Supporting information

Multiple Anti-counterfeiting Realized in $NaBaScSi_2O_7$ with A Single Activator of Eu^{2+}

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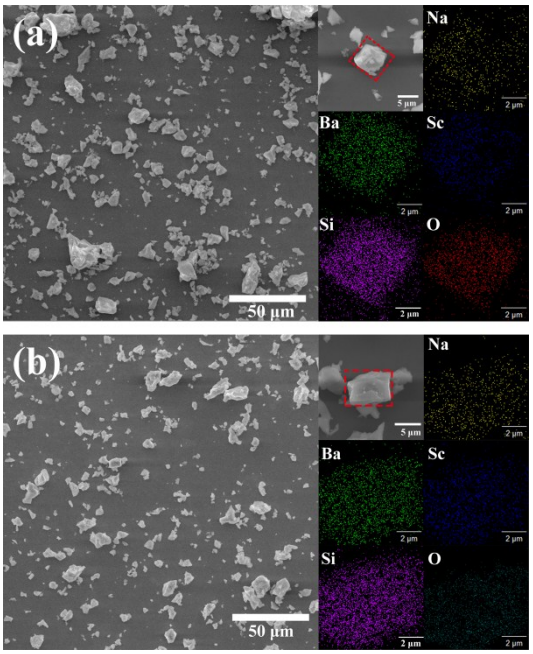

Fig. S1 SEM images microcrystal particles, the enlarged single particle, EDS elemental mapping of the $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$; (b) $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$ for different elements.

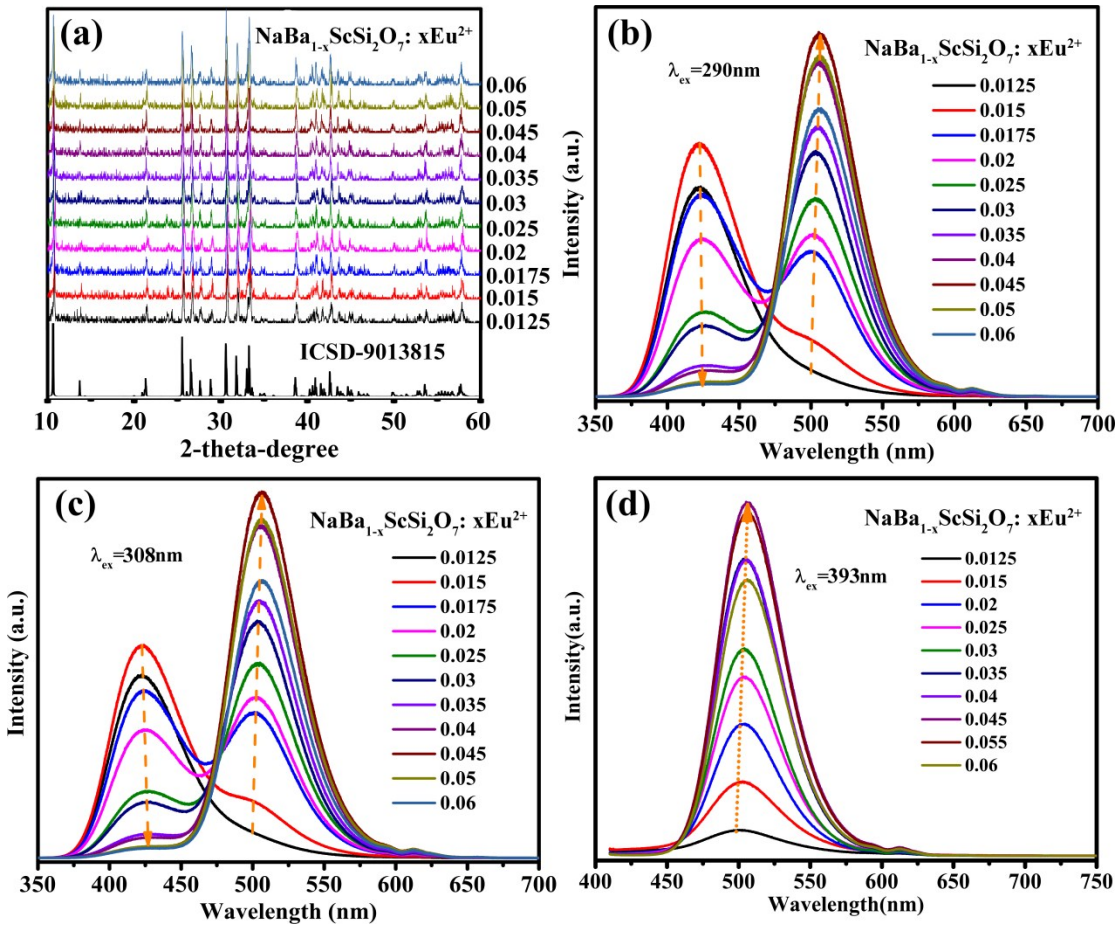

Fig. S2 SEM images microcrystal particles, the enlarged single particle and EDS elemental mapping for different elements of the $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$; (b) $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$.

