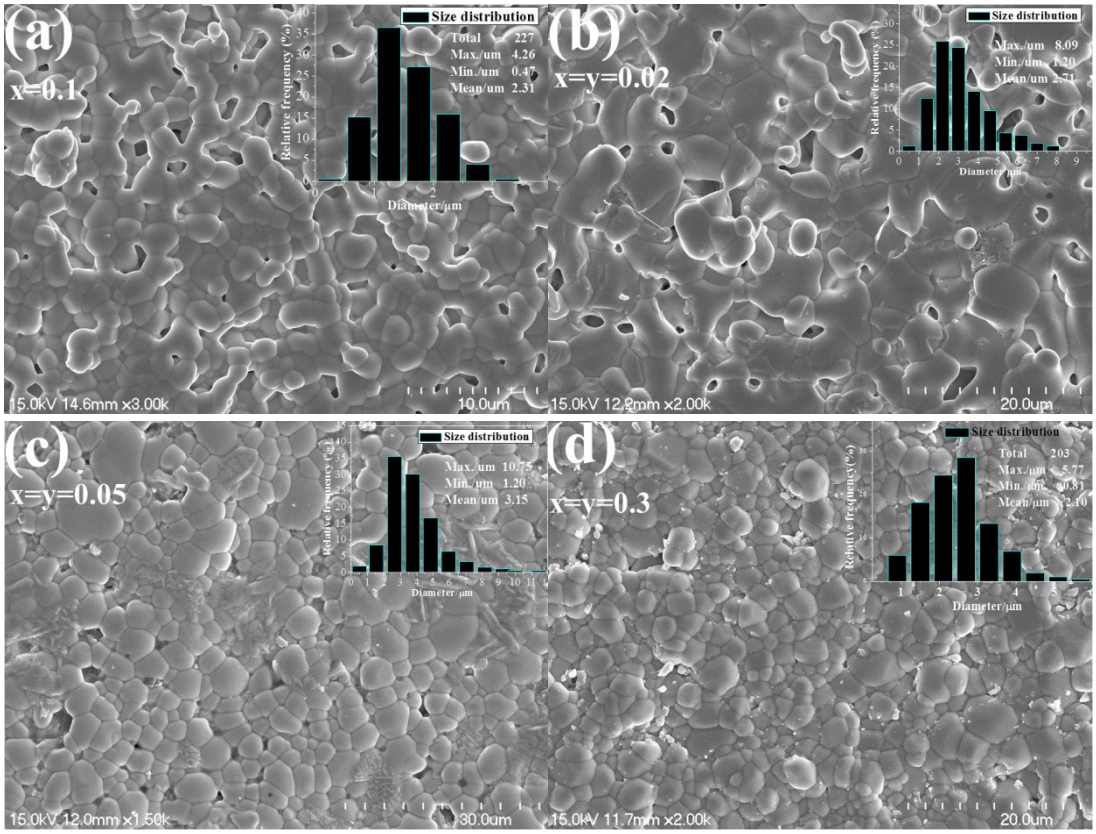

Figure S-2 the SEM images of $Ba_{2-x}Eu_xNaNb_5O_{15}$ (*x*=0.1) (a), $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.02) (b), $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.05) (c), and $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (*x*=y=0.3) (d).

