Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

The Unique Luminescent Properties and Enhanced Thermal Stability of A Novel All-Inorganic Perovskite $CsCaCl_3:Mn^{2+}$ for Solid-state Lighting Application

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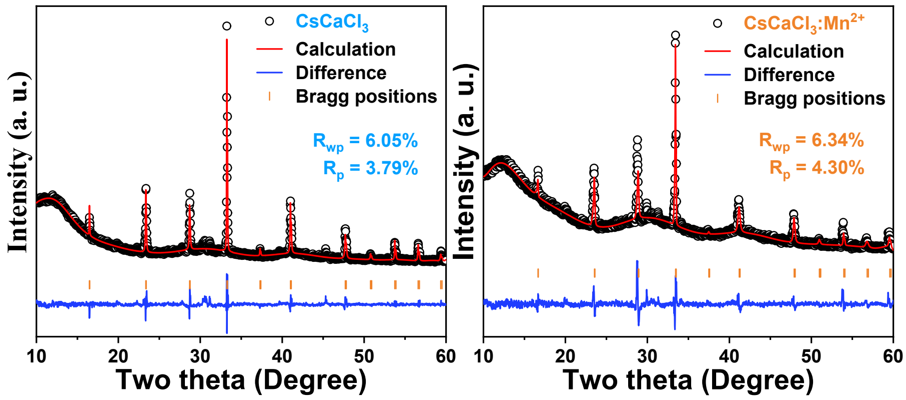

Figure S1. Rietveld refinement plots of the XRD patterns and experimental XRD patterns of $CsCaCl_3$ and $CsCaCl_3$:Mn^{2+}.

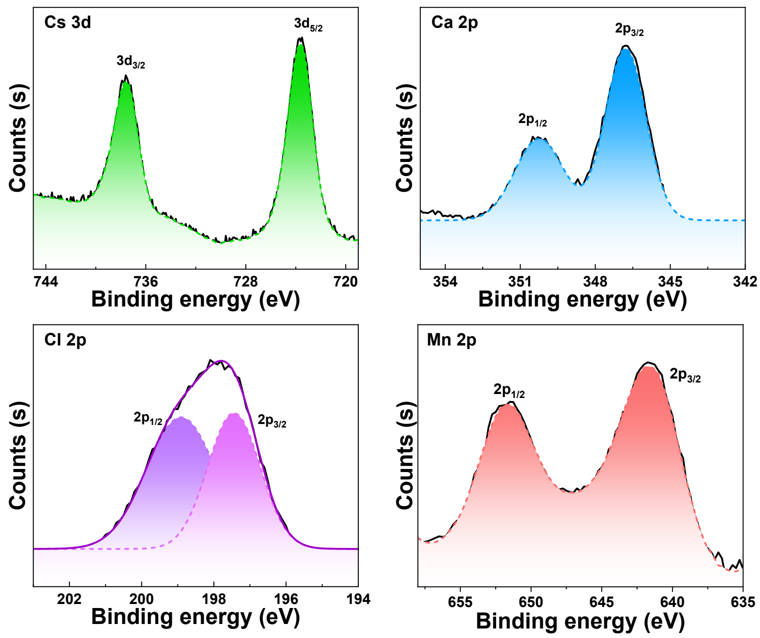

Figure S2. The high-resolution XPS of Cs, Ca, Cl, and Mn element in $CsCaCl_3$:Mn^{2+}.

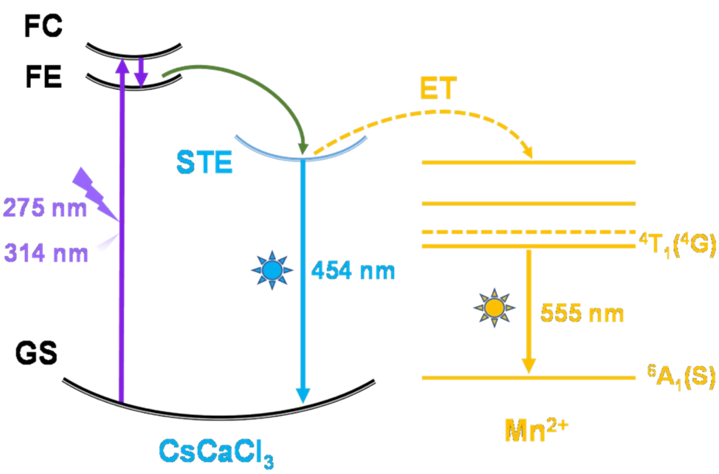

Figure S3. Schematic diagram illustrating the energy transfer mechanism from STE to Mn^{2+} in $CsCaCl_3$:Mn^{2+}.(GS: ground state; FE: free excitons state; FC: free carrier state)

