

eSupporting information

Insight into the Electron Transfer and Anti-thermal Quenching of Europium doped $\text{Li}_4\text{SrCa}(\text{SiO}_4)_2$

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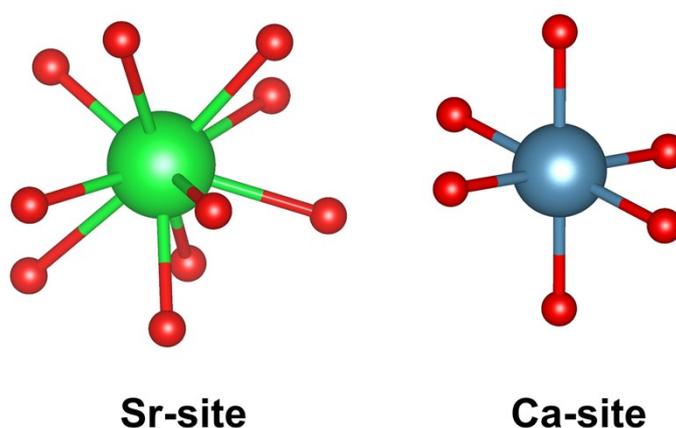


Figure S1 Local coordination structures of Sr^{2+} site and Ca^{2+} site in $\text{Li}_4\text{SrCa}(\text{SiO}_4)_2$.

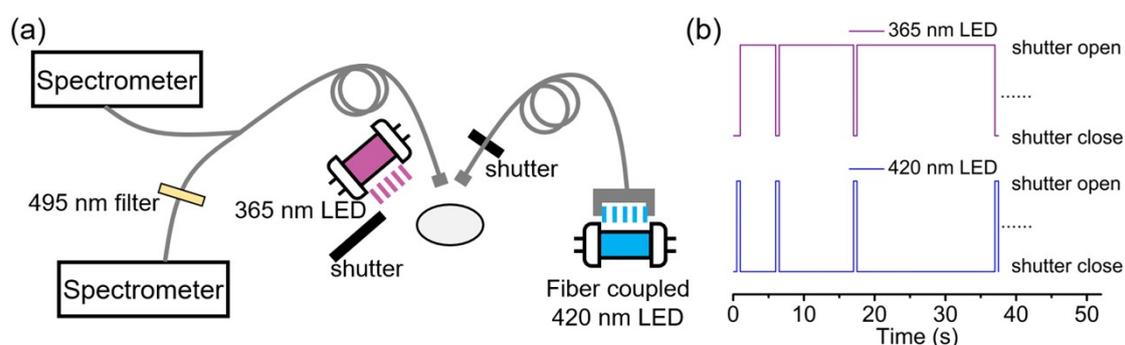


Figure S2 (a) Schematic of the reflectance and PL measurement set-up. (b) Experiment outline for two shutters.

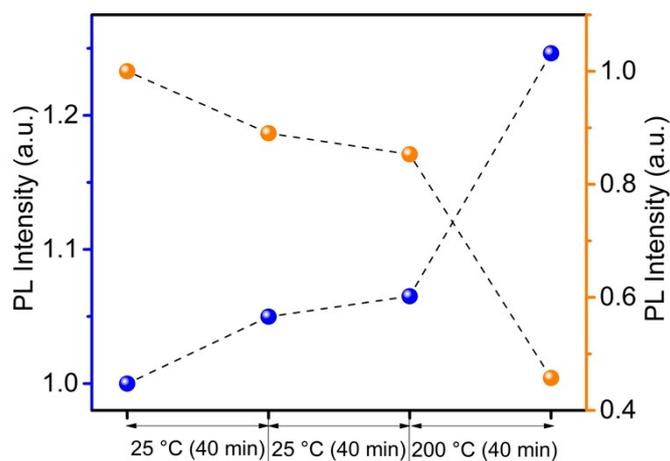


Figure S3 Variations of blue and orange emission intensities in Ca-Sr:0.02Eu recorded at 25°C under 365 nm LED excitation after different waiting time at different temperatures. Prior to the measurement, Ca-Sr:0.02Eu was illuminated by 365 nm LED for 1 h at room temperature.

