Supporting Information

Microstructural origin of peculiar spectra and excellent luminescence properties of $Y_{10}Ta_4O_{25}:Eu^{3+}$ with fluorite-related structure

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Figures

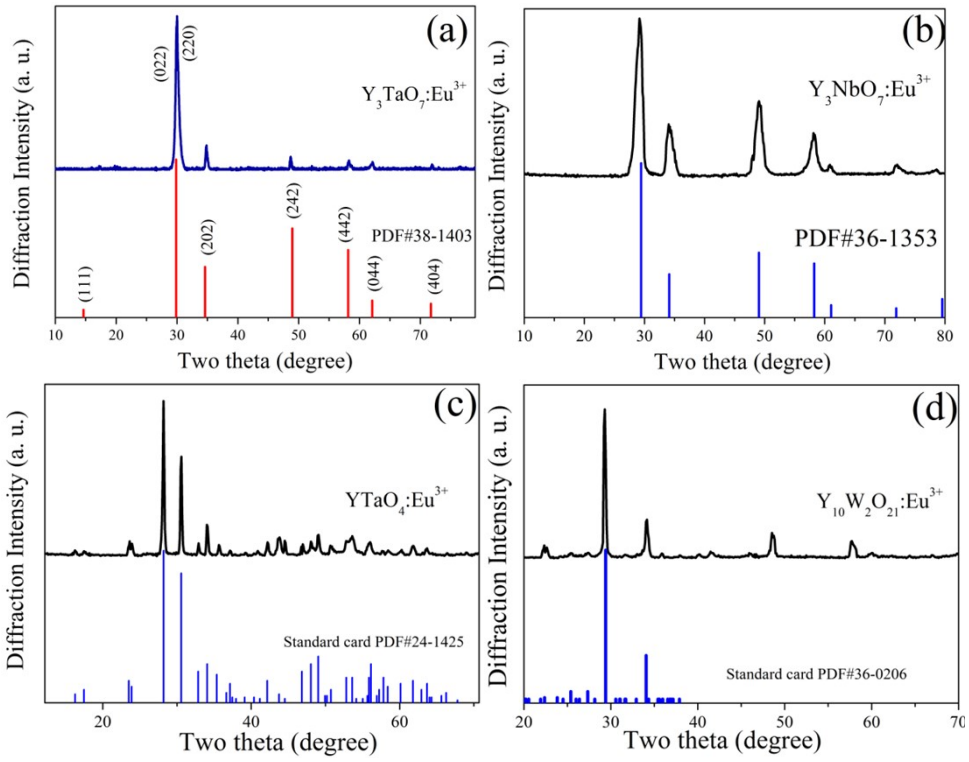

Figure S-1 XRD patterns of the reference samples of $Y_3TaO_7:Eu^{3+}$, $Y_3NbO_7:Eu^{3+}$, $YTaO_4:Eu^{3+}$, $Y_{10}W_2O_{21}:Eu^{3+}$ with the fluorite-related structure. The standard cards were compared with the experimental patterns.

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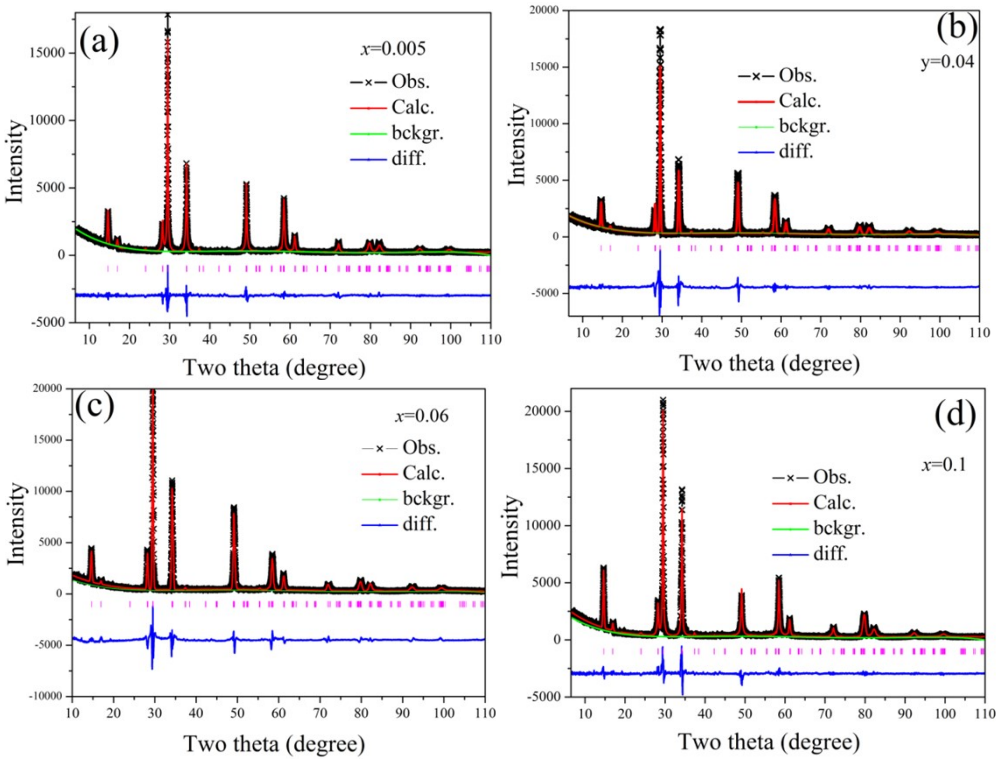


