Supporting Information

Insight into Eu redox and Pr^{3+} 5d emission in $KSrPO_4$ by VRBE scheme construction

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Table S1. Final refined structure parameters of $KSrPO_4$ compound[d].

Z	Wyckoff position	x	y	z	Site occupancy factor	Bep
K	4c	0.1651(3)	1/4	0.584(3)	1	1.3
Sr	4c	-0.0032(2)	1/4	0.198(1)	1	1.3
P	4c	0.2336(4)	1/4	-0.075(8)	1	1.2
O1	4c	0.295 (1)	1/4	0.070(9)	1	0.5
O2	8d	0.282(5)	0.022(1)	0.833(9)	1	1.1
O3	4c	0.536(8)	1/4	0.589(7)	1	1.3

[d] $KSrPO_4$ belongs to orthorhombic with space group *Pnma* and a = 7.34706(4) Å, b = 5.55249(3) Å, c = 9.61716(6) Å, V = 392.325(4) Å^3 as well as the goodness of fitting R_{wp} = 5.891%, R_p = 3.574%, R_B = 5.919%.

Table S2. The Sr-O distance of $KSrPO_4$ compound.

Bond	Length/ Å	Bond	Length/ Å
Sr-O1	2.512(7)	Sr-O2(×2)	2.577(6)
Sr-O1	2.681(8)	Sr-O3(×2)	2.978(2)

Sr-O2(×2)	2.560(5)	Sr-O3	2.767(7)
average	2.688(5)		

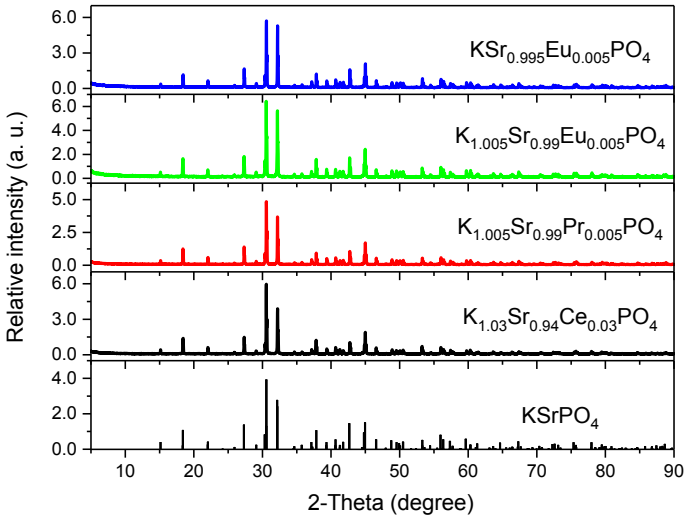

Fig. S1 Representative XRD patterns of Ce^{3+}, Pr^{3+}, Eu^{3+} and Eu^{2+} singly doped $KSrPO_4$ samples at RT.

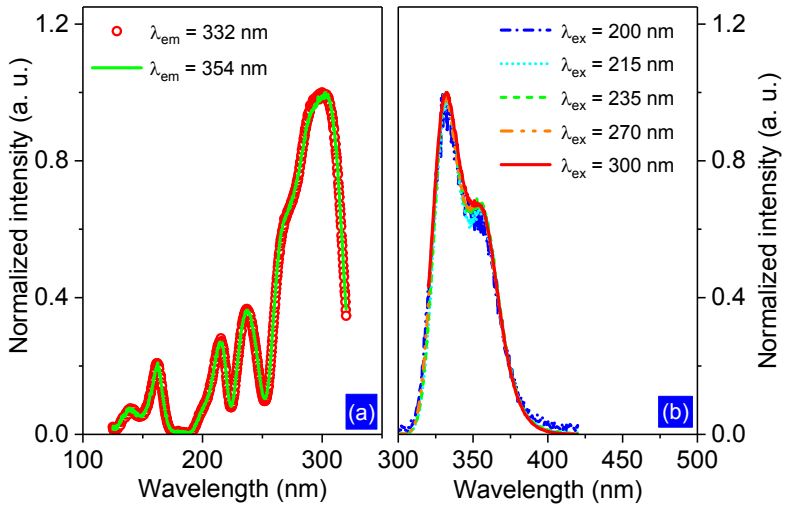

Fig. S2 Highest-height normalized VUV-UV excitation (a, λ_{em} = 332 and 354 nm) and emission (b, λ_{ex} = 200, 215, 235, 270 and 300 nm) spectra of sample $K_{1.001}Sr_{0.998}Ce_{0.001}PO_4$ at 25 K.

