

Trap-regulated highly efficient mechanoluminescence and persistent mechanoluminescence of $\text{Ca}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$

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1. Fabrication of ML composites

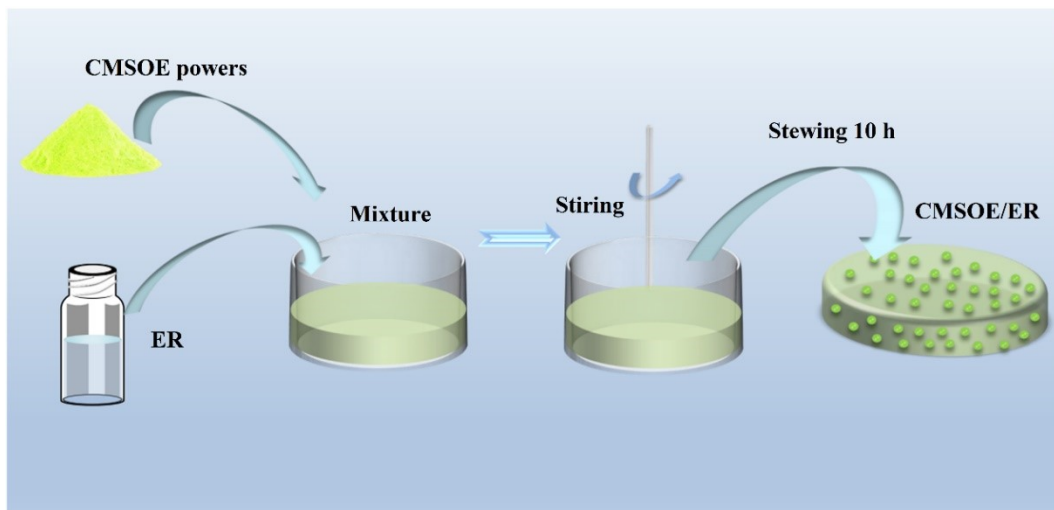


Figure S1. Schematic diagram of the preparation processes of CMSE/ER composites.

2. Trap structure evolution

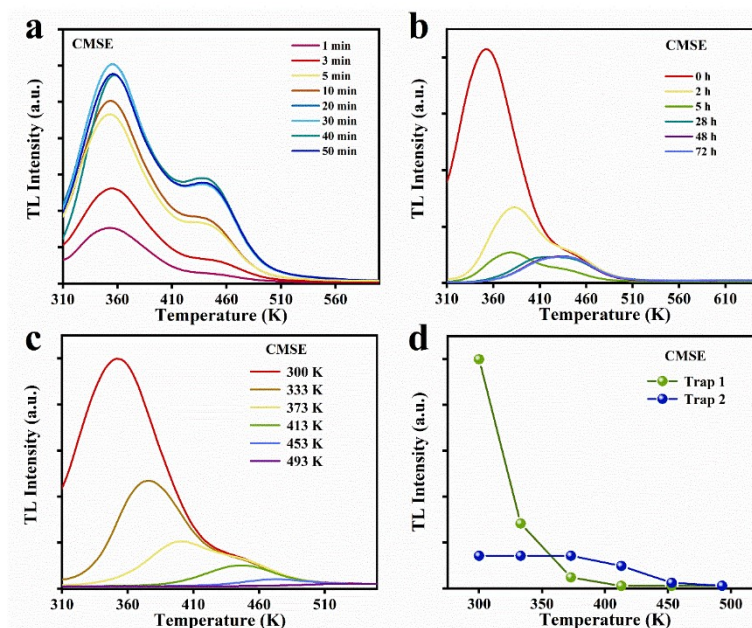


Figure S2. (a) TL spectra of CMSE after different charging times; (b) TL spectra of CMSE which was pre-charged for 1 min and then placed in darkness for various times; (c) TL spectra of CMSE after 1 min pre-charging and treated at various temperature for 10 min. (d) Corresponding TL intensity variations of CMSE in (c).

