

Supporting Information

Polaronic Magnetic Excitons and Photoluminescence in Mn^{2+} -Doped CsCdBr_3 Metal Halide

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Table S1. Elements content of $x\%$ Mn:CsCdBr₃ from the quantitative analysis of EDS data.

$x\%$ Mn:CsCdBr ₃	Cs (At %)	Cd (At %)	Mn (At %)	Br (At %)	Mn/(Cd+Mn)
x=0	22.33	19.87	0	57.80	0%
x=5	22.94	18.39	0.93	57.75	5%
x=10	23.25	18.05	1.99	56.71	10%
x=13	23.31	17.03	2.20	57.47	11%
x=15	22.92	17.18	2.64	57.27	13%
x=30	22.75	13.07	6.09	58.09	32%

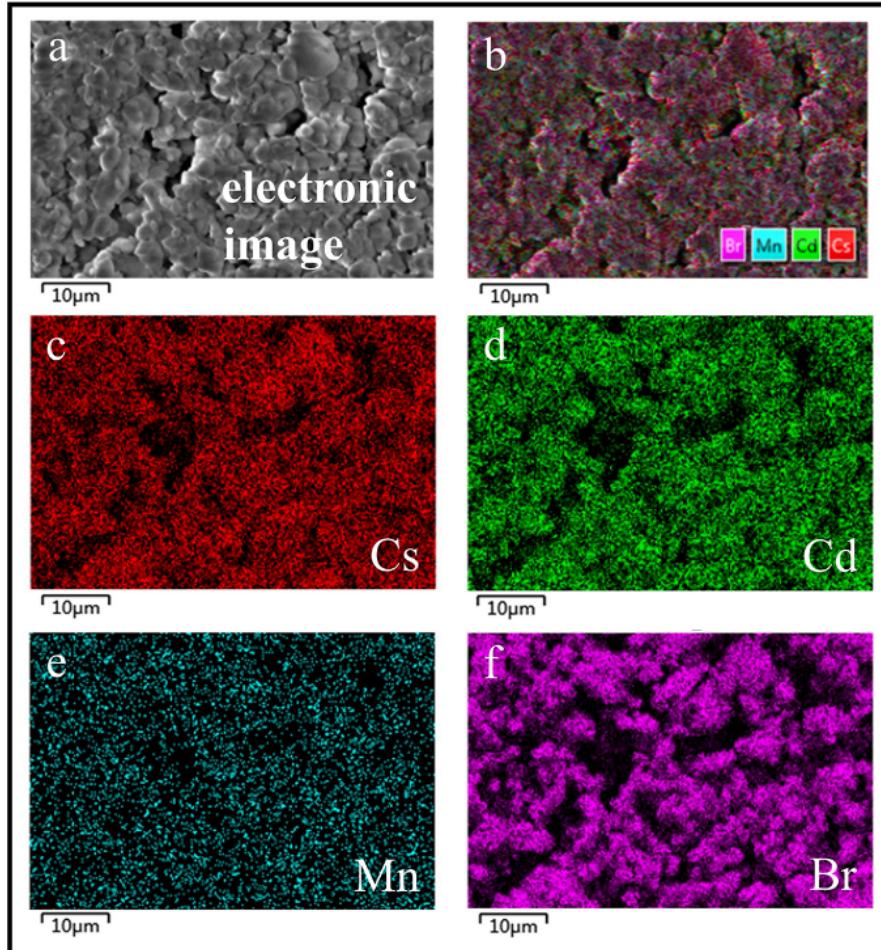


Figure S1. SEM image of 13%Mn:CsCdBr₃ and corresponding EDS mappings of Cs (c), Cd (d), Mn (e), and Br (f) elements.

