

Supporting Information

Color manipulation of intense multi-luminescence from Ca-ZnOS:Mn²⁺ by Mn²⁺ concentration effect

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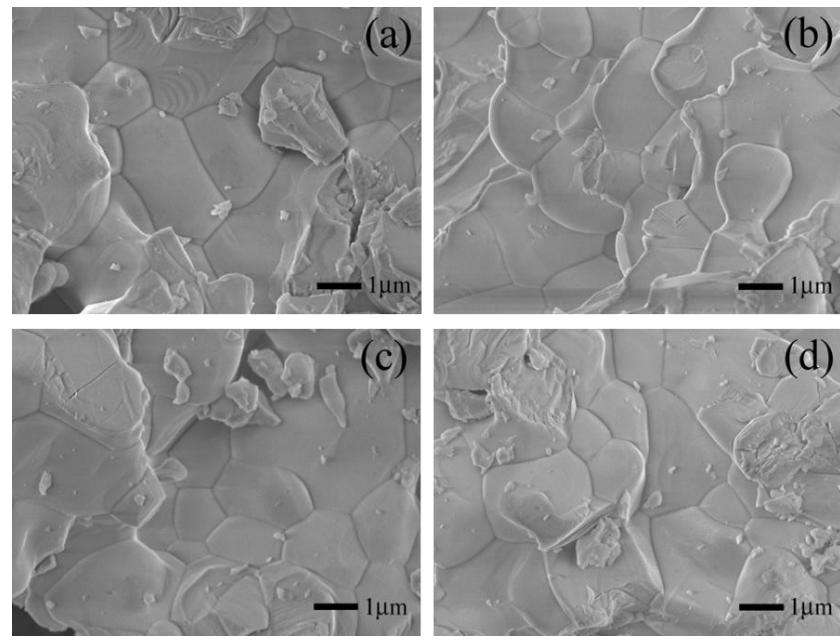


Figure S1. FESEM images of $\text{CaZn}_{1-x}\text{Mn}_x\text{OS}$ pellets: (a) $x = 0$; (b) $x = 0.02$; (c) $x = 0.04$; (d) $x = 0.1$.

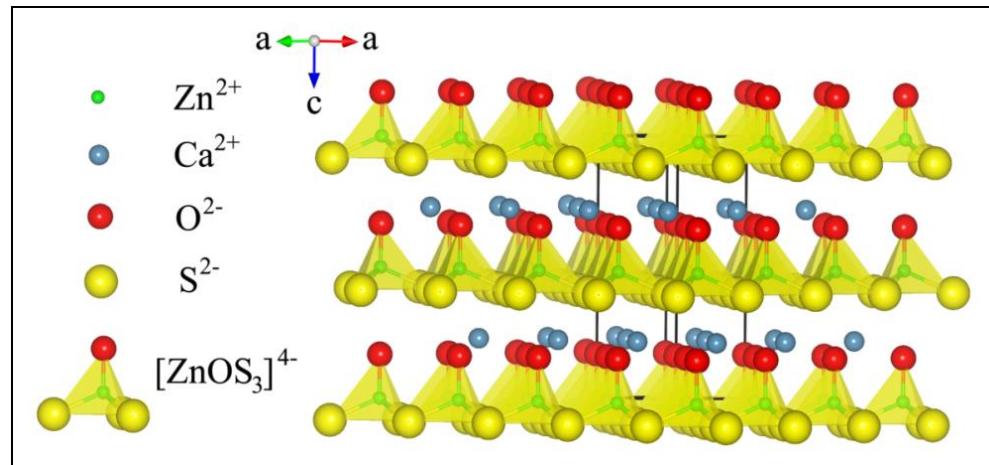


Figure S2. Crystal structure of CaZnOS .