3. High temperature LPL

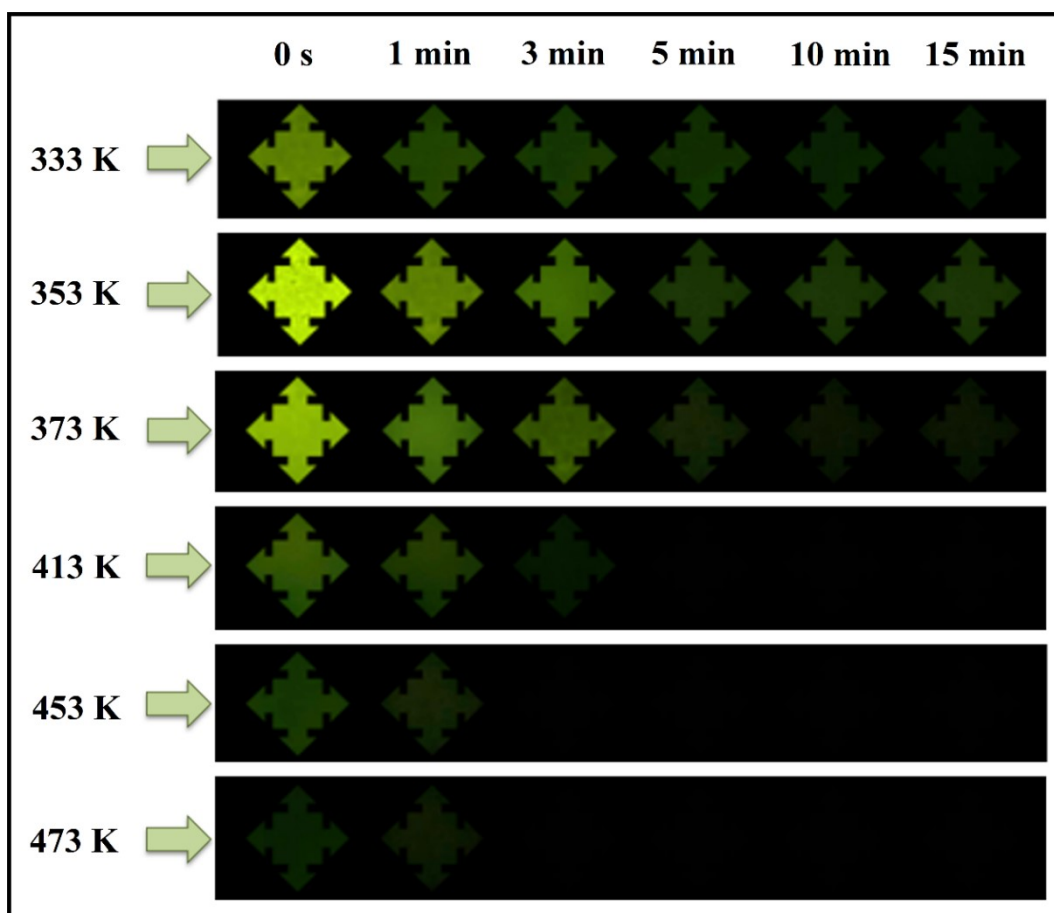


Figure S3. Optical photos of afterglow attenuation at different temperature (333 K, 353 K, 373 K, 413 K, 453 K, 473 K). The samples were pre-charged by 254 nm and 365 nm light for 1 min.

4. Cyclic ML performance

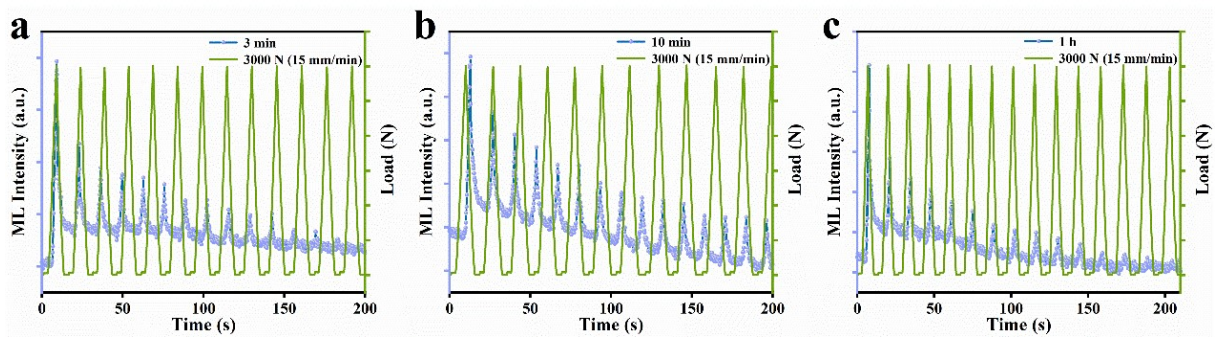


Figure S4. The ML intensity variations under cyclic compression conditions of the samples after pre-irradiated for various time: (a) 3 min; (b) 10 min; (c) 1 h.