Figure S-2 the representative Rietveld refinements of $Y_{10-10x}Eu_{10x}Ta_4O_{25}$ ceramics with x=0.005 (a), x=0.04 (b), x=0.06 (c) and x=0.1 (d).

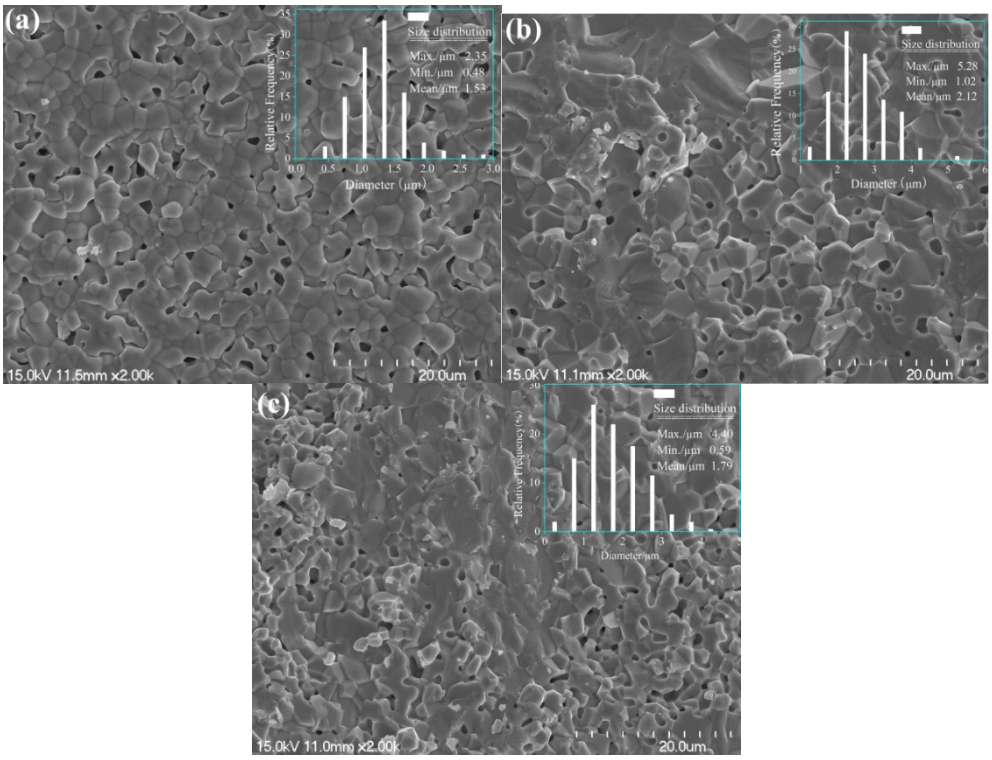


Figure S-3 the representative SEM pictures and the size distribution of the particles of $Y_{10-10x}Eu_{10x}Ta_4O_{25}$ ceramic phosphors with x=0.005 (a), x=0.04 (b), and x=0.06 (c).

