Electronic Supplementary Information

A broadband yellow Yb^{2+}-doped oxynitride phosphor for high-performance white light-emitting diodes

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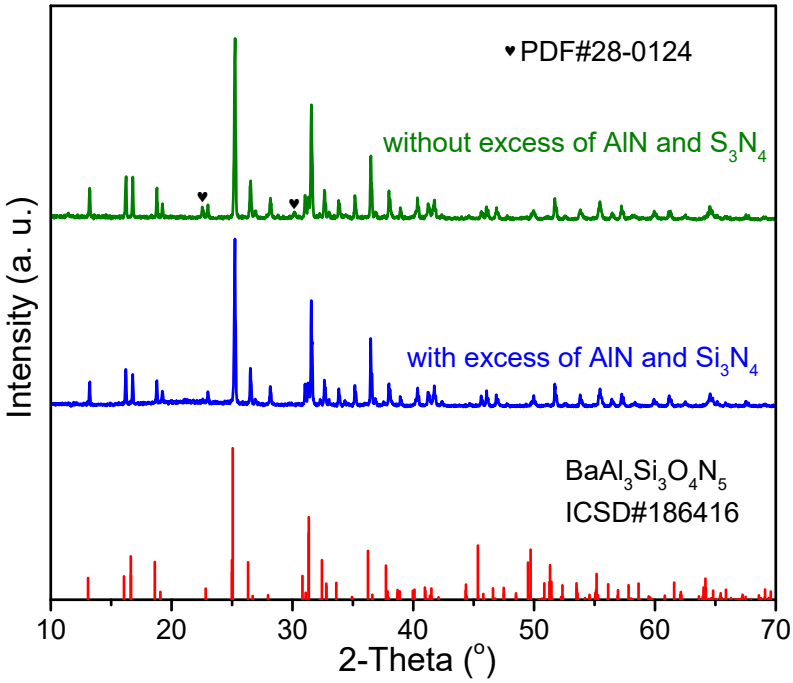

Figure S1. XRD results of target samples with or without the excess of AlN and Si_3N_4 in the synthetic method. Standard card of $BaAl_3Si_5O_4N_5$ (ICSD#186416) is also given as reference.

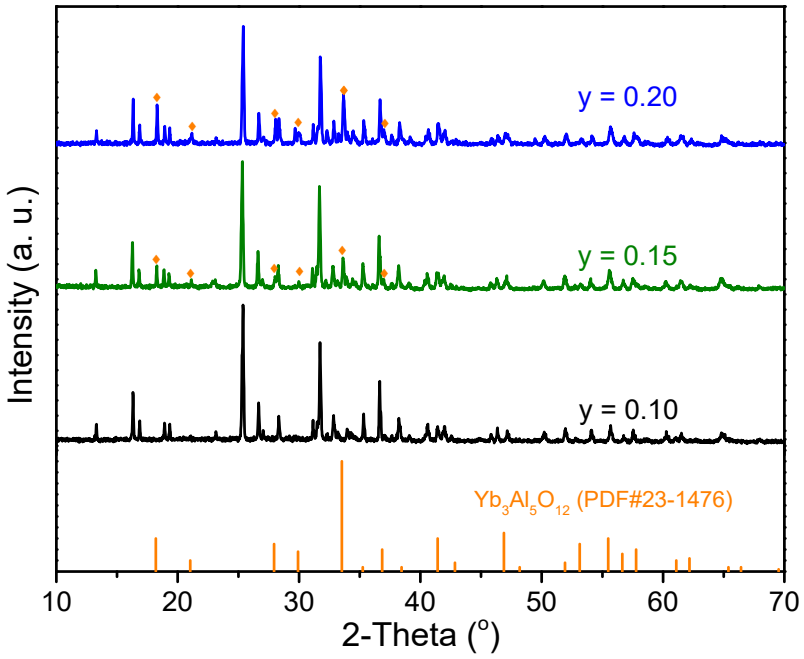

Figure S2. XRD patterns of $Ba_{0.6-y}Sr_{0.4}Si_3Al_3O_4N_5:yYb^{2+}$ (y = 0.10, 0.15, and 0.20) phosphors. Standard card of $Yb_3Al_5O_{12}$ (PDF#23-1776) is used to illustrate the impurity growth under a certain doping concentration.