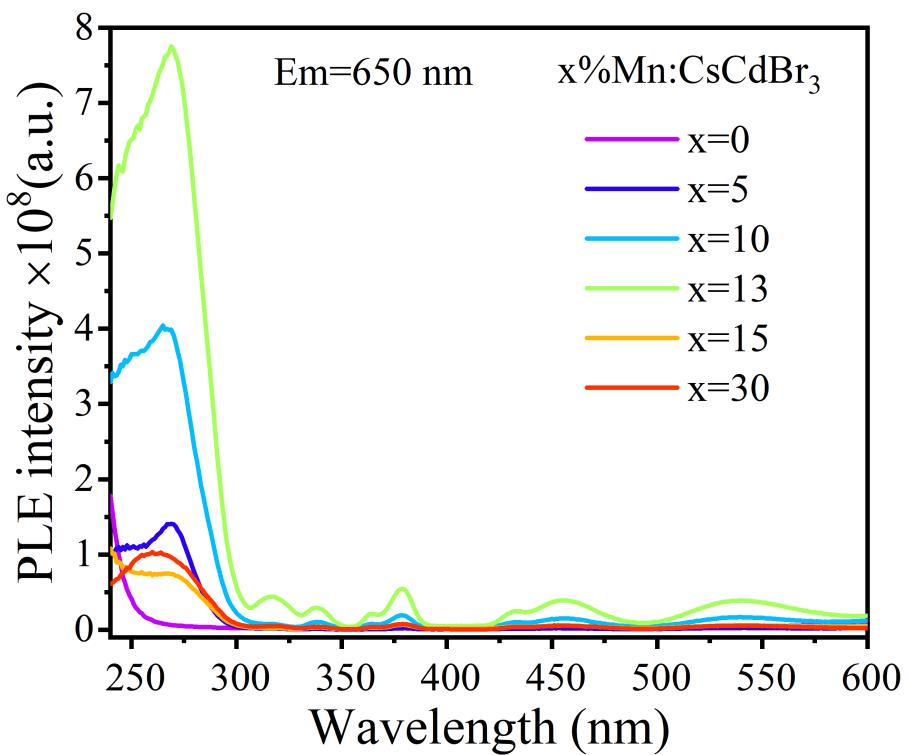


Figure S2. PLE spectra of $x\%$ Mn:CsCdBr₃, the emission wavelength is 650 nm.

Table S2. When λ_{ex} is 276 nm, λ_{em} , FWHM, PLQY, τ_1 and τ_2 of x%Mn:CsCdBr₃ versus Mn²⁺ feed ratio x.

x%Mn:CsCdBr ₃	λ_{ex} [nm]	λ_{em} [nm]	FWHM [nm]	PLQY	τ_1 [ms]	τ_2 [ms]
x=0	276	630	-	1.02%	-	-
x=5	276	652	90	3.32%	0.46 (65%)	3.58 (35%)
x=10	276	650	91	28.29%	0.36 (62%)	1.87 (38%)
x=13	276	650	92	54.42%	0.19 (52%)	1.22 (48%)
x=15	276	650	91	34.23%	0.12 (54%)	0.88 (46%)
x=30	276	652	90	15.21%	0.04 (60%)	0.86 (40%)

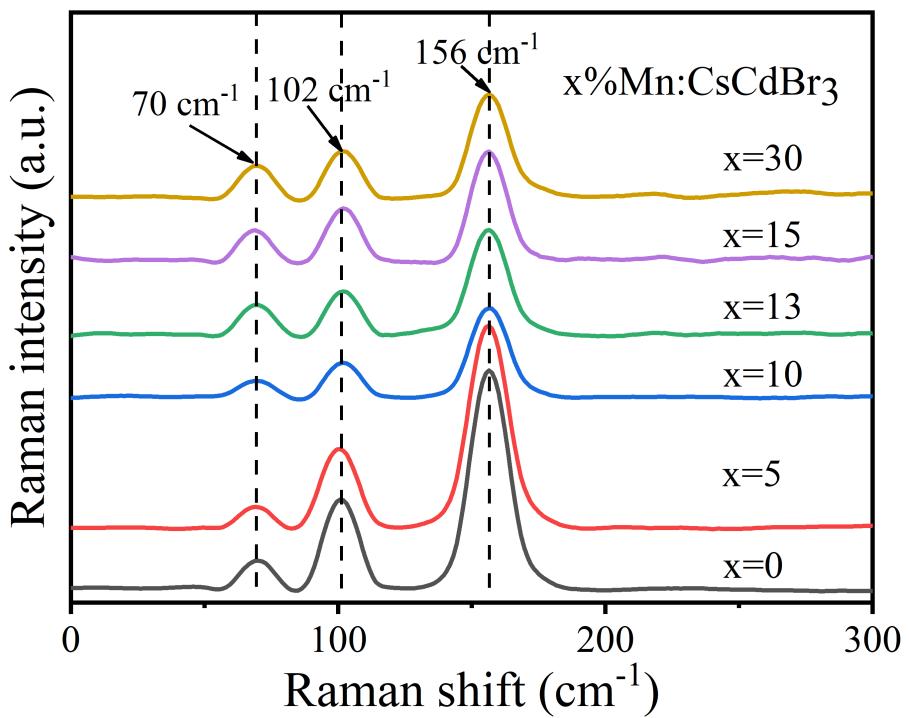


Figure S3. Raman spectra of $x\%$ Mn:CsCdBr₃, excited by 532 nm laser.

Table S3. The relative intensity of the Raman peak of $x\%$ Mn:CsCdBr₃.