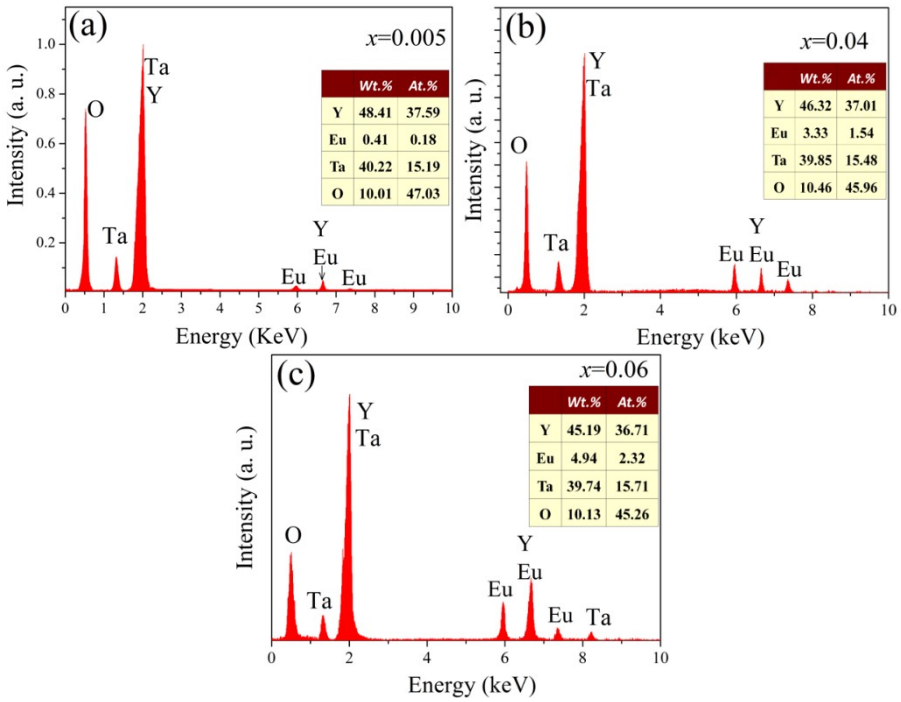


Figure S-4 the representative EDS spectra and the experimental element ratio of $Y_{10-10x}Eu_{10x}Ta_4O_{25}$ with x=0.005 (a), x=0.04 (b), and x=0.06 (c).

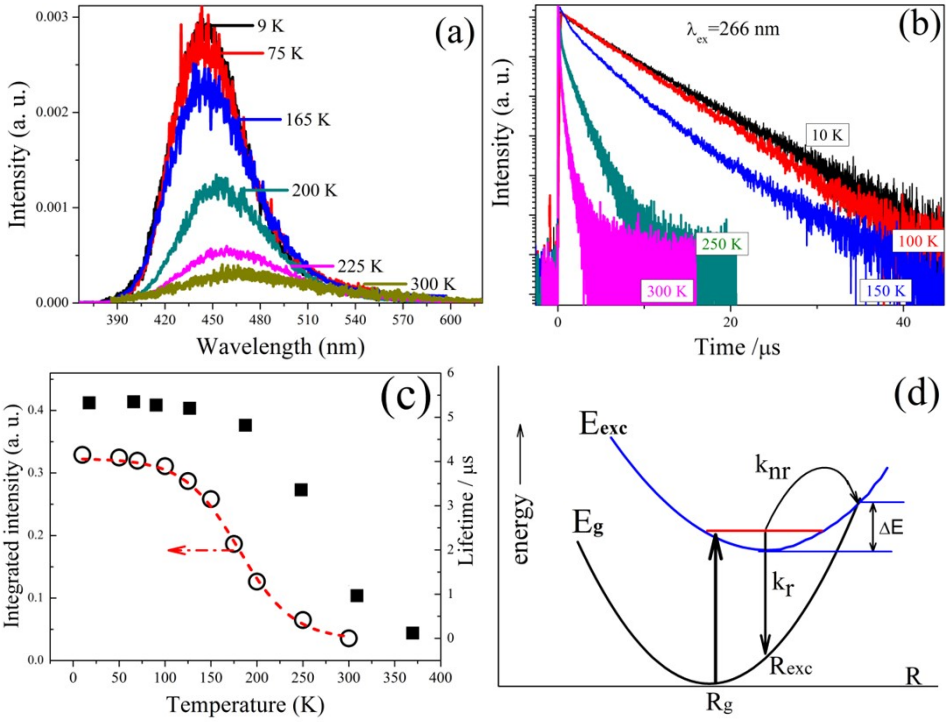


Figure S-5 The intrinsic emission (a), the decay curves (b), temperature-dependent luminescence (c), and the configuration diagram for the ground state (E_g), the excited state (E_{exc}), and electronic transitions (d) of pure $Y_{10}Ta_4O_{25}$ host. R_{exc} and R_g are the equilibrium distances off the excited and ground states, respectively. The excitation was pulsed 266 nm Nd:YAG laser.