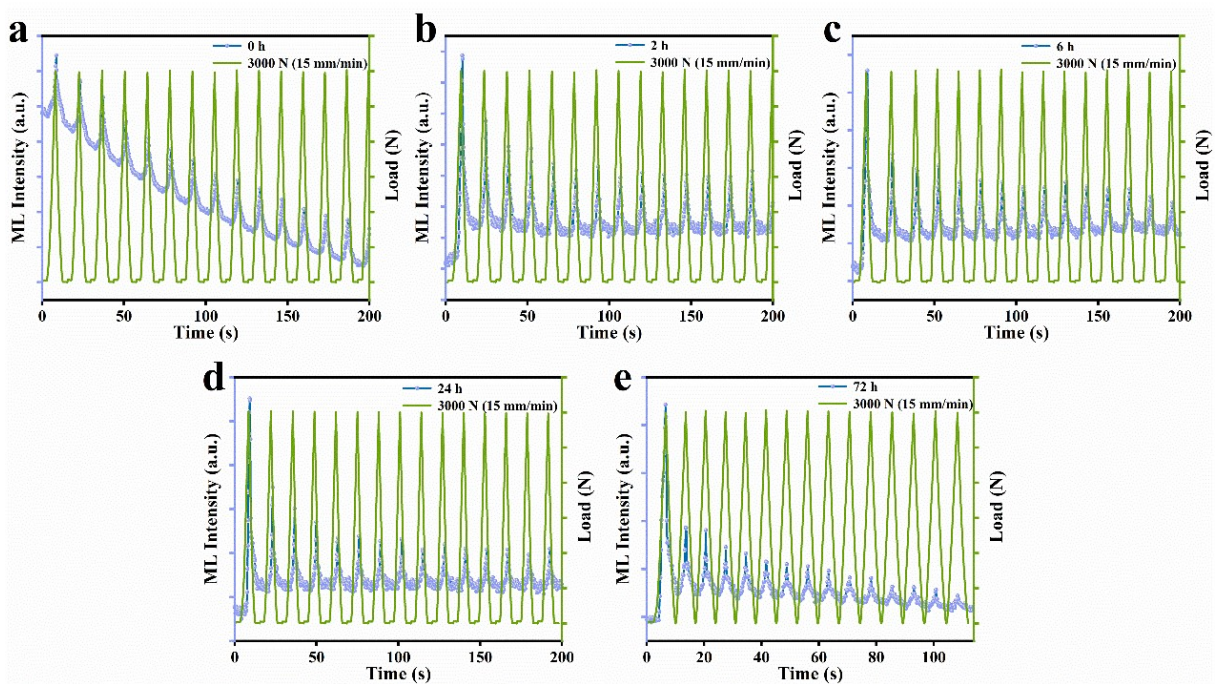


Figure S5. The ML intensity variations under cyclic compression conditions of the samples after placed in dark for various durations: (a) 0 h; (b) 2 h; (c) 6 h; (d) 24 h; (e) 72 h.

