Supporting Information

Ce:(Lu,Sr)$_3$(Al,Si)$_5$O$_{12}$ transparent ceramics for high-power white LEDs/LDs with ultra-high luminance saturation threshold

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Table S1. Reports on commercial green phosphor material

Components	Color convertor	Central wavelength	Luminous efficiency(excited by LD)	Saturation threshold	Year	Reference
LuAG:Ce	PC	520 nm	216.9 lm/W	>19.75 W mm^{-2}	2021	1
LuAG:Ce/Al_2O_3	PC	510nm	283lm/W	>20.5 W mm^{-2}	2023	2
$Ba_{1.5}Lu_{1.5}Al_{3.5}Si_{1.5}O_{12}$:$Ce^{3+}$	PC	520 nm	/	/	2020	3
YLuAG:Ce	PC	519 nm	148 lm/W	/	2021	4
YAGG:Ce^{3+}	PIG	520nm	/	/	2021	5
LuAG:Ce-PiSG	PIG	510nm	/	13.4 W mm^{-2}	2022	6
β-Sialon:Eu^{2+}	PIG	540 nm	154 lm/W	2.7 W mm^{-2}	2021	7
LuAG:Ce	PIG	520 nm	225 lm/W	4.3 W mm^{-2}	2021	8
LuAG:Ce	PIF	520nm	/	21 W mm^{-2}	2022	9
β-Sialon:Eu^{2+}	PIF	520nm	/	15.49 W mm^{-2}	2022	10
YAGG:Ce^{3+}	PIF	530 nm	230 lm/W	39 W mm^{-2}	2019	11
γ-AlON: Mn^{2+},Mg^{2+}	phosphor	510 nm	/	/	2019	12
$CaY_2ZrGaAl_3O_{12}$:Ce^{3+}	phosphor	514 nm	/	/	2023	13
Sr[Be_6ON_4]:Eu^{2+}	phosphor	500 nm	/	/	2018	14
$Ba_9Sc_2Si_6O_{24}$:Eu^{2+}	phosphor	508 nm	/	/	2009	15

* PC：phosphor ceramic, PIG：phosphor-in-glass, PIF: phosphor-in-glass film

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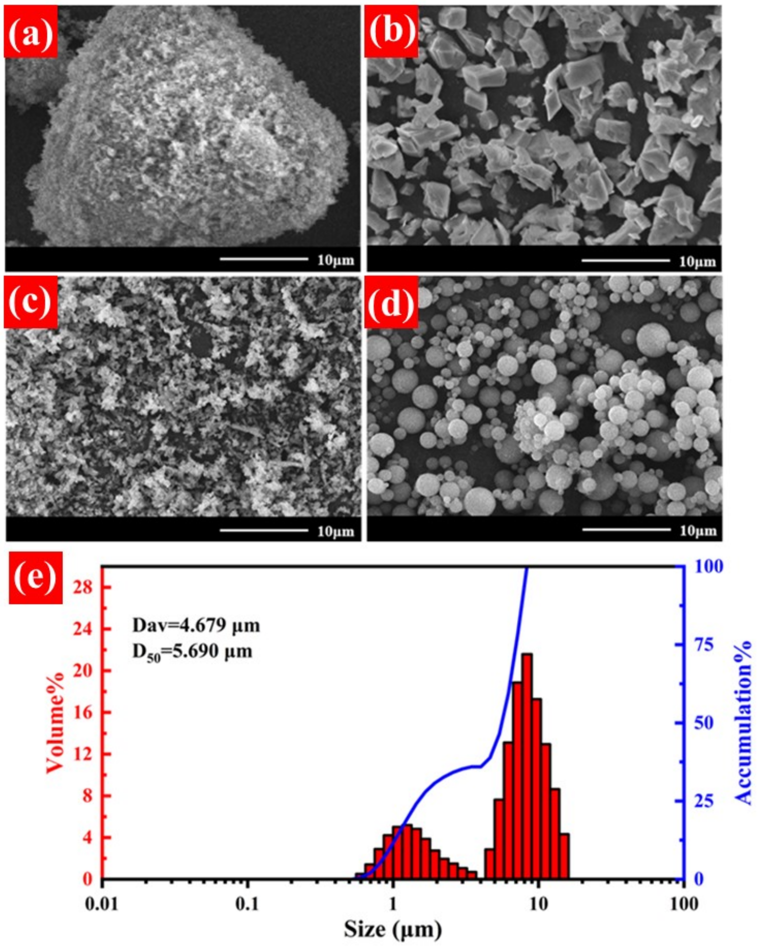