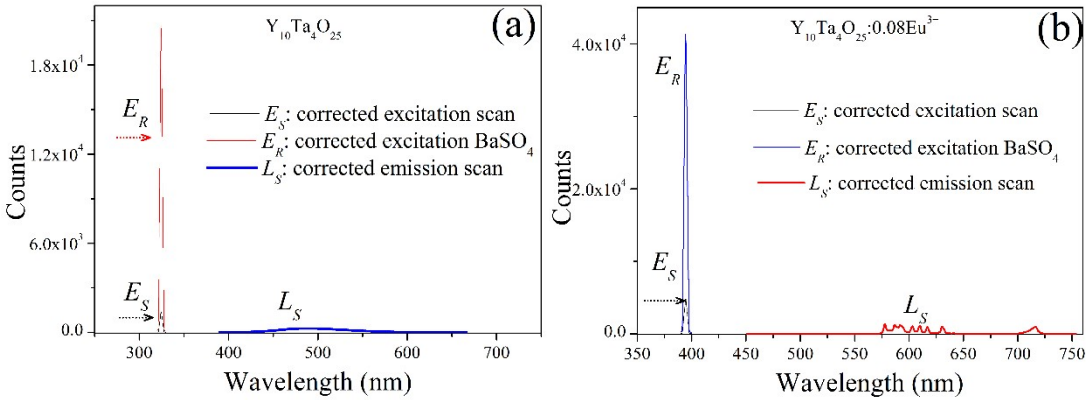
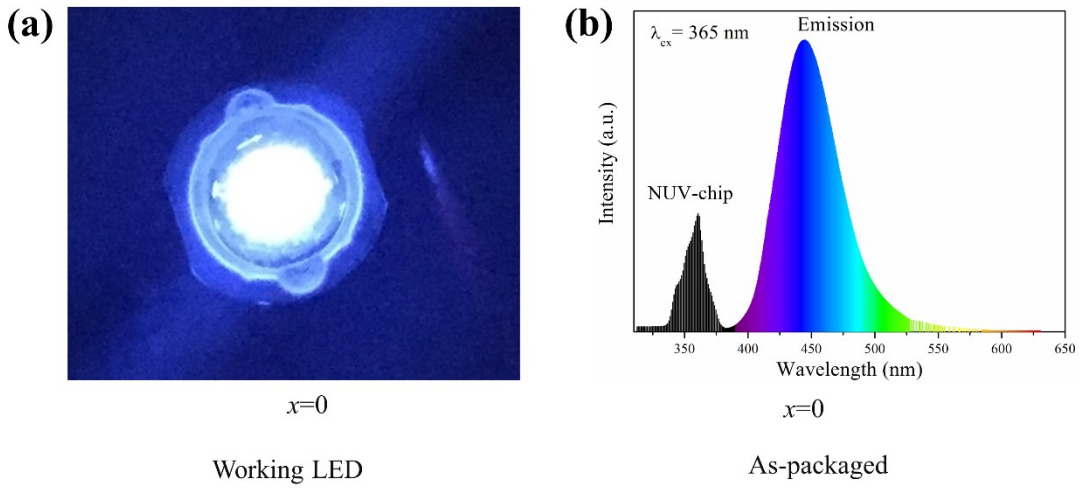


Figure S-6 The corrected excitation line of $BaSO_4$ and emission spectra of pure (a) and Eu^{3+}-doped $Y_{10}Ta_4O_{25}$ (b) obtained by using an integrating sphere;



x=0 *x*=0

Working LED As-packaged

Figure S-7 The experimental LED lighting devises by combining $Y_{10}Ta_4O_{25}$ with 365 nm chip (a), and its electroluminescence spectrum (b).