5. Characterizations of CMSEH

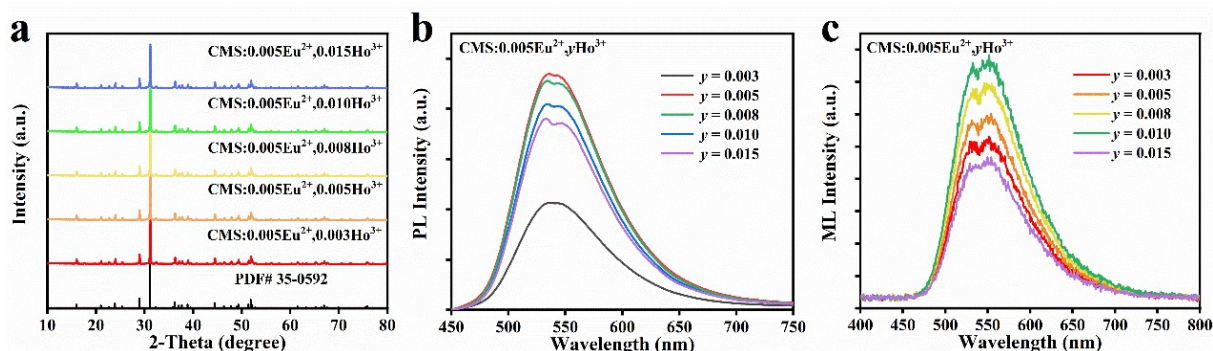


Figure S6. (a) XRD patterns of $\text{Ca}_{1.995-y}\text{MgSi}_2\text{O}_7:0.005\text{Eu}^{2+}, y\text{Ho}^{3+}$ ($y = 0.003, 0.005, 0.008, 0.01, 0.015$) samples; (b) PL spectra of $\text{Ca}_{1.995-y}\text{MgSi}_2\text{O}_7:0.005\text{Eu}^{2+}, y\text{Ho}^{3+}$ ($y = 0.003, 0.005, 0.008, 0.01, 0.015$) excited by 397 nm; (c) ML spectra of $\text{Ca}_{1.995-y}\text{MgSi}_2\text{O}_7:0.005\text{Eu}^{2+}, y\text{Ho}^{3+}$ ($y = 0.003, 0.005, 0.008, 0.01, 0.015$) under friction (load: 10 N, rotation speed: 1000 rpm).

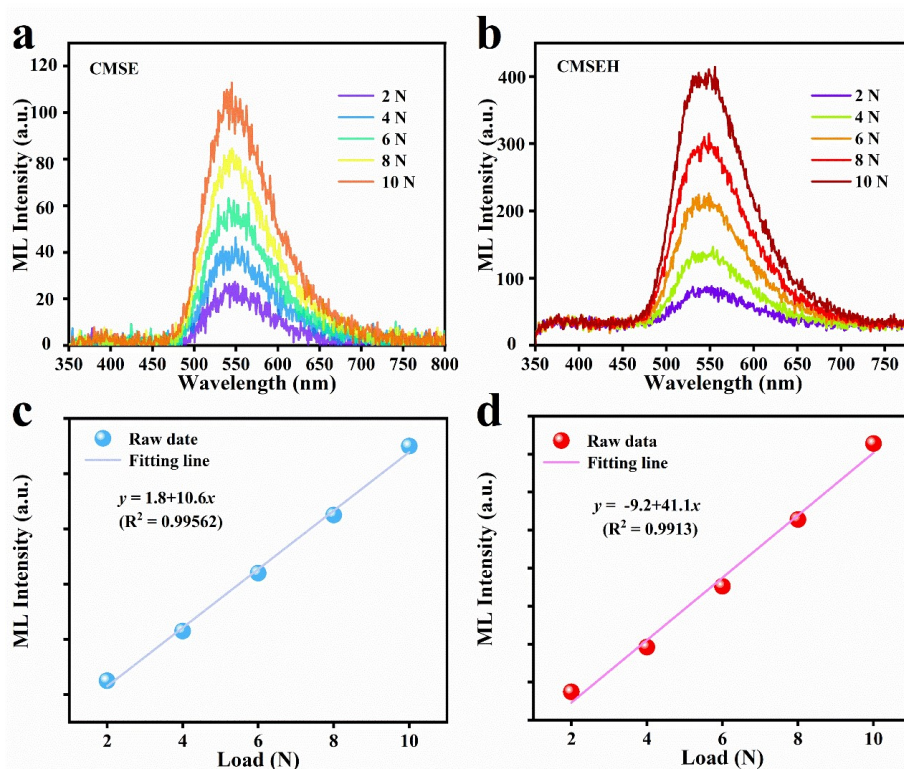


Figure S7. ML spectra of (a) CMSE/ER and (b) CMSEH/ER under different loads; Relationship between the ML intensity and applied load in (c) CMSE/ER and (d) CMSEH/ER.