Fig. S1 SEM images of raw material powders: (a) Al_2O_3, (b) Lu_2O_3, (c) $SrCO_3$, (d) SiO_2. (e) Particle size distribution of Sr05 precursor powders

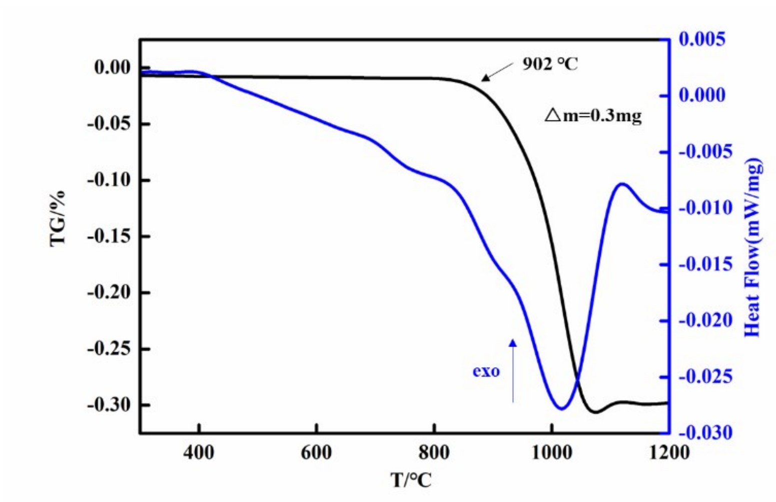

Fig. S2 TG/DSC curves of $SrCO_3$ powders

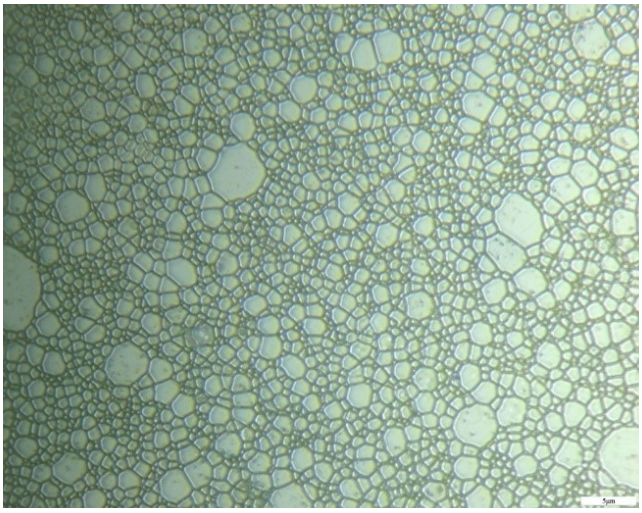

Fig. S3 Optical microscope image of Sr05 TC

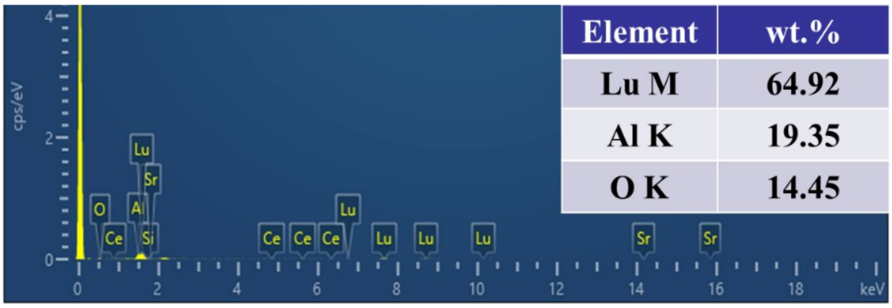

Fig. S4 EDS elemental mapping images of Sr05 TC

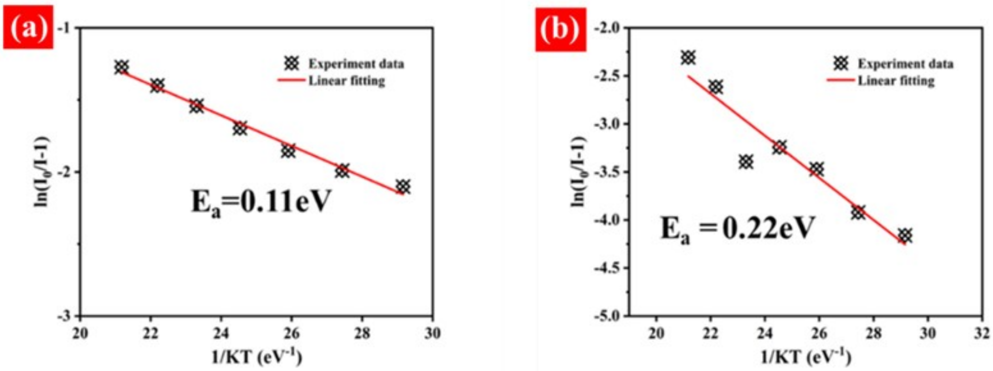

Fig. S5 The emission intensity and temperature Arrhenius fitting of (a) Sr00 and (b) Sr05 TC