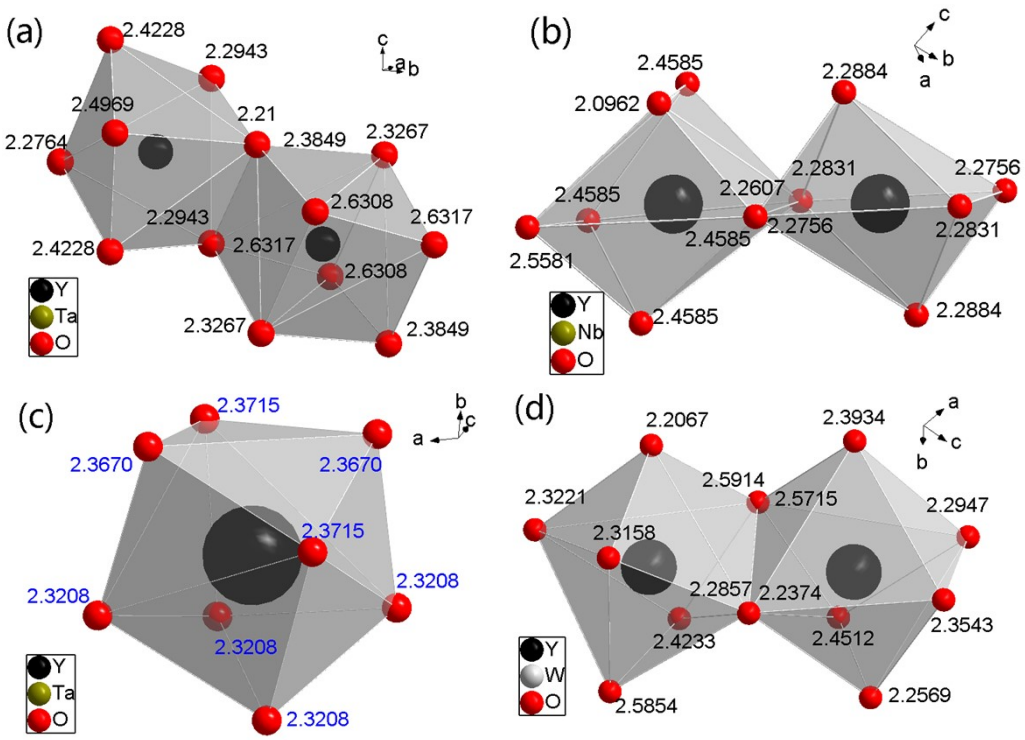


Figure S-8 The local coordination environments of cation sites Y1 and Y2 in the lattices of Y_3TaO_7 (a), Y_3NbO_7 (b), $YTaO_4$ (c), $Y_{10}W_2O_{21}$ (d). The structures were downloaded from the data base in https://materialsproject.org.

Tables

Table S-1 The refined structural parameters of $Y_{10-10x}Eu_{10x}Ta_4O_{25}$ (x=0.005, 0.04, 0.06, 0.1) from the Rietveld refinement using X-ray powder diffraction data taken at room temperature.

formula	x=0.005	x=0. 04	x=0.06	x=0.1
radiation	Cu-K_a	Cu-K_a	Cu-K_a	Cu-K_a
2θ (º)	5-110	5-110	5-110	5-110
symmetry	orthorhombic	orthorhombic	orthorhombic	orthorhombic
space group#	C*mmm* (65)	C*mmm* (65)	C*mmm* (65)	C*mmm* (65)
a/Å	10.4851	10.5542	10.5873	10.6733
b/Å	7.3615	7.3832	7.3881	7.41615
c/Å	3.7327	3.7471	3.8033	3.8565
α/°	90	90	90	90
β/°	90	90	90	90
γ/°	90	90	90	90
Z	2	2	2	2
R_p	0.0838	0.0976	0.0908	0.08218
R_{wp}	0.1149	0.1156	0.1249	0.1122
X^2	2.21	2.31	2.13	2.53
V/Å^3	288.11782	291.98816	297.49424	305.26046

Table S-2 the Raman mode (cm^{-1}), the average distances of $Y_{10}Ta_4O_{25}:Eu^{3+}$ compared with the reference samples of $Y_3TaO_7:Eu^{3+}$, $Y_3NbO_7:Eu^{3+}$, $YTaO_4:Eu^{3+}$, $Y_{10}W_2O_{21}:Eu^{3+}$, $BaSrMWO_6$ and Bi_2WO_6.

	Raman mode (cm^{-1})	(Y/Eu)-O distances (Å)		references
		(Y/Eu)1-O	(Y/Eu)2-O	
$Y_{10}Ta_4O_{25}:Eu^{3+}$	630	2.0123	2.4182	This work
$Y_3TaO_7:Eu^{3+}$	770	2.3453	2.4933	[1]
$Y_3NbO_7:Eu^{3+}$	783	2.3927	2.2824	[2]
$YTaO_4:Eu^{3+}$	816	2.3434		[3]
$Y_{10}W_2O_{21}:Eu^{3+}$	-	2.39	2.3656	
$BaSrMWO_6$	850	-	-	[4]
Bi_2WO_6	840	-	-	[5]

References

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