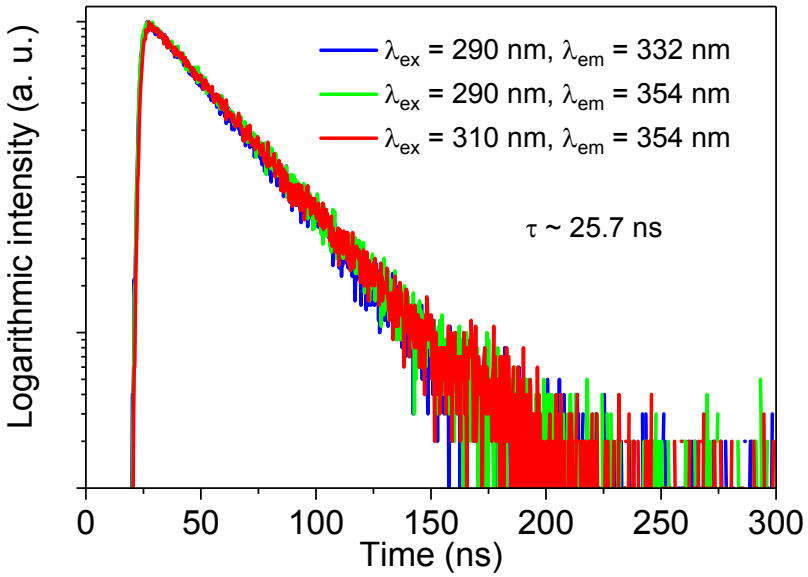

Fig. S3 Luminescence decay curves of sample $K_{1.001}Sr_{0.998}Ce_{0.001}PO_4$ at RT.

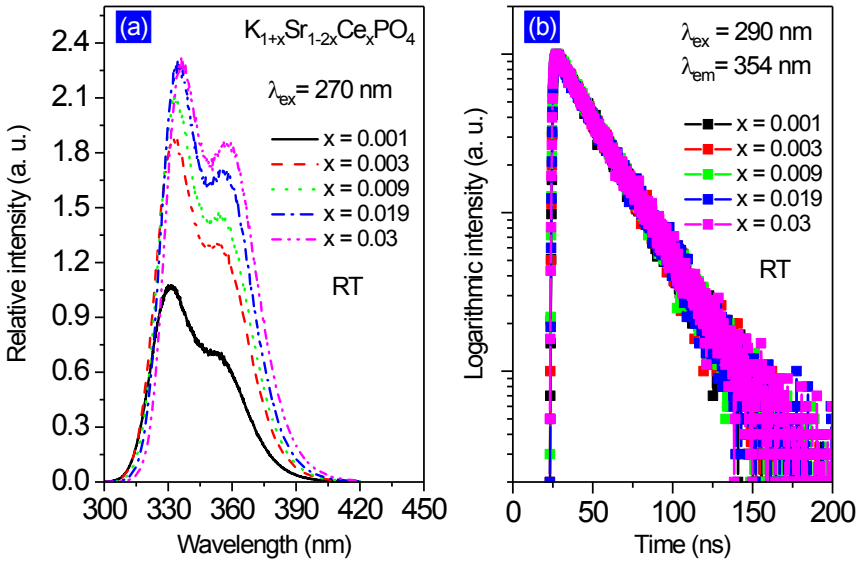

Fig. S4 (a) Emission spectra and (b) decay curves of samples $K_{1+x}Sr_{1-2x}Ce_xPO_4$ (x = 0.001, 0.003, 0.009, 0.019 and 0.03) under 270 and 290 nm excitation, respectively.

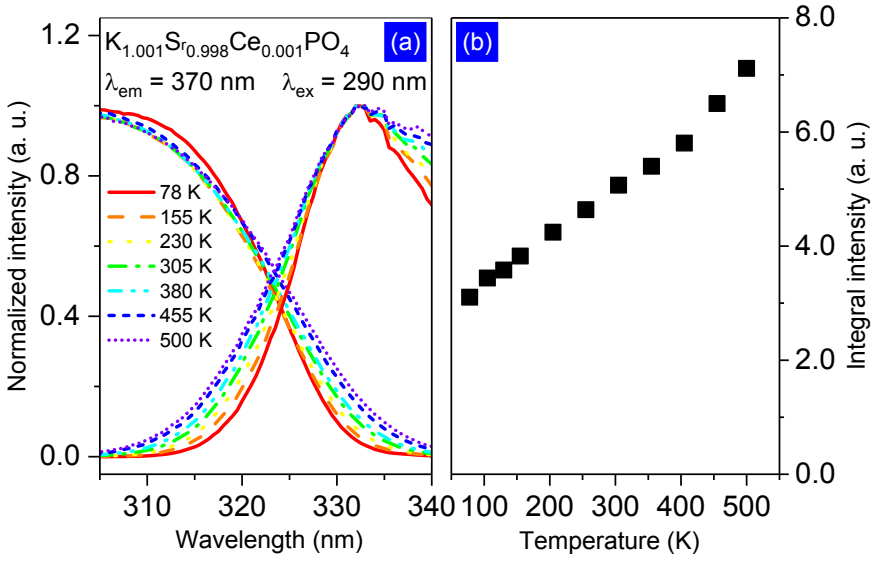

Fig. S5 (a) Highest-intensity normalized excitation (λ_{em} = 370 nm) and emission (λ_{ex} = 290 nm) spectra of sample $K_{1.001}Sr_{0.998}Ce_{0.001}PO_4$ at different temperatures; (b) temperature-dependent integral intensities of spectral overlapping between normalized excitation and emission spectra shown in (a).