<i>Intensity (a.u.)</i>	<i>Peak</i>	70 cm^{-1}	102 cm^{-1}	156 cm^{-1}
x value				
x=0		19	62	151
x=5		14	54	140
x=10		11	24	61
x=13		21	30	73
x=15		21	34	75
x=30		22	32	72

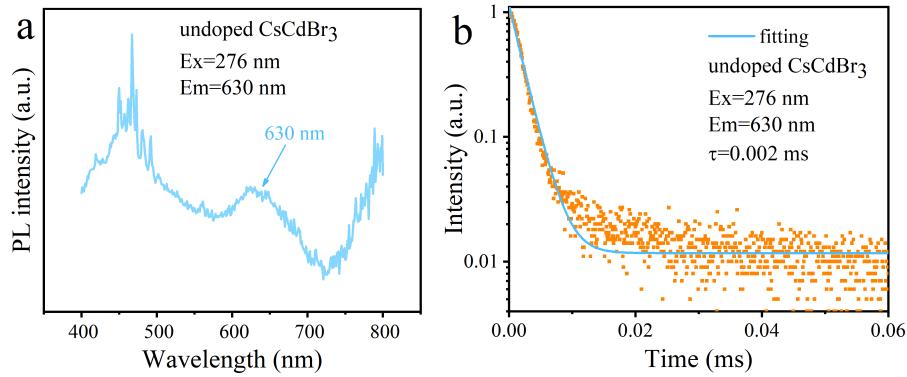


Figure S4. PL spectrum (a) and PL lifetime (b) of undoped CsCdBr₃.

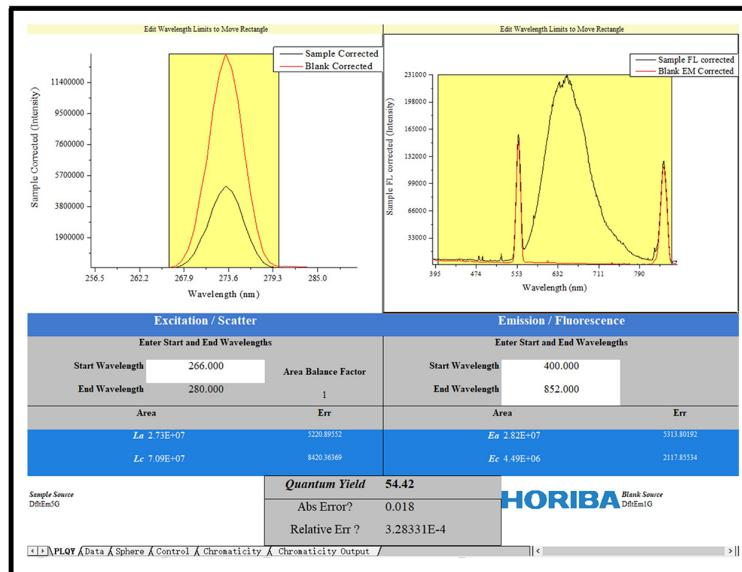


Figure S5. The PL emission quantum yield (QY) of sample 13%Mn:CsCdBr₃ is as high as 54.42%, excited by 276 nm. The black and red lines are the reference background and the emission of the sample, respectively.