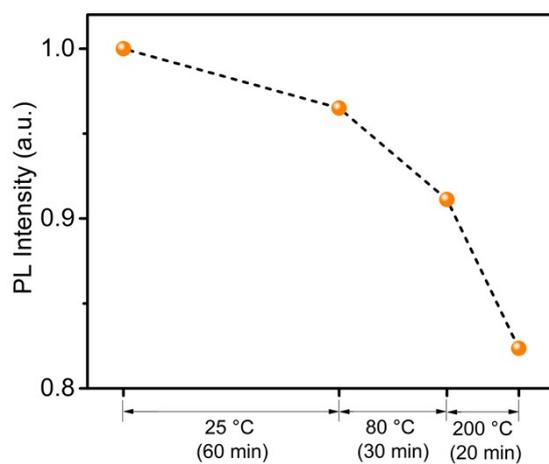


Figure S4 Variations of orange emission in Ca-Sr:0.02Eu after different waiting time at different temperatures under 420 nm LED excitation at 25 °C. Prior to the measurement, Ca-Sr:0.02Eu was illuminated by 365 nm LED at 227 °C for 20 min.

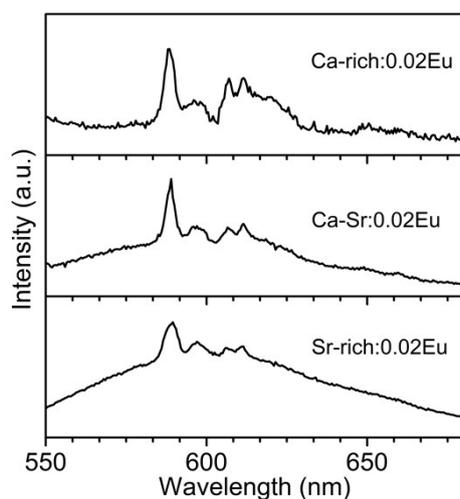


Figure S5 PL spectra of as-prepared Ca-rich:0.02Eu, Ca-Sr:0.02Eu and Sr-rich:0.02Eu under 527 nm excitation recorded at room temperature. Peaks at 588.5 nm and 612.0 nm originate from Eu_{Ca}^{3+} sites.

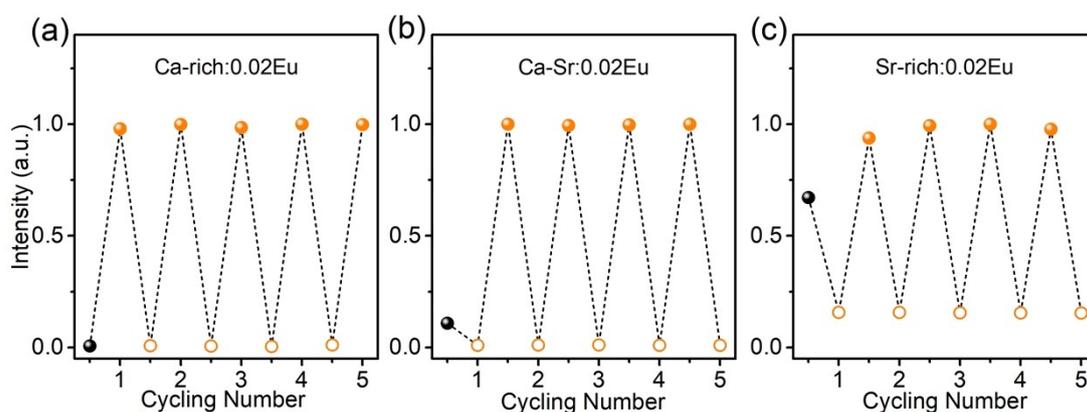


Figure S6 Variation of orange emission intensity under 420 nm excitation under alternating 330 nm and 420 illuminations.