$$I(T) = \frac{I_0}{1 + Cexp\left(\frac{-\Delta E}{KT}\right)} \qquad Eq.S1$$

where I_0 and I_T represent the emission intensity at room temperature (RT) and operating temperature respectively, C is a constant and K is boltzmann constant (8.617×10^{-5} eV/K).

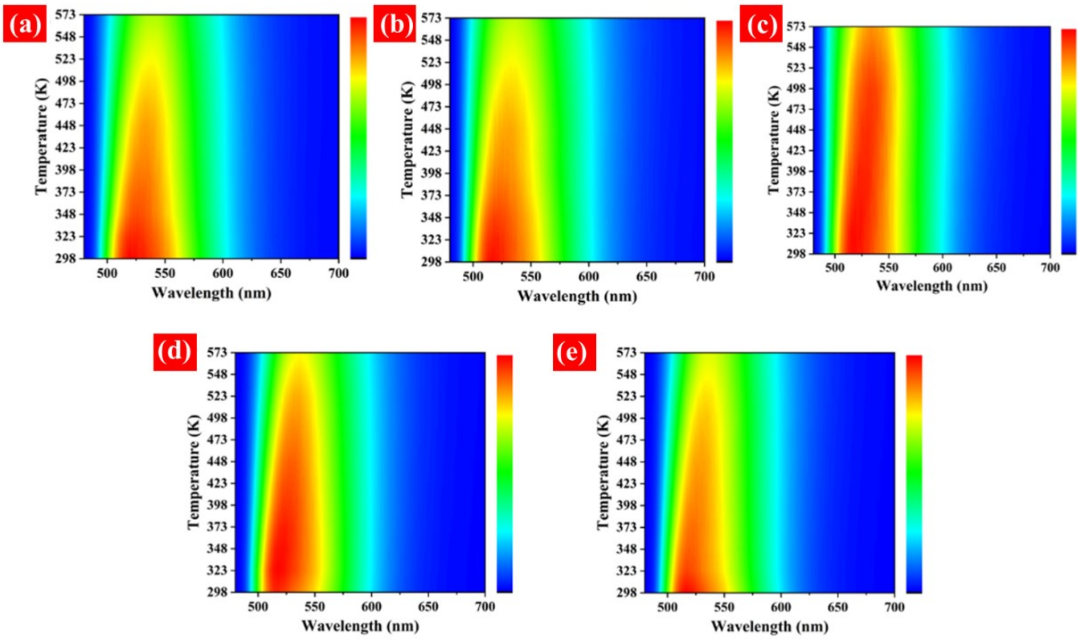

Fig. S6 Temperature-dependent PL spectra of (a) Sr00, (b) Sr025, (c) Sr05, (d) Sr075, (e) Sr10 TC under 460 nm excitation in the temperature range of 298-573 K

