

White light Emission in Bi³⁺/Mn²⁺ ions co-doped CsPbCl₃ Perovskite Nanocrystals

*He Shao^{a,b}, Xue Bai^{*a}, Haining Cui^b, Gencai Pan^a, Pengtao Jing^c, Songnan Qu^c,
Jinyang Zhu^b, Yue Zhai^a, Biao Dong^a, Hongwei Song^{*a}*

^a State key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, Changchun 130012, China.

Email: baix@jlu.edu.cn, songhw@jlu.edu.cn

^b College of Physics, Jilin University, Changchun 130012, China

^c State Key Laboratory of Luminescence and Applications, Changchun Institute of Optics Fine Mechanics and Physics Chinese Academy of Sciences 3888 Eastern South Lake Road, Changchun 130033, P. R. China.

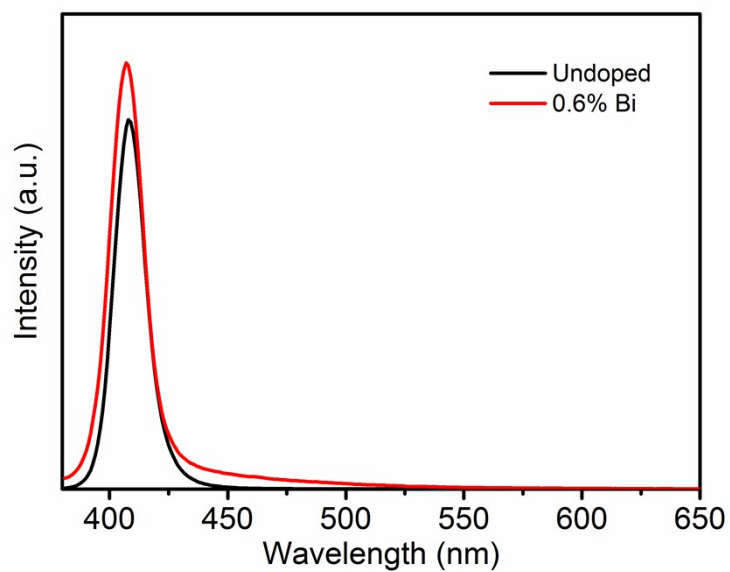


Fig S1. The emission spectra of 0.6% Bi³⁺ ions doped CsPbCl₃ NCs.

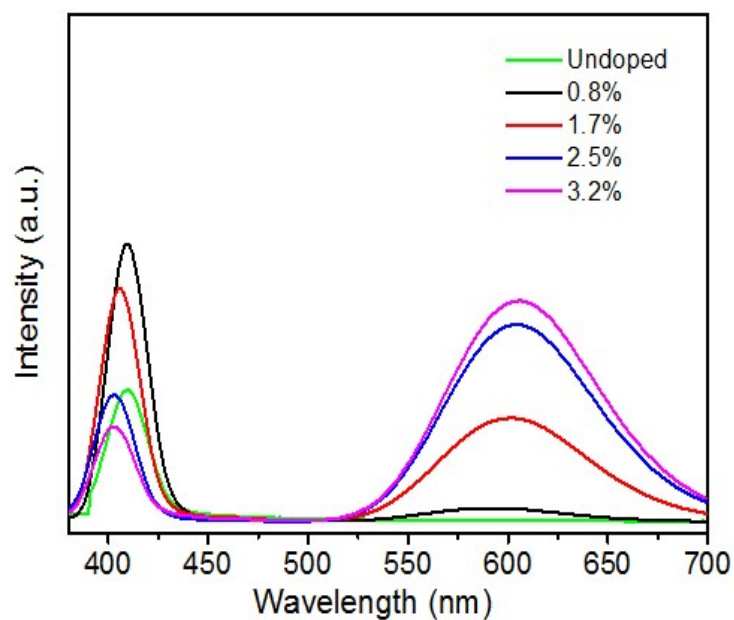


Fig S2. The emission spectra of Mn²⁺ ions doped CsPbCl₃ NCs with different doping concentrations under 365 nm excitation.