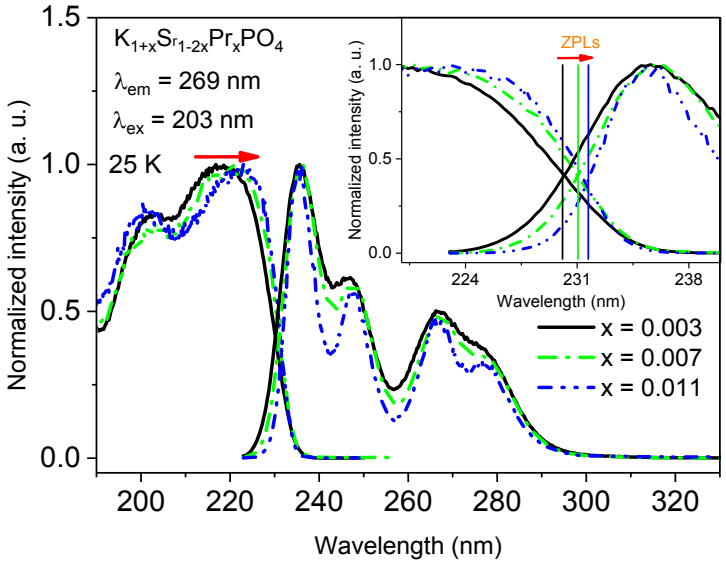

Fig. S6 Height-normalized VUV excitation (λ_{em} = 269 nm) and emission spectra (λ_{ex} = 203 nm) of samples $K_{1+x}Sr_{1-2x}Pr_xPO_4$ (x = 0.003, 0.007, 0.011) at 25 K; the inset shows magnified spectra (λ_{ex} = 203 nm) in the 220-240 nm range.

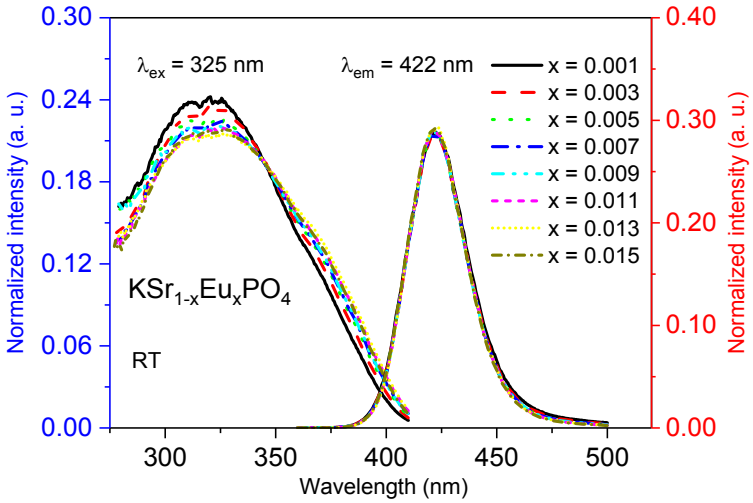

Fig. S7 Integrated intensity-normalized excitation (λ_{em} = 422 nm) and emission (λ_{ex} = 325 nm) spectra of $KSr_{1-x}Eu_xPO_4$ (x = 0.001-0.015) samples as-prepared in CO ambiance.

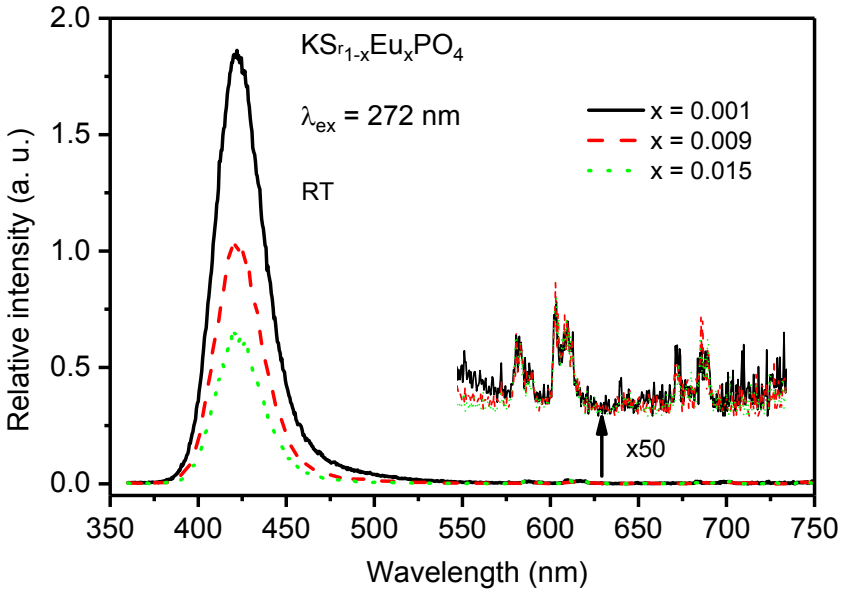

Fig. S8 Emission spectra (λ_{ex} = 272 nm) of representative $KSr_{1-x}Eu_xPO_4$ (x = 0.001, 0.009 and 0.015) samples synthesized in CO ambiance.