

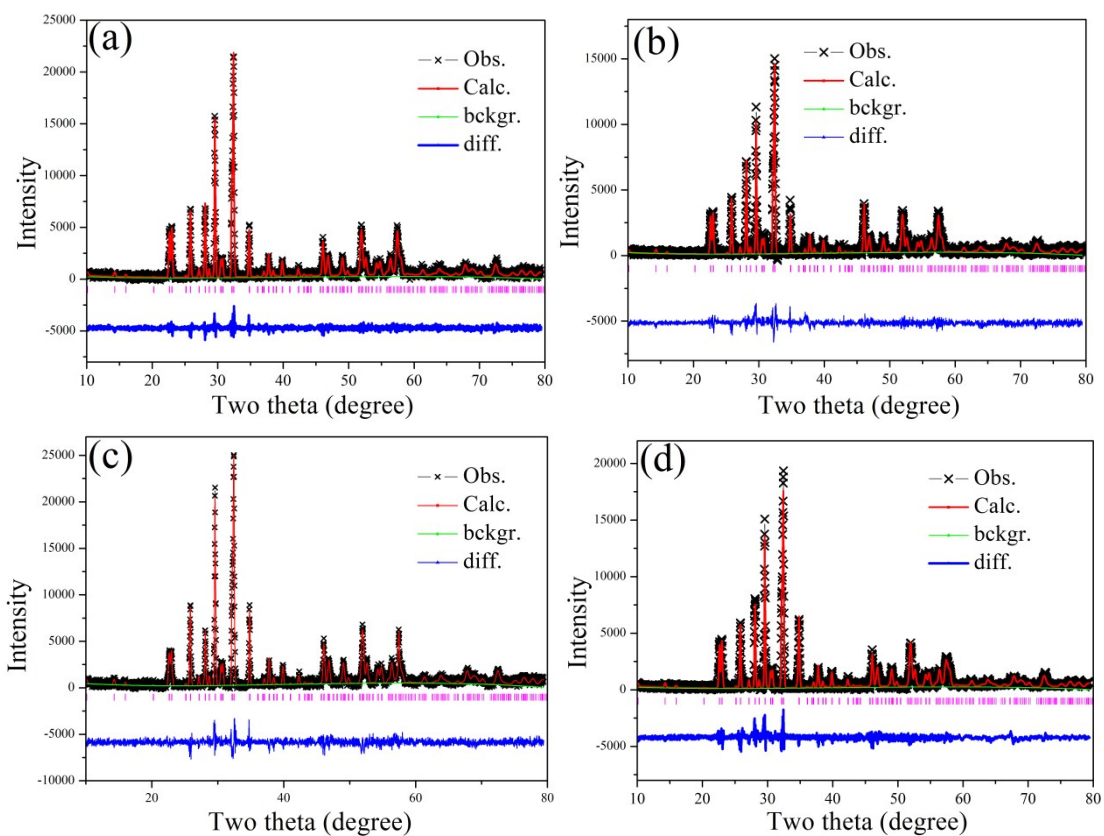
Supplementary information

Realizing luminescent and dielectric abilities via lattice-disturbance

with $\text{Eu}^{3+}/\text{Ti}^{4+}$ co-substitutions in $\text{Ba}_2\text{NaNb}_5\text{O}_{15}$ ceramics

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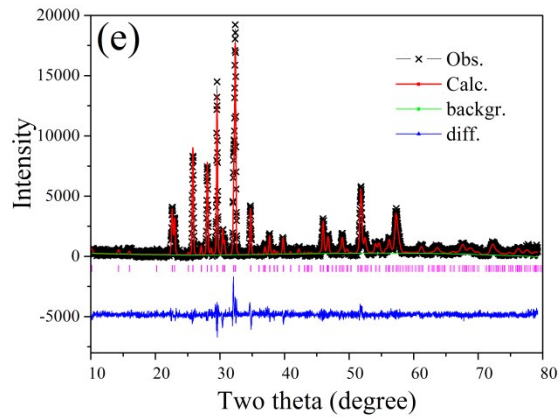


Figure-S1 the representative structural Rietveld refinement of $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_5\text{O}_{15}$ ($x=0.01$) (a), $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_5\text{O}_{15}$ ($x=0.1$) (b), $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.1$) (c), and $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.3$) (d, f) $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.2$) (e) at 300 K.