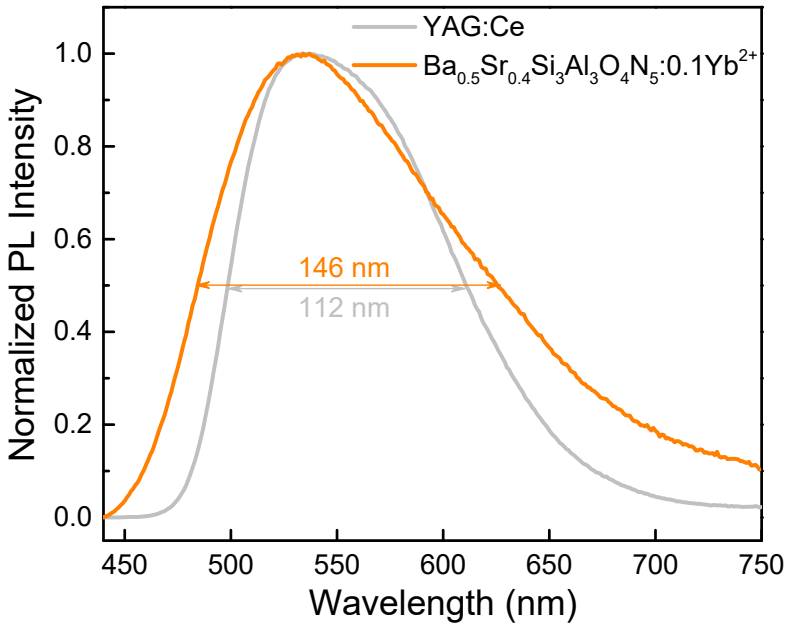

Figure S3. Comparison of emission spectra of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5:0.1Yb^{2+}$ and commercial YAG:Ce phosphor. A broader emission makes $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5:0.1Yb^{2+}$ can be used for high Ra and low CCT w-LEDs.

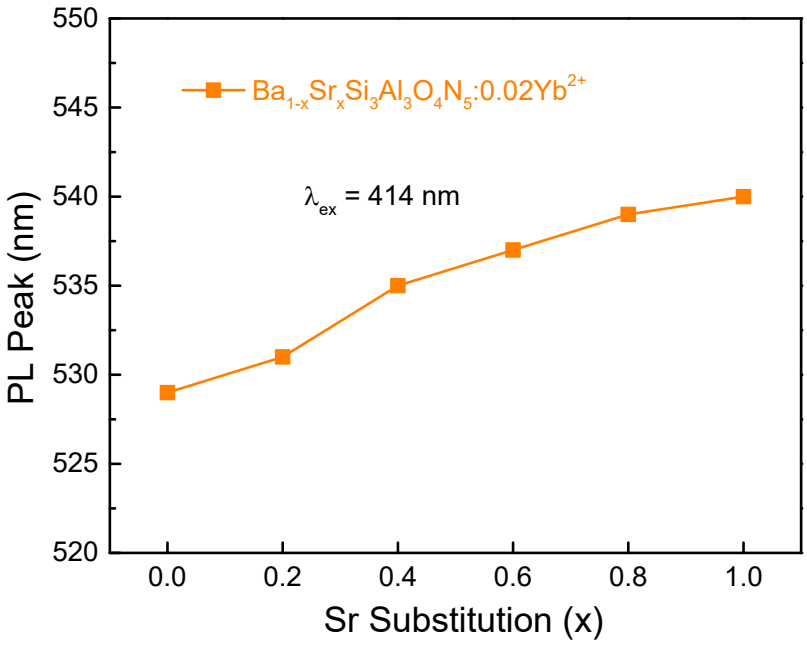

Figure S4. PL peaks as function of Sr substitution in $Ba_{1-x}Sr_xSi_3Al_3O_4N_5:0.02Yb^{2+}$ (x = 0 - 1) under the excitation of 414 nm.