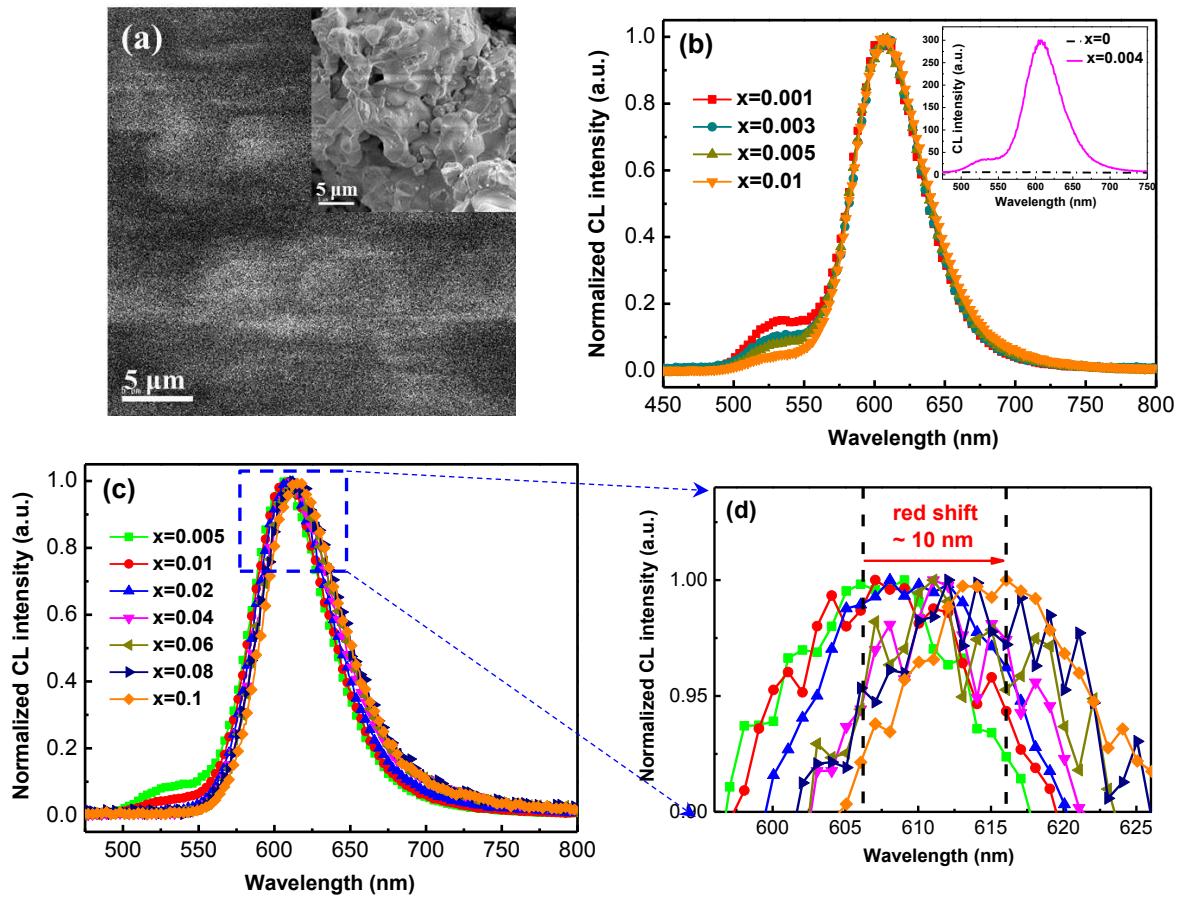


Figure S3. Color manipulation of CL from CaZnOS:Mn by Mn²⁺ concentration effect. (a) FESEM-CL image of CaZn_{1-x}Mn_xOS ($x = 0.004$). Inset is FESEM image. (b) Normalized CL spectra of CaZn_{1-x}Mn_xOS ($x = 0.001, 0.003, 0.005$, and 0.01). Inset shows CL spectra of CaZn_{1-x}Mn_xOS ($x = 0$ and 0.004). (c) Normalized CL spectra of CaZn_{1-x}Mn_xOS ($x = 0.005, 0.01, 0.02, 0.04, 0.06, 0.08$, and 0.1). (d) Enlarged CL spectra, showing the red shift.

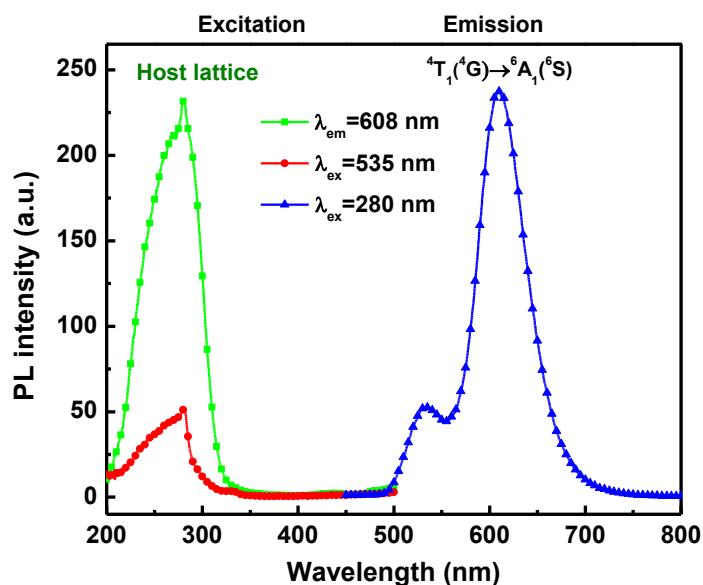


Figure S4. PL excitation and emission spectra of $\text{CaZn}_{1-x}\text{Mn}_x\text{OS}$ ($x = 0.002$).