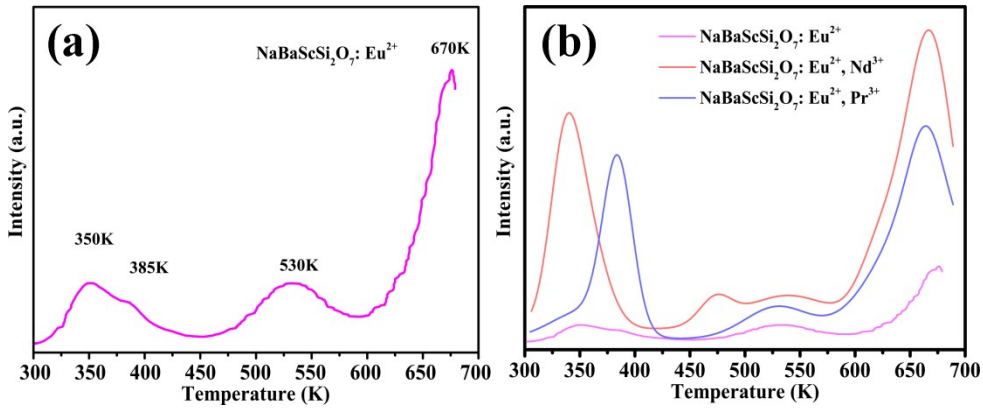

Fig. S3 TL curve of $NaBa_{0.98}ScSi_2O_7$: $0.02Eu^{2+}$ (a); and TL curves of $NaBaScSi_2O_7$: Eu^{2+}, $NaBaScSi_2O_7$: Eu^{2+}, Nd^{3+}, $NaBaScSi_2O_7$: Eu^{2+}, Pr^{3+} (b).

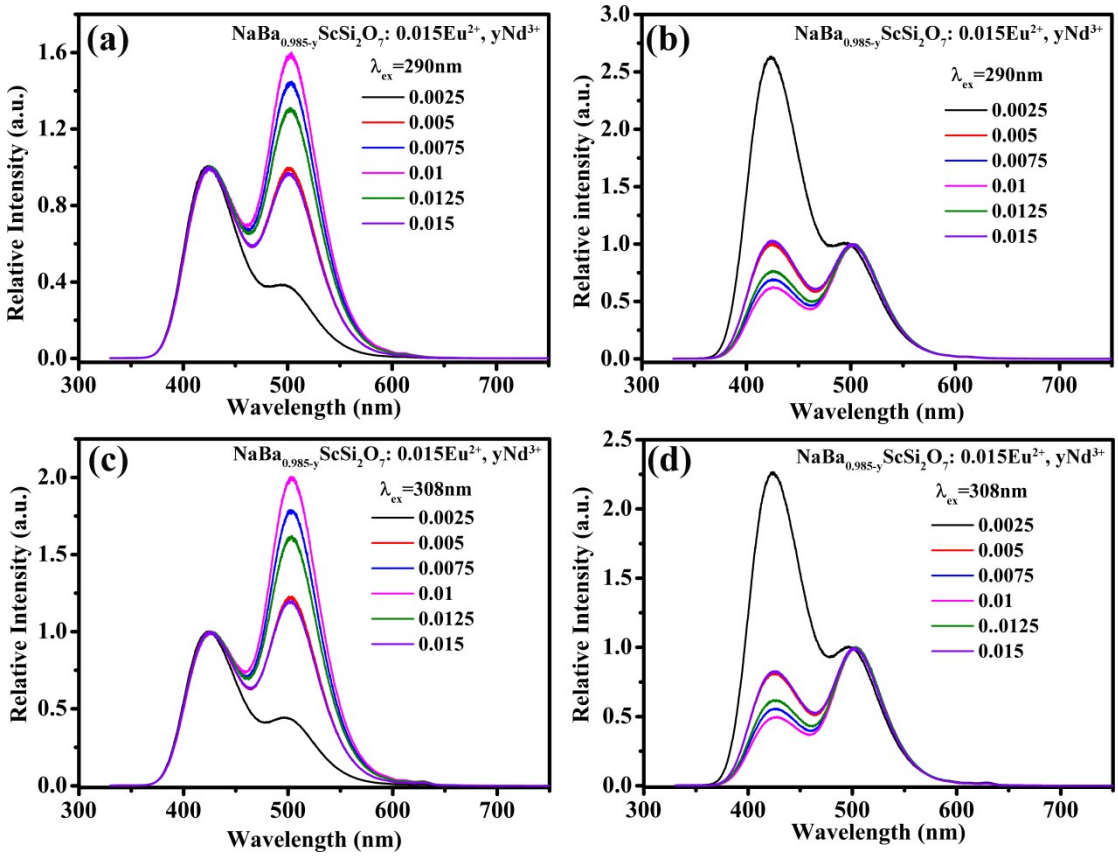

Fig. S4 PL spectra with normalized blue emission (a, c) and normalized green emission (b, d) of $NaBa_{0.985-y}ScSi_2O_7$: $0.015Eu^{2+}$, yNd^{3+} phosphors under the excitation of 290 and 308 nm, respectively.