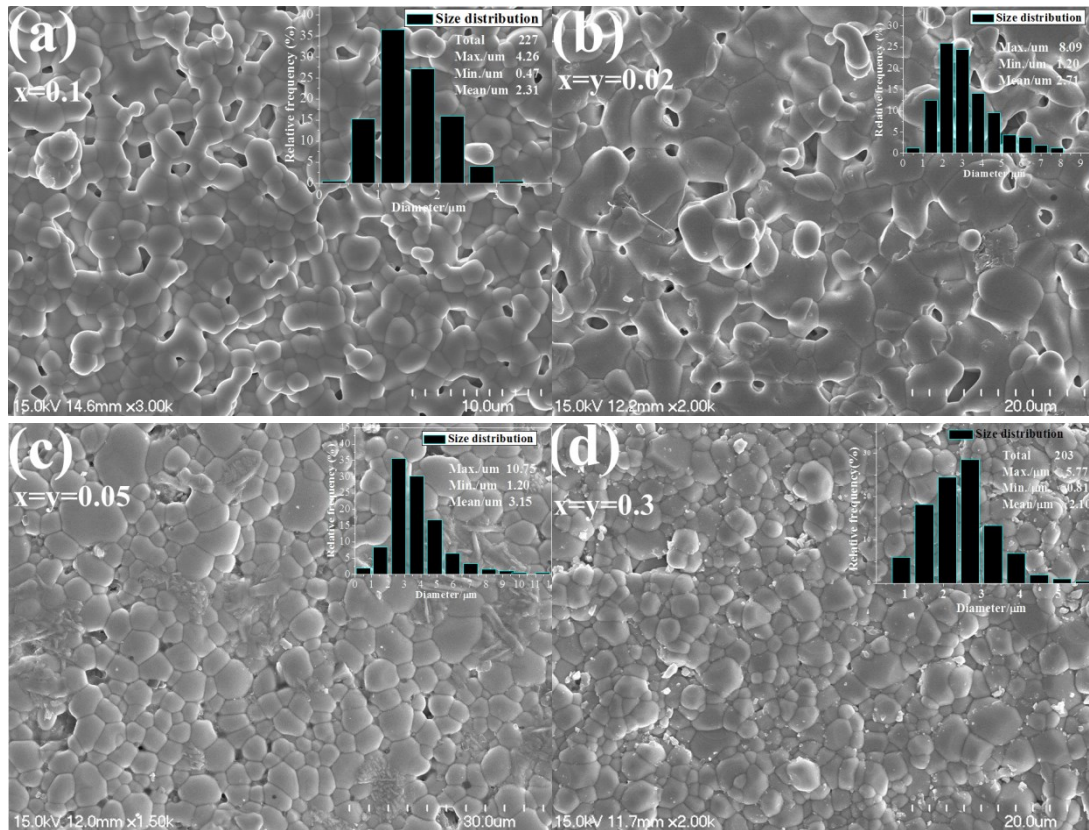


Figure S-2 the SEM images of $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_5\text{O}_{15}$ ($x=0.1$) (a), $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.02$) (b), $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.05$) (c), and $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.3$) (d).