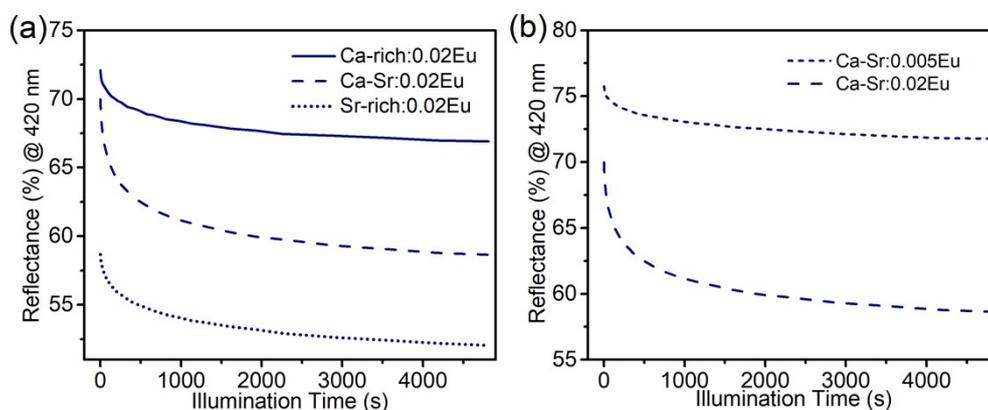


Figure S7 Variation of reflectance at 420 nm over time under continuous 365 nm illumination in different samples.

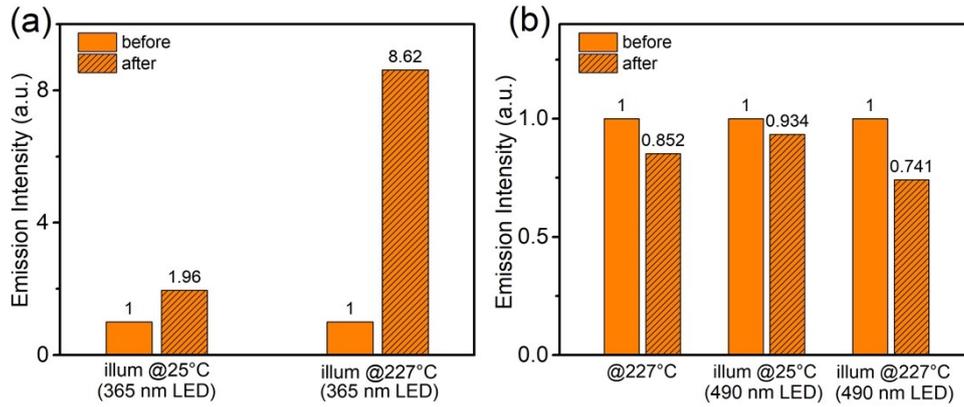


Figure S8 (a) Variation of orange emission intensity ($\lambda_{\text{ex}} = 420 \text{ nm}$, $25 \text{ }^\circ\text{C}$) of Ca-Sr:0.02Eu by 365 nm illumination at $25 \text{ }^\circ\text{C}$ or at $227 \text{ }^\circ\text{C}$. (b) Variation of orange emission intensity ($\lambda_{\text{ex}} = 420 \text{ nm}$, $25 \text{ }^\circ\text{C}$) by thermal treatment ($227 \text{ }^\circ\text{C}$, 3.5 min), or illumination (490 nm illumination, 3.5 min, $25 \text{ }^\circ\text{C}$), or combined simultaneously (490 nm illumination, 3.5 min, $227 \text{ }^\circ\text{C}$). Prior to the measurement in (b), Ca-Sr:0.02Eu was illuminated by 365 nm LED (40 min) at $25 \text{ }^\circ\text{C}$, and then kept in dark for 40 min.