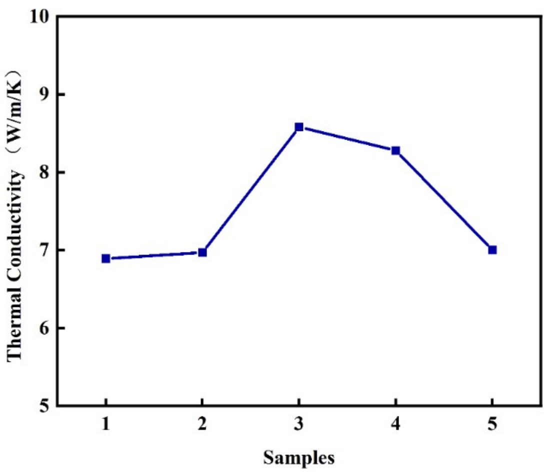

Fig. S7 Thermal conductivities of the Ce:LSASG at 50 ℃

Table S2 The detailed CCT and CRI values of Ce: LSASG TCs

Sample	CRI	CCT
Sr00	48.5	5297
Sr025	47.7	5297
Sr05	48.1	5260
Sr075	47.3	5297
Sr10	46.1	5550

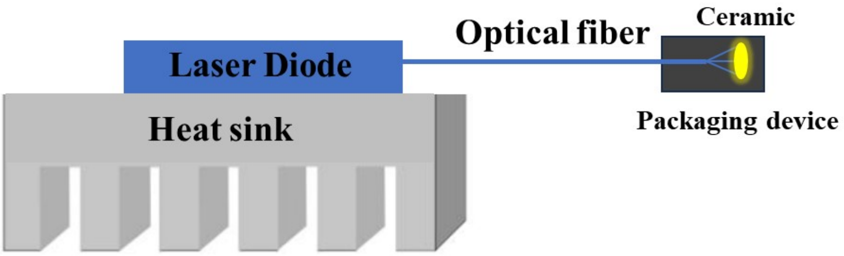

Fig. S8 A schematic of the designed white LD device

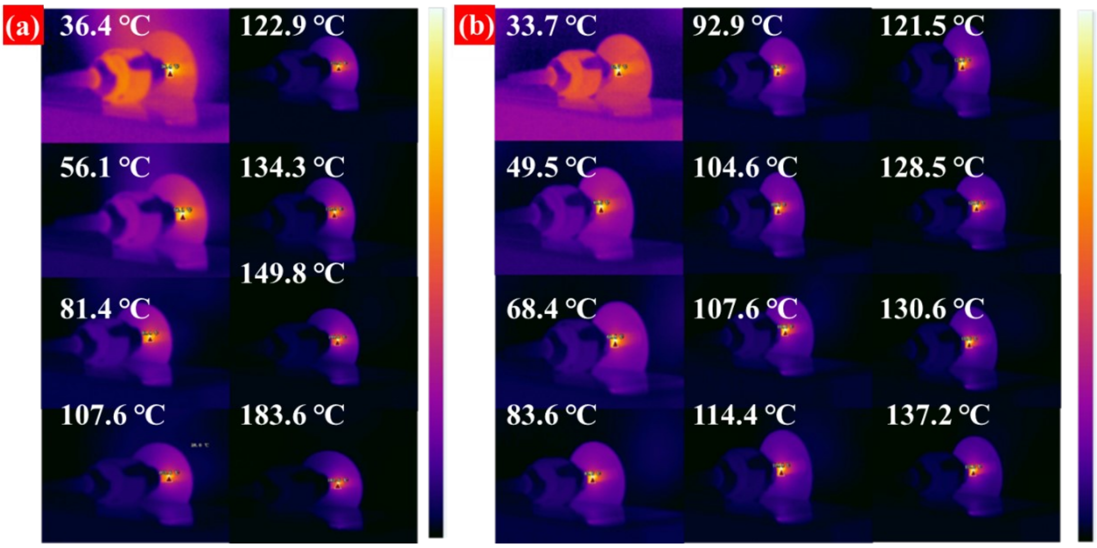

Fig. S9 Infrared thermal images and surface temperatures of (a) Sr05 and (b) Sr10 TC based LDs