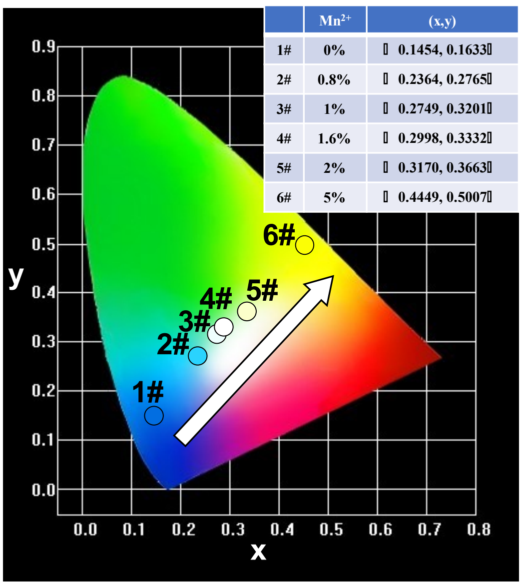

Figure S4. The chromaticity coordinates diagram of $CsCaCl_3$:$x$$Mn^{2+}$ (x = 0%, 0.8%, 1%, 1.6%, 2%, and 5%).

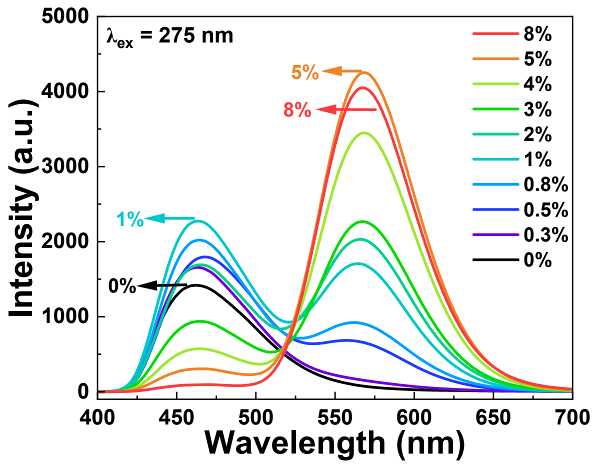

Figure S5. Emission spectra (λ_{ex} = 275 nm) of $CsCaCl_3$:$x$$Mn^{2+}$ varied with x value.

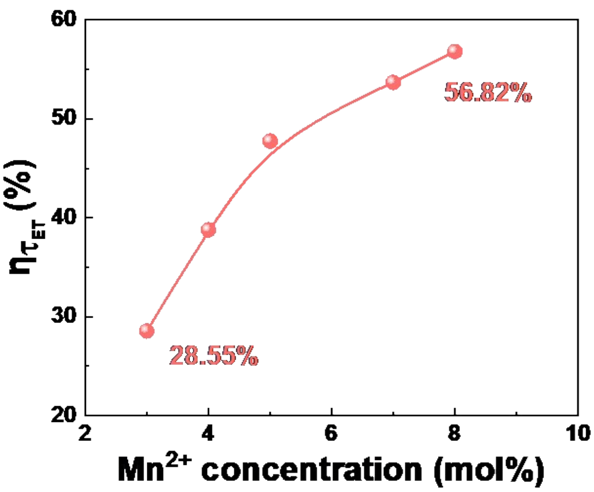

Figure S6. Dependence of the energy transfer efficiency from STE to Mn^{2+} on the concentration of Mn^{2+}.

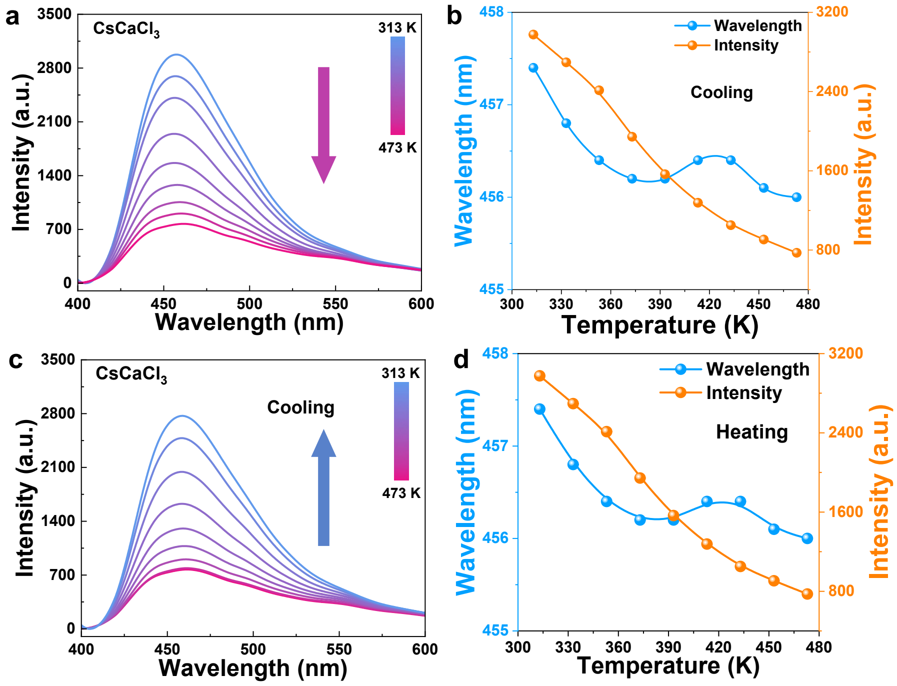

Figure S7. (a, c) Temperature-dependent PL emission spectra, and (b, d) Emission wavelength and intensity of $CsCaCl_3$ as a function of measurement temperature (a,b) heating and (c,d) cooling processes, respectively.