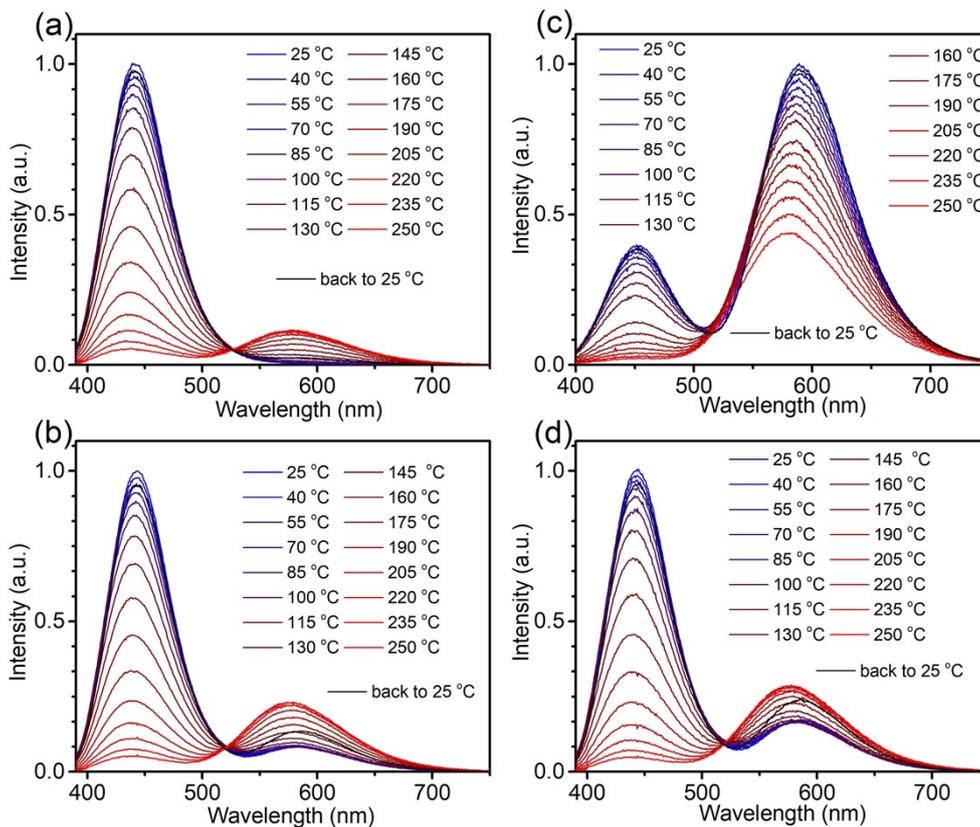


Figure S9 Temperature-dependent PL spectra of (a) Ca-rich:0.02Eu, (b) Ca-Sr:0.02Eu, (c) Sr-rich:0.02Eu, (d) Ca-Sr:0.005Eu, recorded under 365 nm LED excitation while heating at a rate of $60 \text{ }^\circ\text{C}/\text{min}$. The PL spectra after cooling back to $25 \text{ }^\circ\text{C}$ (without illumination during cooldown) are also shown.

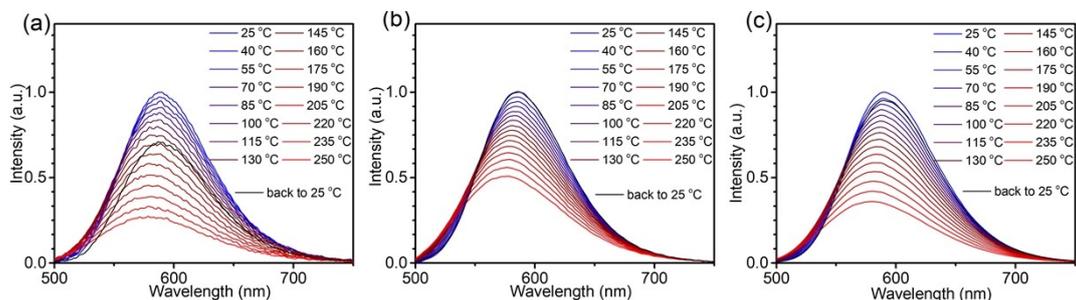


Figure S10 Temperature-dependent PL spectra of (a)Ca-rich:0.02Eu, (b) Ca-Sr:0.02Eu, (c) Sr-rich:0.02Eu, recorded under 420 nm LED excitation while heating at a rate of 60 °C/min. Ca-rich:0.02Eu in (a) was pre-illuminated by 365 nm LED for 1.5 h and then kept in the dark at room temperature for 1.5 h because there is no orange emission in the as-synthesized material. The emission spectra after cooling back to 25 °C (without illumination during cooldown) are also shown.