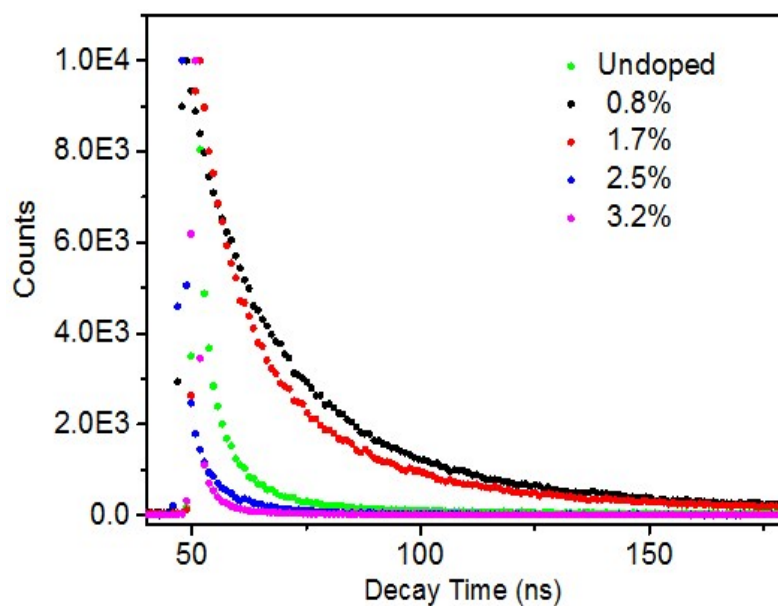


Fig S3. Time-resolved photoluminescence decays monitoring at the 410 nm for the undoped CsPbCl₃ NCs and Mn²⁺ ion doped NCs with different doping concentrations.

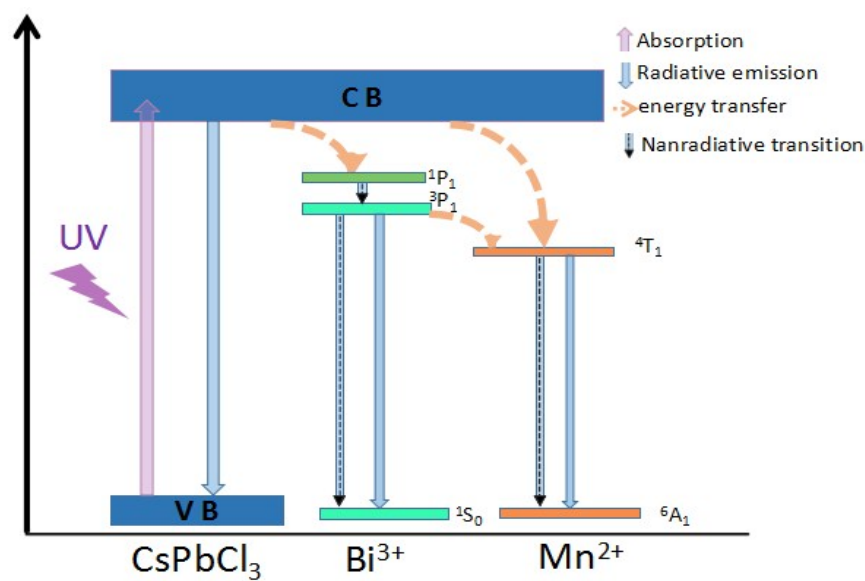


Fig S4. Energy level diagram of Bi³⁺/Mn²⁺ ions codoped CsPbCl₃ NCs and the possible photoluminescence mechanism.

Table S1. Fitting parameters of normalized transient absorption data to $-\sum a_i \exp(t/\tau_i)$

Sample	a1	a2	a3	τ_1 (ps)	τ_2 (ns)	τ_3 (ps)
CsPbCl ₃	0.29±0.02	0.71±0.03		4.32±0.05	8.56±0.02	
0.6% Bi	0.33±0.02	0.51±0.02	0.15±0.03	6.23±0.01	8.78±0.02	653±1
8.7% Bi	0.53±0.03	0.35±0.06	0.12±0.03	2.15±0.04	8.44±0.03	663±1

Table S2. Lifetime values of undoped CsPbCl₃ NCs and Mn²⁺ ion doped NCs with different doping concentrations (0.8%, 1.7%, 2.5%, and 3.2%) monitored at 410 nm.

	Undoped	0.8%	1.7%	2.5%	3.2%
τ_1 (ns)	1.7	1.8	1.7	1.8	1.9
Percent (%)	36.3	25.3	30.3	41.3	50.9
τ_2 (ns)	17.2	18.9	19.3	17.8	18.0
Percent (%)	43.7	74.7	71.7	58.7	49.1
Average (ns)	11.0	14.4	13.6	10.3	9.7