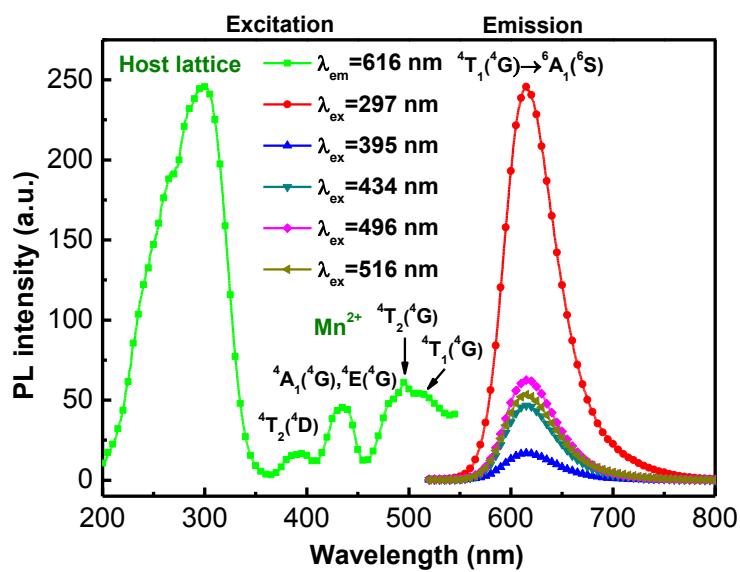


Figure S5. PL excitation and emission spectra of $\text{CaZn}_{1-x}\text{Mn}_x\text{OS}$ ($x = 0.04$).