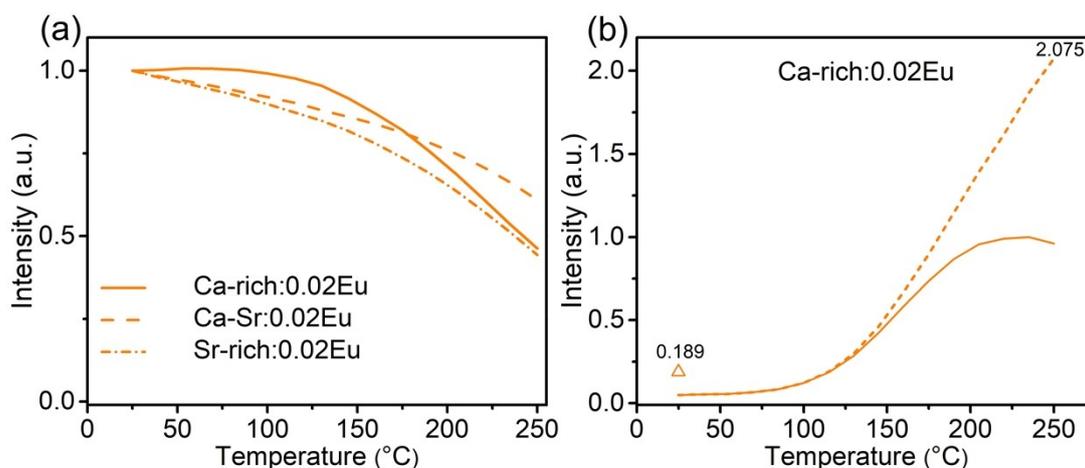


Figure S11 (a) Thermal quenching profiles of orange emission shown in Figure 7f after correction for the electron transfer process during measurement. (b) Thermal quenching profiles of Ca-rich:0.02Eu without (—, also see Figure 7a) and with (---) the correction for conventional thermal quenching of Ca-rich:0.02Eu shown in Figure S10a.

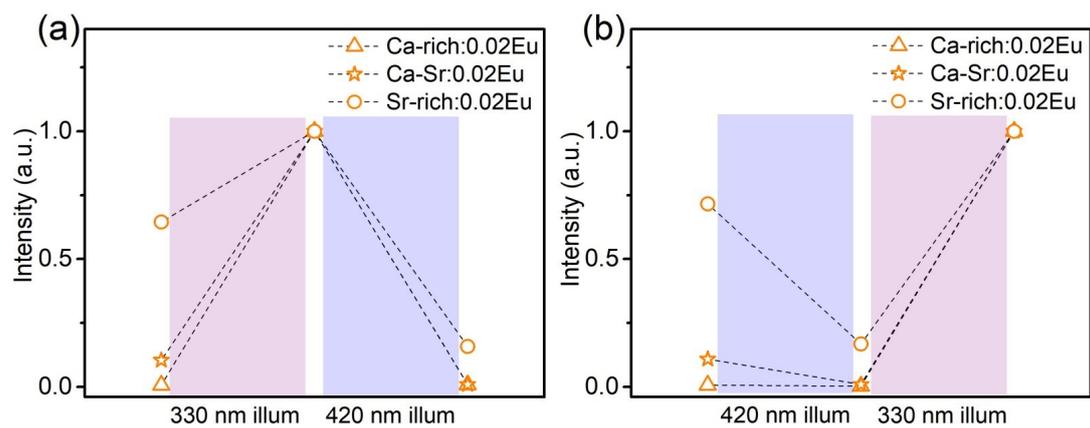


Figure S12 Variation of orange emission of the solid solution series under 420 nm LED excitation when illuminated in the sequence of (a) 330 nm then 420 nm or (b) 420 nm then 330 nm.