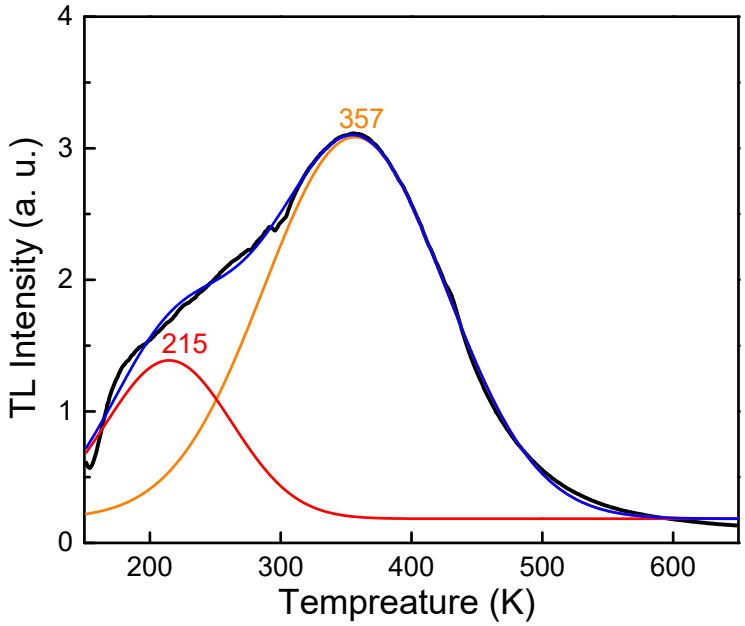

Figure S5. TL spectrum of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$:0.1$Yb^{2+}$ after irradiation of 254 nm for 5 min in the temperature range from 300 to 650 K. Two fitted broadband TL peaks (215 and 357 K) mean that instinct defects exist in $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$:0.1$Yb^{2+}$.

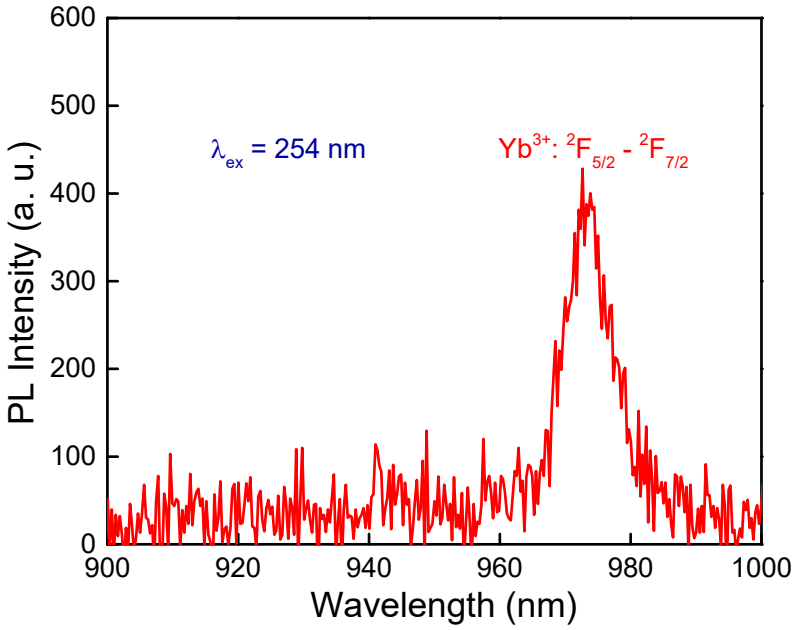

Figure S6. PL spectrum of Yb-doped $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$ under the excitation of 254 nm. Typical NIR emission around 973 nm indicates the existing of Yb^{3+} ions in this oxynitride phosphor.

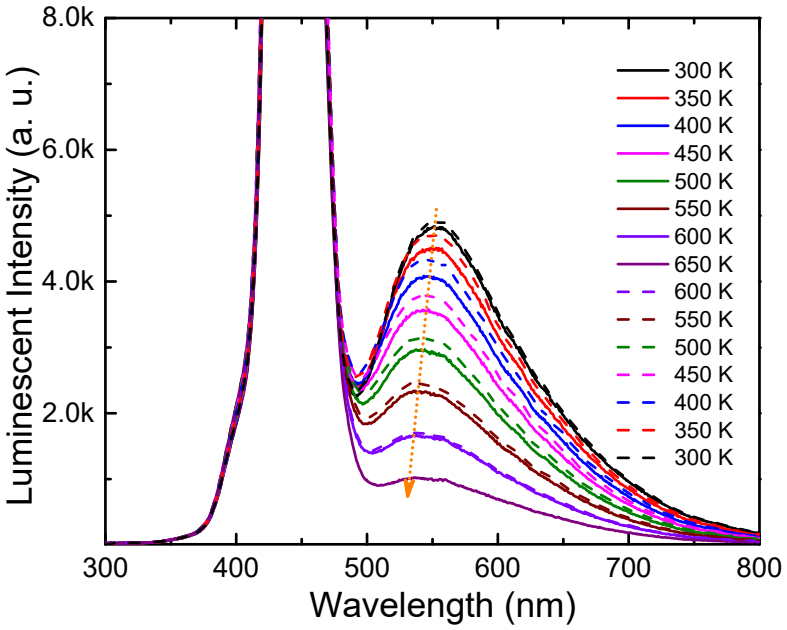

Figure S7. PL spectra of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5:0.1Yb^{2+}$ under different temperature from 300 - 650 K. The emission peak positions of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5:0.1Yb^{2+}$ are slightly red-shifted due to the excitation wavelength excesses 420 nm in thermal quenching measurement.