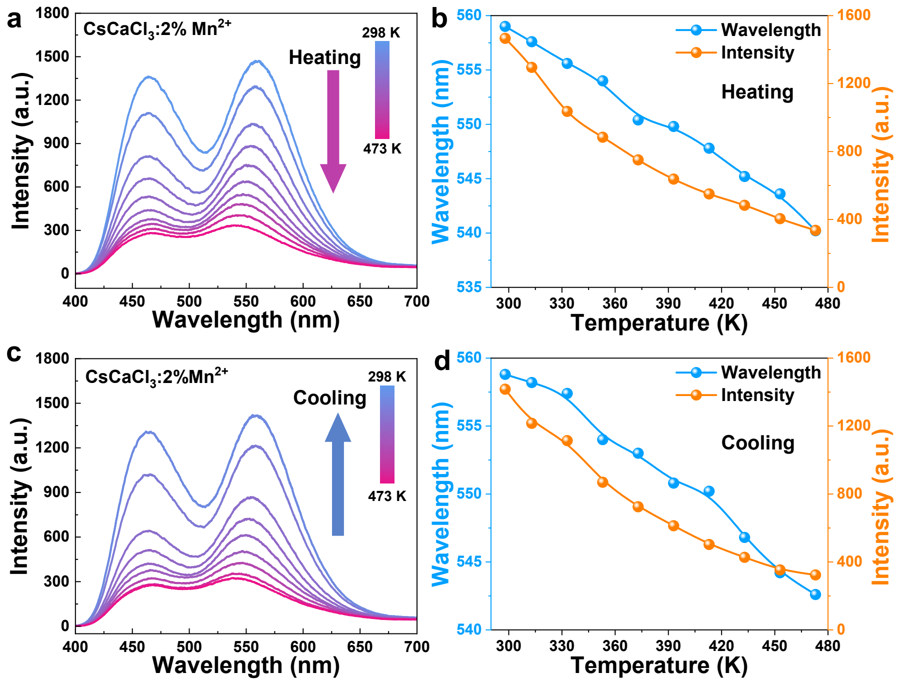

Figure S8. (a, c) Temperature-dependent PL emission spectra, and (b, d) Emission wavelength and intensity of Mn^{2+} emission in $CsCaCl_3$:2%Mn^{2+} as a function of measurement temperature (a,b) heating and (c,d), respectively.

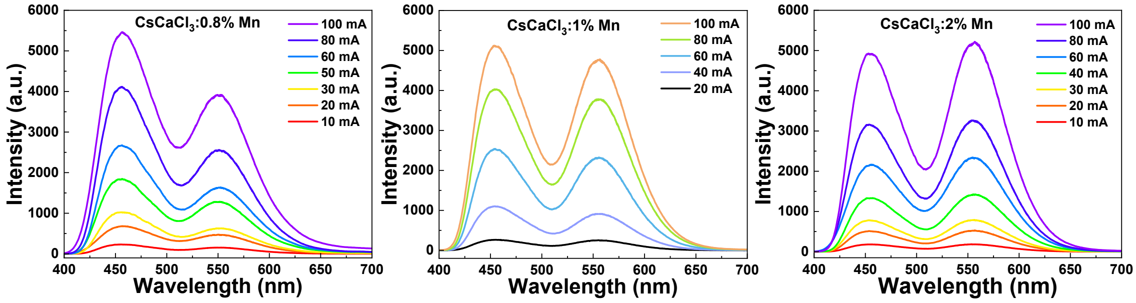

Figure S9. EL spectra of WLEDs fabricated with the $CsCaCl_3$:xMn^{2+} (x = 0.8%, 1%, 2%) measured on various working currents.

Table S1. Recently reported the Debye temperatures of all-inorganic metal halide perovskite materials

Compounds	Debye temperatures (K)	Refs
Rb_4CdCl_6	154.0	[29]
$KCaF_3$	367.3	[39]
$CsPbCl_3$	225.4	[40]
$RbCaF_3$	270.0	[41]
Rb_2TeCl_6	235.2	[42]
K_2LiAlF_6	267.0	[43]
$FAPbBr_3$	205.0	[44]
$CsCaCl_3$	233.7	This work
$CsCaCl_3$:Mn^{2+}	227.7	This work

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