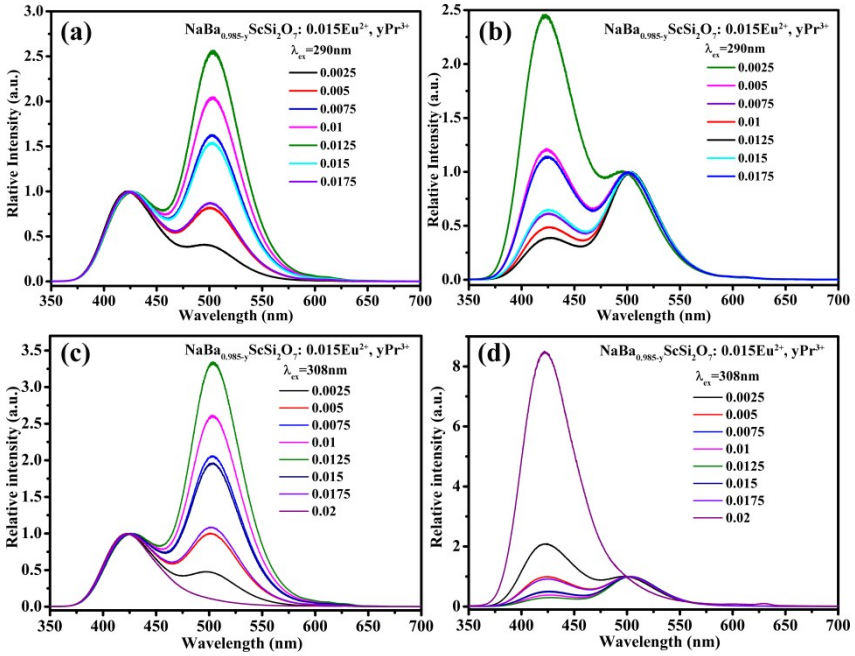

Fig. S5 PL spectra with normalized blue emission (a, c) and normalized green emission (b, d) of $NaBa_{0.985-y}ScSi_2O_7$: $0.015Eu^{2+}$, yPr^{3+} phosphors under the excitation of 290 and 308 nm, respectively.

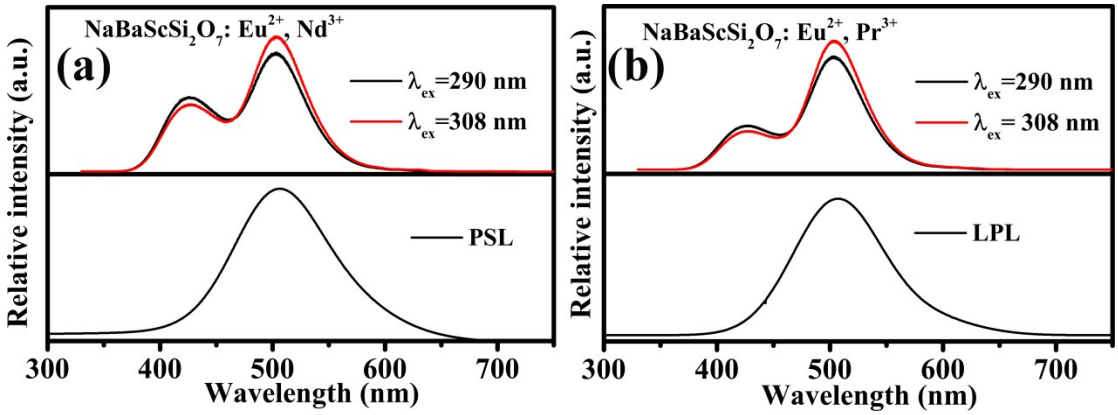

Fig. S6 PL, PSL spectra of $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$ (a); and PL, LPL spectra of $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$ (b).