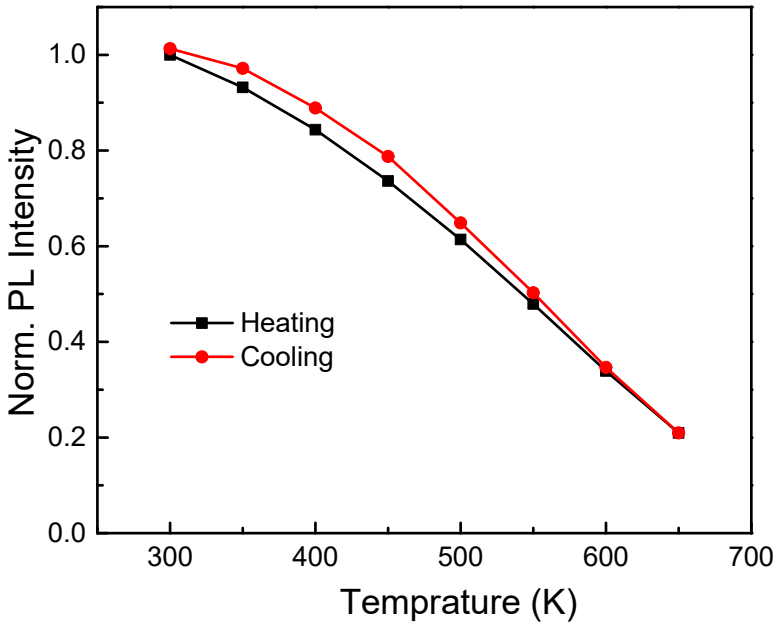

Figure S8. Normalized PL peak intensities of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5:0.1Yb^{2+}$ under different temperature from 300 - 650 K.

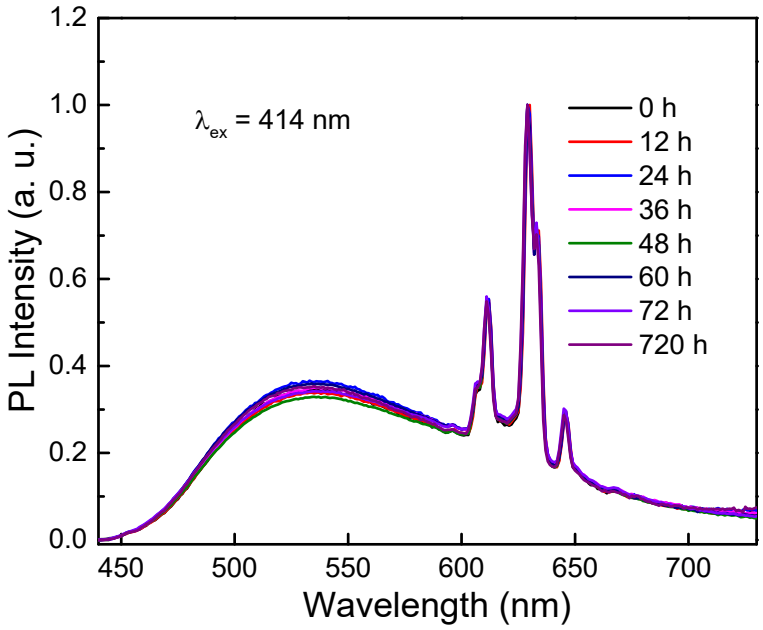

Figure S9. Normalized PL spectra (λ_{ex} = 414 nm) of the mixtures, which were mixed soaked $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$:0.1$Yb^{2+}$ in water for different time with KSF in a fixed mass ratio of 5:2 (all emission intensities of KSF were normalized to 1). The emission peak (~538 nm) intensities from soaked $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$:0.1$Yb^{2+}$ indicate the excellent waterproof stability of $Ba_{0.5}Sr_{0.4}Si_3Al_3O_4N_5$:0.1$Yb^{2+}$.