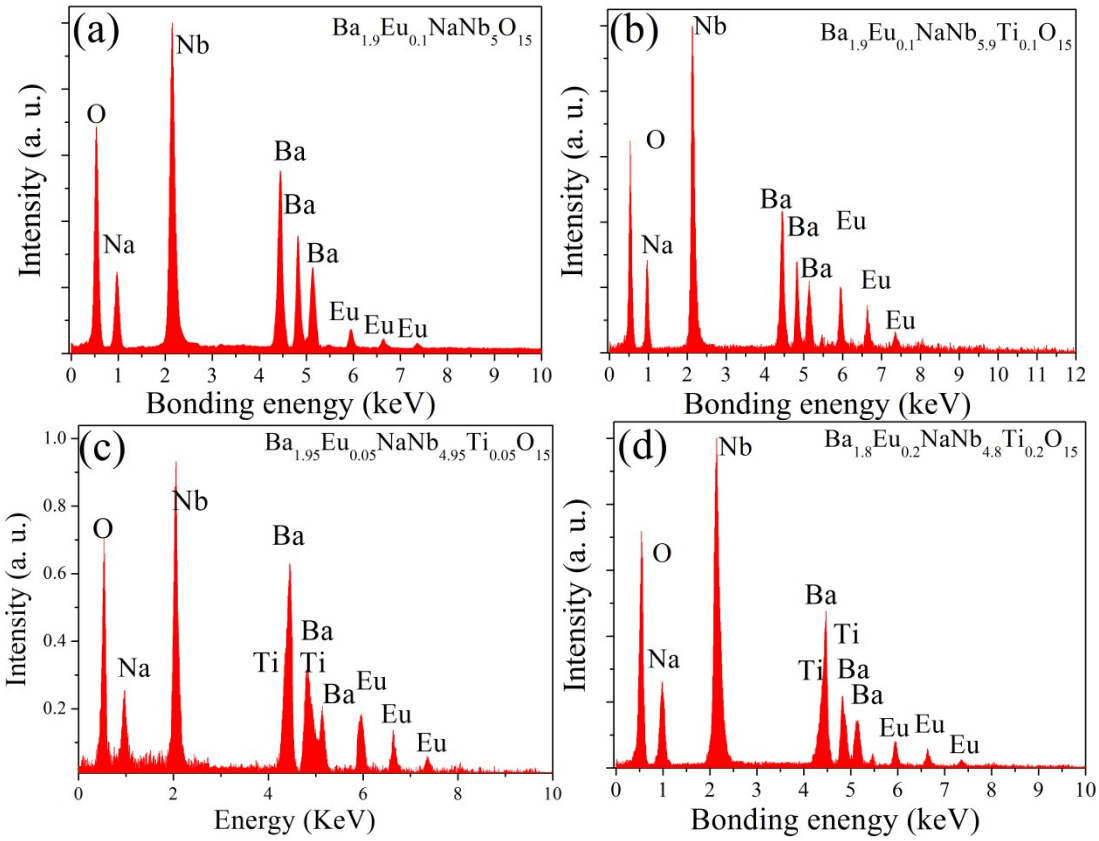

Figure S-3 the EDS spectra of $Ba_{2-x}Eu_xNaNb_5O_{15}$ (x=0.01) (a), $Ba_{2-x}Eu_xNaNb_5O_{15}$ (x=0.1) (b), $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x=y=0.1) (c), and $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x=y=0.3) (d).

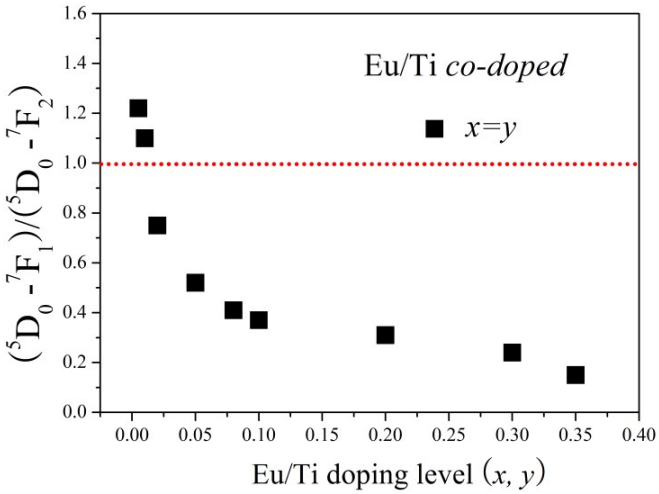

Figure S-4 The emission intensity ratio of $(^5D_0 \rightarrow {}^7F_1)/(^5D_0 \rightarrow {}^7F_2)$ of $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x = y = 0.005 - 0.35).

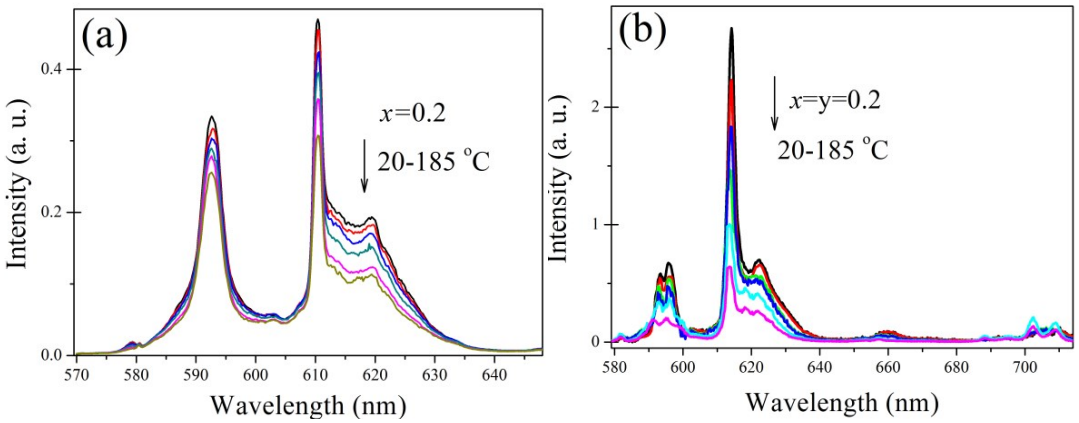

Figure S-5 the experimental luminescence spectra of $Ba_{2-x}Eu_xNaNb_5O_{15}$ (x=0.2), $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x=y=0.2) at different temperature.

Table S1 The refined structural parameters of $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x=y=0.2) from the Rietveld refinement using X-ray powder diffraction data taken at room temperature.

formula	$Ba_{1.8}Eu_{0.2}NaNb_{4.8}Ti_{0.2}O_{15}$
radiation	Cu-K_a
2θ range(degree)	10-80
symmetry	tetragonal
space group#	P4bm (100)
a/Å	12.5361(6)
b/Å	12.5361(6)
c/Å	4.0039(3)
α/°	90.000
β/°	90.000
γ/°	90.000
Z	2
R_p	0.4552
R_{wp}	0.5657
X^2	204.4
V	629.26 (7)Å^3

Table S2 The refined structural parameters of $Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO_{15}$ (x=y=0.2) from the Rietveld refinement using X-ray powder diffraction data taken at room temperature.

Atom	Wyckoff	x/a	y/b	z/c	Occupancy	U [Å^2]
(Ba/Eu)1	2a	0	0	0.863(13)	0.44	0.068(7)
Na1	2a	0	0	0.673(23)	0.56	0.0526(35)
(Ba/Eu)2	4c	0.1879(11)	0.6879(11)	0.826(10)	0.78	0.082(7)
Na2	4c	-0.602(6)	-0.102(6)	4.013(27)	0.22	0.0035
(Nb/Ti)1	2b	0	1/2	0.105(8)		0.0055
(Nb/Ti)2	8d	0.0647(9)	0.2165(9)	0.143(7)		0.0052
O1	8d	0.34450	0.00690	0.97400		0.032(29)
O2	8d	0.14190	0.07130	0.97700		0.0003
O3	4c	0.28260	0.78260	0.97400		0.0003
O4	2b	0	1/2	0.48300		0.0003
O5	8d	0.29140	0.42240	0.47400		0.0003