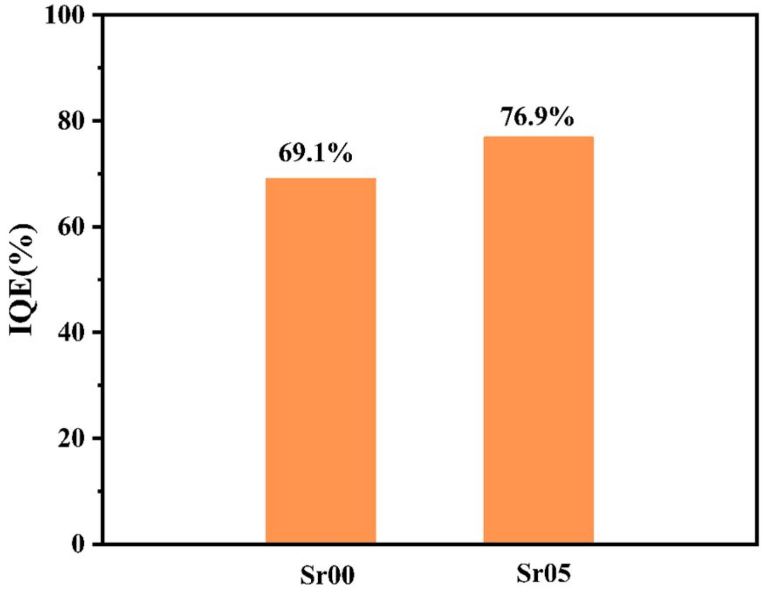

Fig.S10 IQE of Sr00 and Sr05 TCs

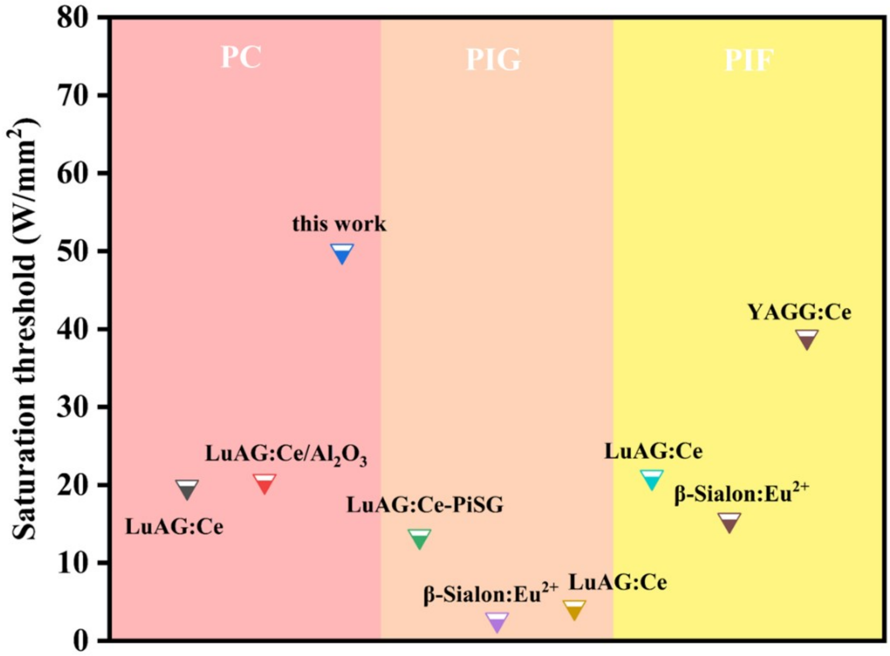

Fig. S11 The summarize of reported Saturation threshold of white LD source based on single structured phosphor ceramics