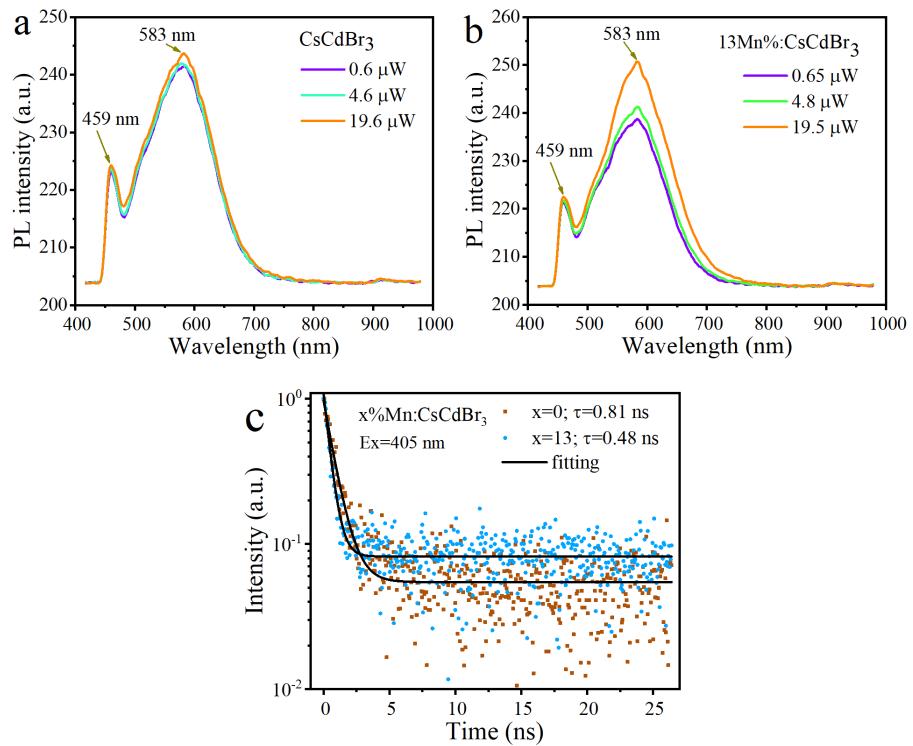


Figure S6. The power-dependent PL emissions of CsCdBr_3 (a) and 13%Mn:CsCdBr₃ (b) excited by 405 nm laser. c Time-resolved PL spectra excited by 405 nm laser.

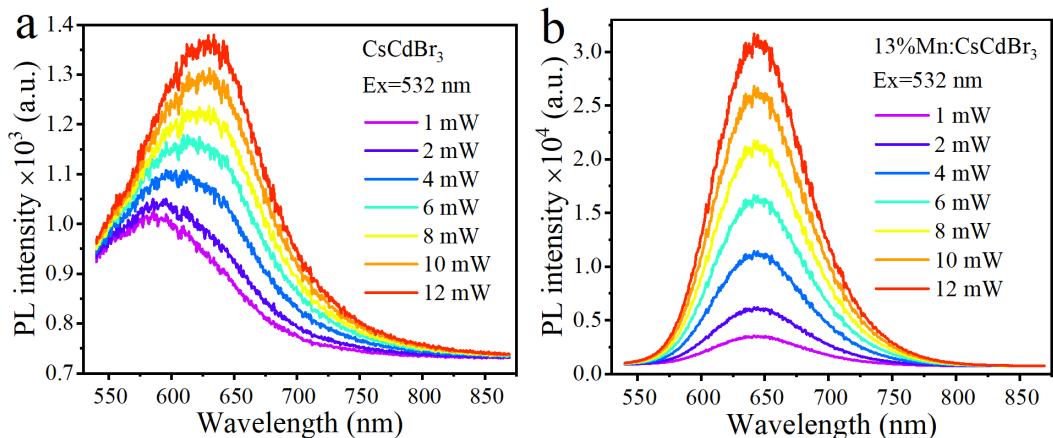


Figure S7. The power-dependent PL emissions of CsCdBr_3 (a) and 13%Mn:CsCdBr₃ (b) excited by 532 nm laser.

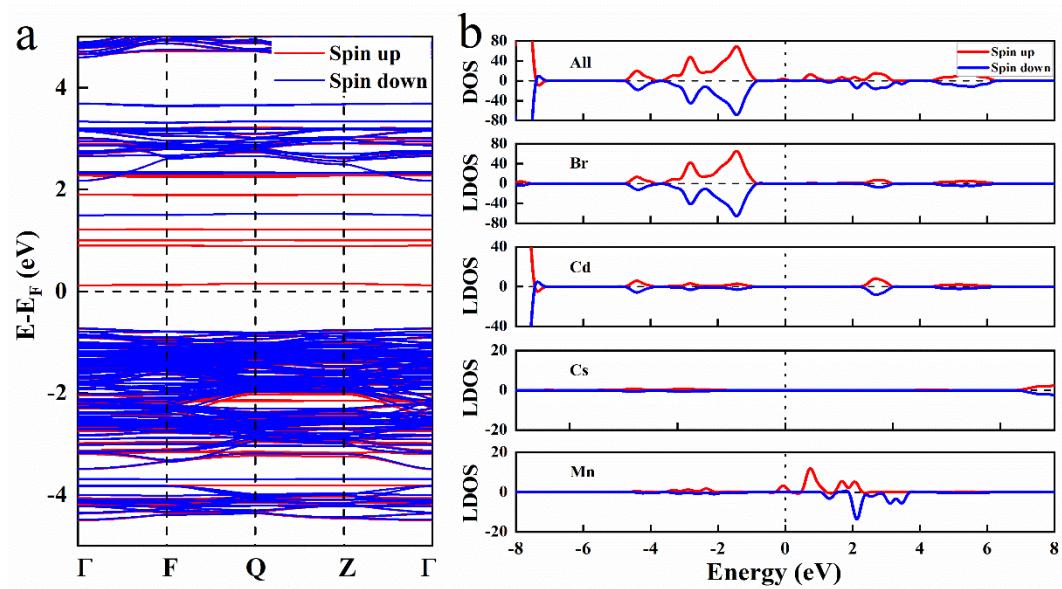


Figure S8. The energy band structure (a) and density of states (b) of $x\%$ Mn:CsCdBr₃.