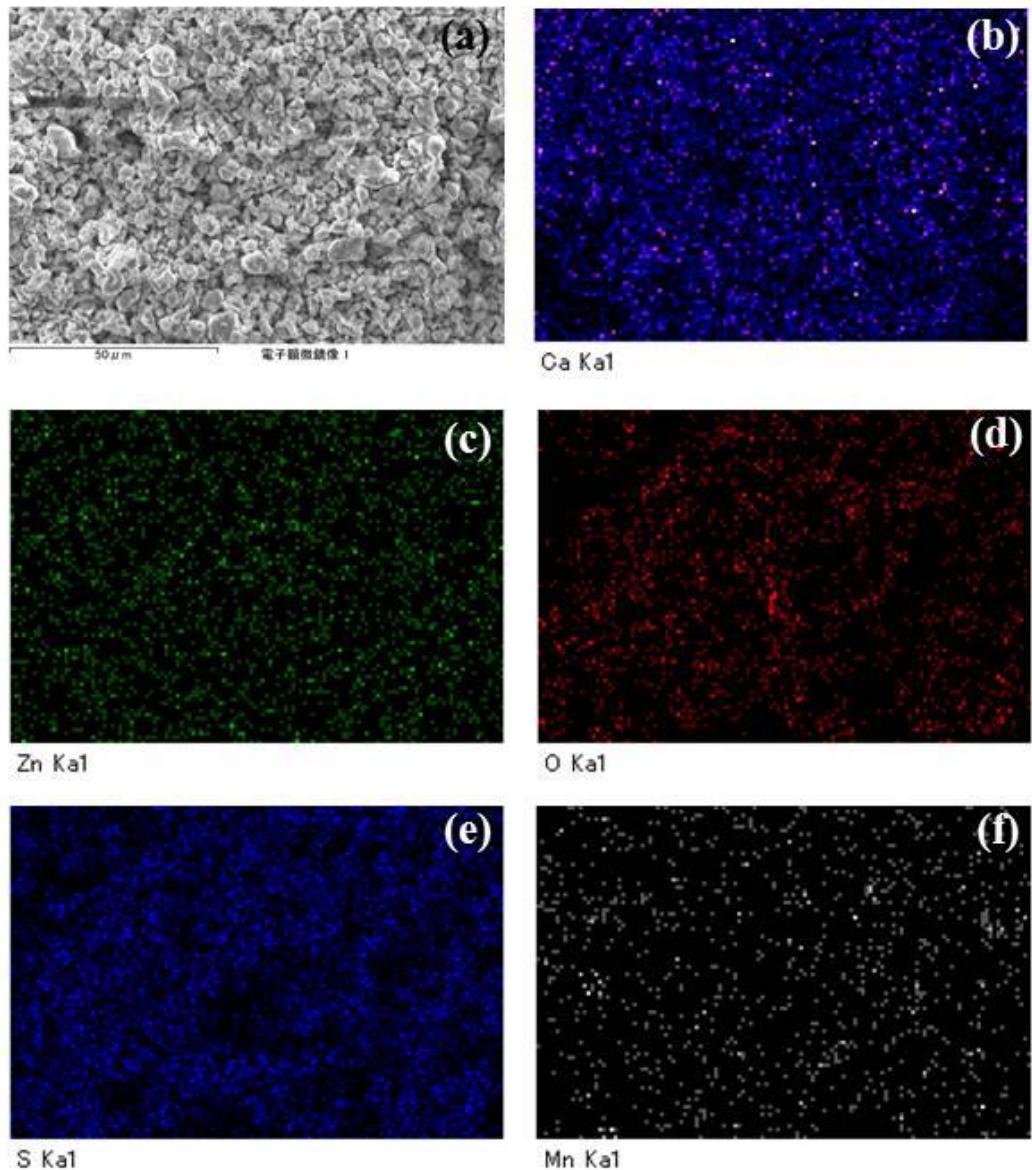


Figure S6. (a) FESEM image of sintered $\text{CaZn}_{1-x}\text{Mn}_x\text{OS}$ ($x = 0.1$). (b)-(f) Different elemental distribution mappings.

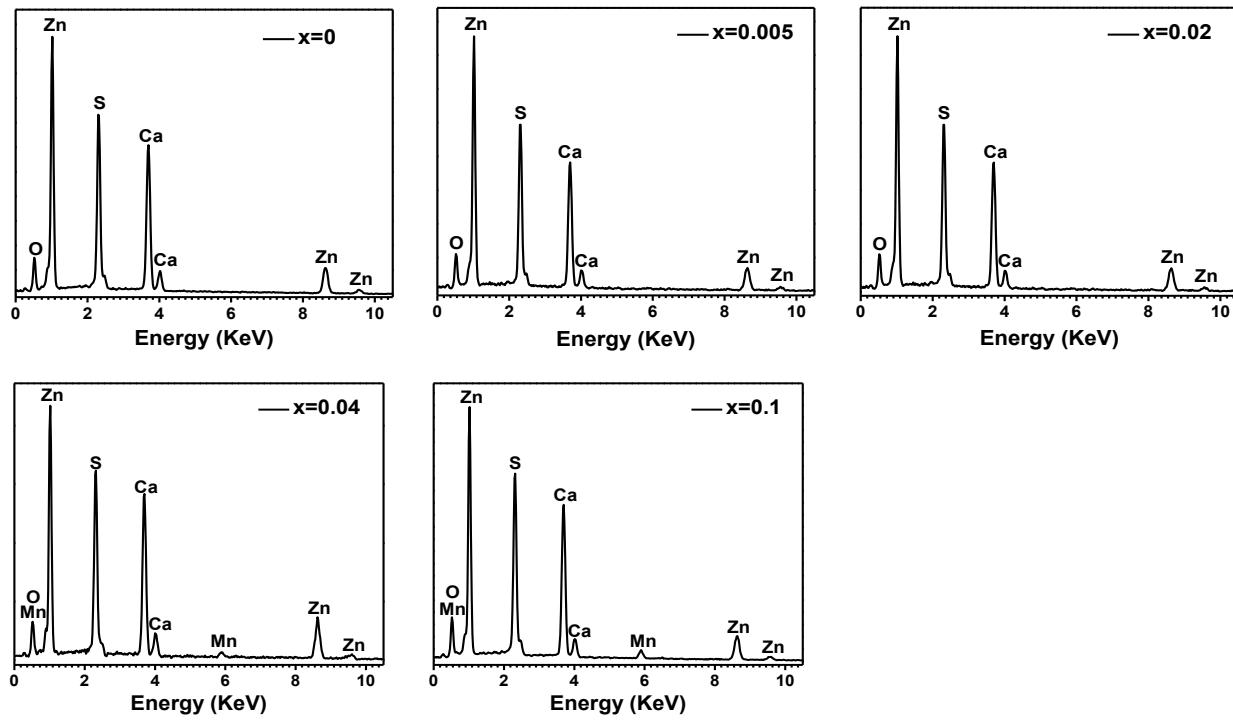


Figure S7. EDS spectra of $\text{CaZn}_{1-x}\text{Mn}_x\text{OS}$ ($x = 0, 0.005, 0.02, 0.04$, and 0.1).

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-Supporting Information-

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Video S1. Intense Tribo-ML from CaZnOS:Mn²⁺ with 3 mol% Mn²⁺.

The discrete tribo-ML trail during the manual friction in Video S1 was ascribed to the nonuniformity of the samples. The oscillating Tribo-ML phenomena were also observed in other Tribo-ML measurements.^{1,2}

References

- (1) Matsui H.; Xu C. N.; Liu Y.; Tateyama H. Origin of mechanoluminescence from Mn-activated ZnAl₂O₄: Triboelectricity-induced electroluminescence. *Phys. Rev. B* **2004**, *69*, 235109.
- (2) Fu X.; Yamada H.; Xu C. N. Property of highly oriented SrAl₂O₄:Eu film on quartz glass substrates and its potential application in stress sensor. *J. Electrochem. Soc.* **2009**, *156*, J249.