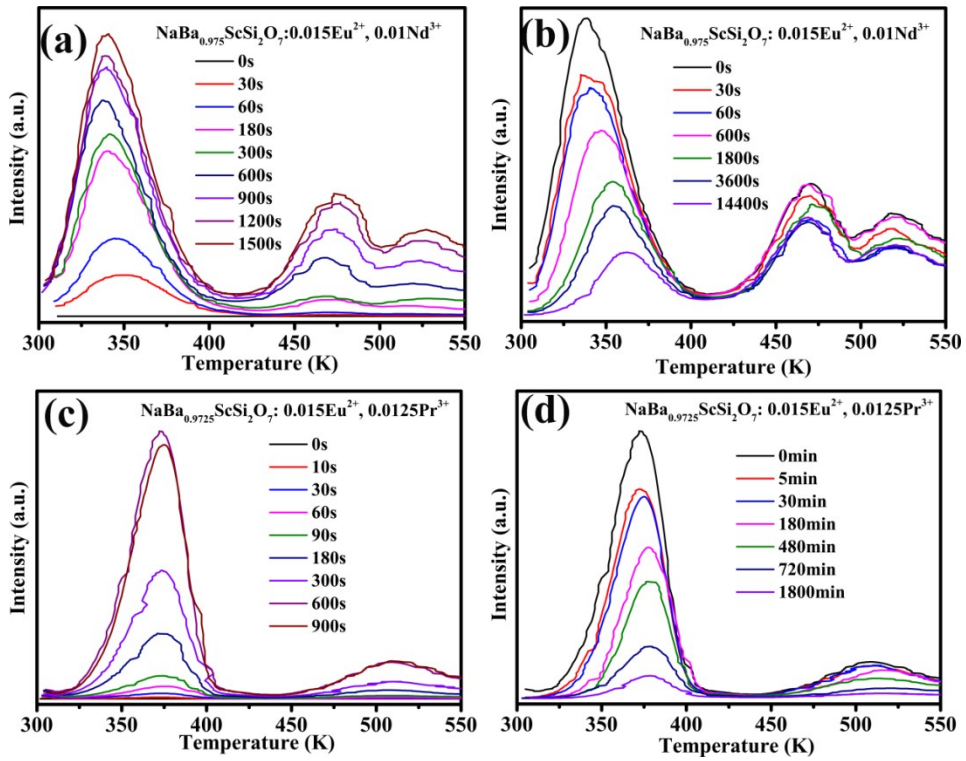

Fig. S7 TL curves of $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$ (a) and $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$ (c) under 254 and 365 nm excitation with different irradiation time; TL decay curves of $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$ (b) and $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$ (d).

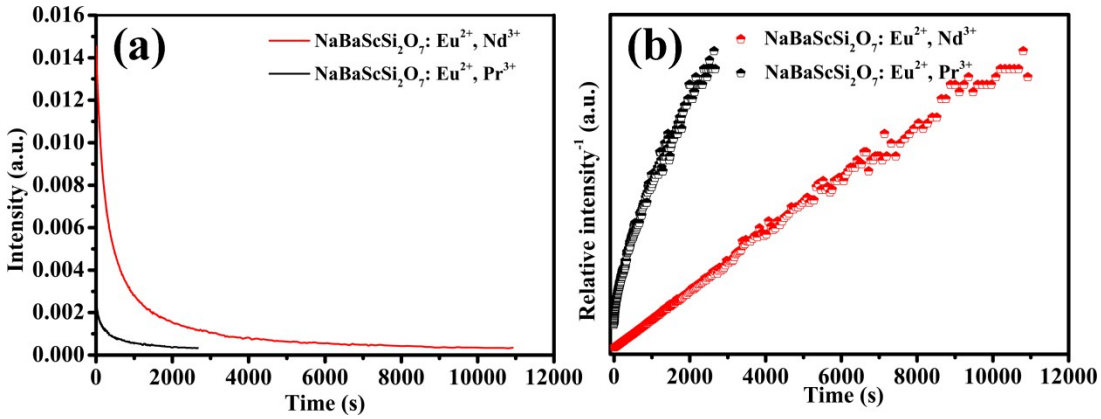

Fig. S8 Persistent decay curves (a) and Time dependence of the reciprocal of the persistent luminescence intensity (b) of $NaBa_{0.975}ScSi_2O_7$: $0.015Eu^{2+}$, $0.01Nd^{3+}$ and $NaBa_{0.9725}ScSi_2O_7$: $0.015Eu^{2+}$, $0.0125Pr^{3+}$ after UV light (254 and 365 nm) irradiation for 20 min.

Table S1. The lifetimes of $NaBa_{1-x}ScSi_2O_7$: xEu^{2+} phosphors.

x	0.015	0.02	0.03	0.04	0.045	0.05
τ (421nm)	4.577μs	4.312μs	4.211μs	4.119μs	3.940μs	3.719μs
τ (500nm)	3.151μs	4.216μs	4.477μs	4.715μs	4.781μs	4.839μs