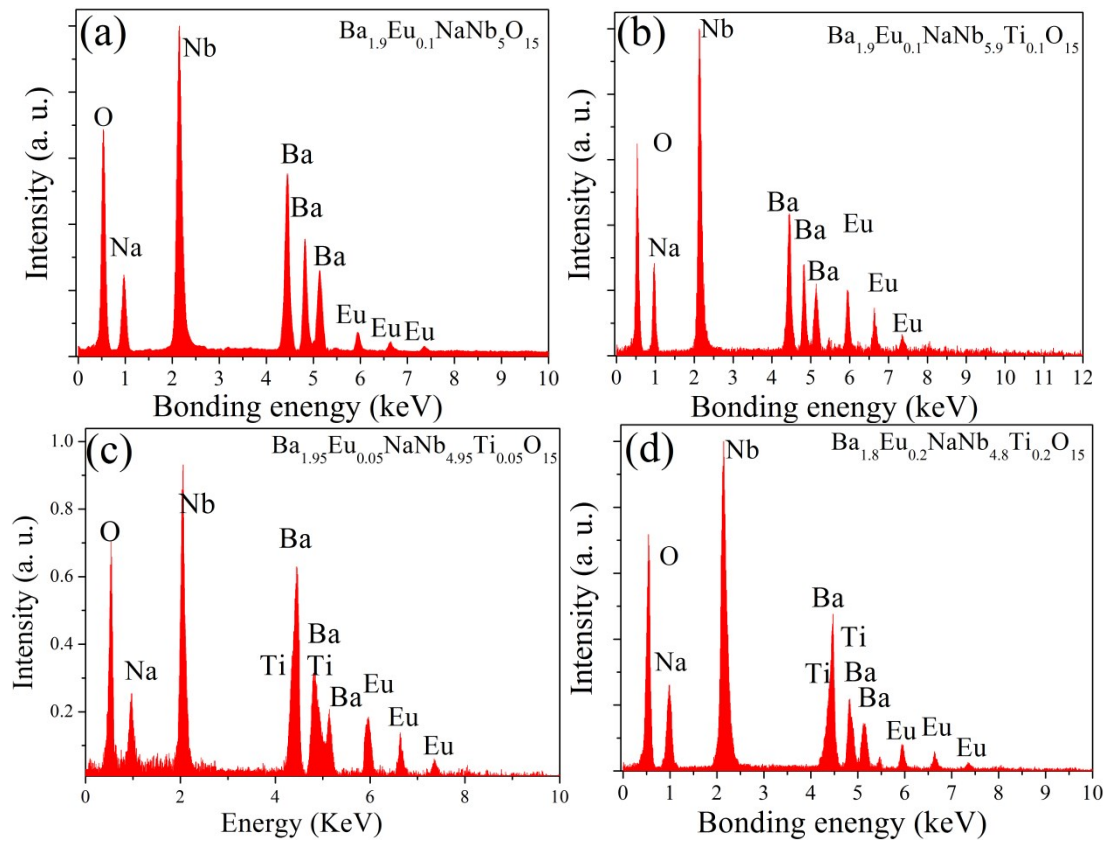


Figure S-3 the EDS spectra of Ba_{2-x}Eu_xNaNb₅O₁₅ ($x=0.01$) (a), Ba_{2-x}Eu_xNaNb₅O₁₅ ($x=0.1$) (b), Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO₁₅ ($x=y=0.1$) (c), and Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO₁₅ ($x=y=0.3$) (d).

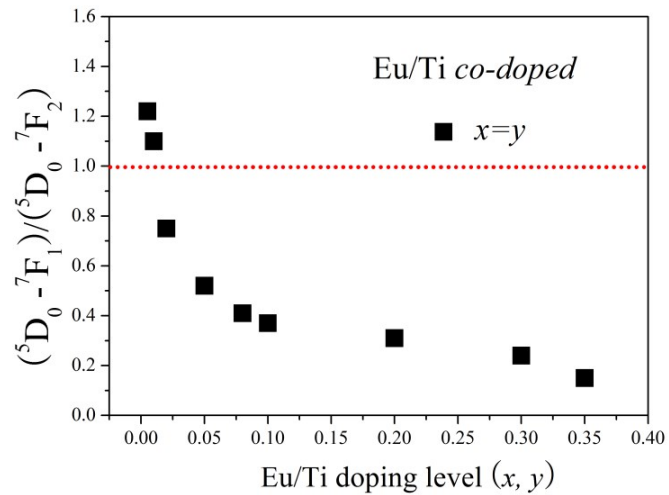


Figure S-4 The emission intensity ratio of $(^5D_0 \rightarrow ^7F_1) / (^5D_0 \rightarrow ^7F_2)$ of Ba_{2-x}Eu_xNaNb_{5-y}Ti_yO₁₅ ($x = y = 0.005 - 0.35$).

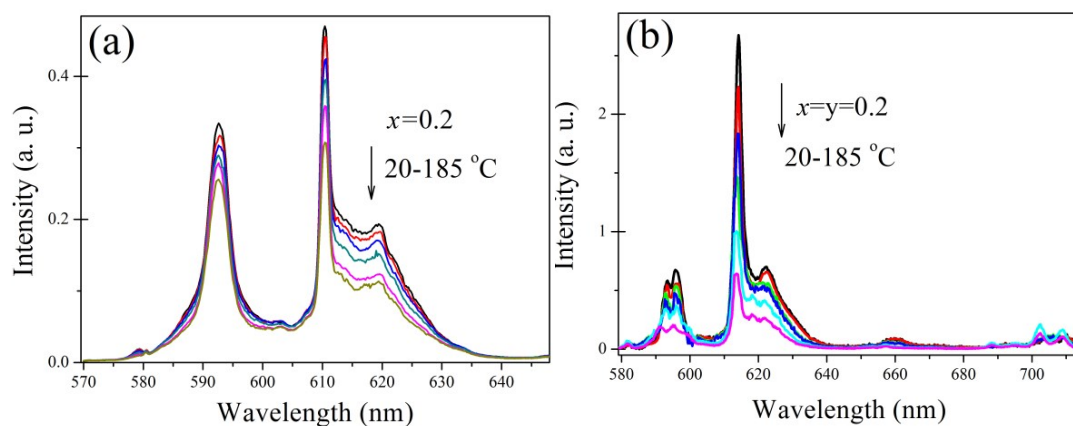


Figure S-5 the experimental luminescence spectra of $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_5\text{O}_{15}$ ($x=0.2$), $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.2$) at different temperature.

Table S1 The refined structural parameters of $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.2$) from the Rietveld refinement using X-ray powder diffraction data taken at room temperature.

formula	$\text{Ba}_{1.8}\text{Eu}_{0.2}\text{NaNb}_{4.8}\text{Ti}_{0.2}\text{O}_{15}$
radiation	Cu-K α
2θ range(degree)	10-80
symmetry	tetragonal
space group#	P4bm (100)
$a/\text{\AA}$	12.5361(6)
$b/\text{\AA}$	12.5361(6)
$c/\text{\AA}$	4.0039(3)
$\alpha/^\circ$	90.000
$\beta/^\circ$	90.000
$\gamma/^\circ$	90.000
Z	2
R_p	0.4552
R_{wp}	0.5657
χ^2	204.4
V	629.26 (7) \AA^3

Table S2 The refined structural parameters of $\text{Ba}_{2-x}\text{Eu}_x\text{NaNb}_{5-y}\text{Ti}_y\text{O}_{15}$ ($x=y=0.2$) from the

Rietveld refinement using X-ray powder diffraction data taken at room temperature.

Atom	Wyckoff	x/a	y/b	z/c	Occupancy	U [\AA^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