

Electronic Supplementary Information

Enhanced luminescence and energy transfer in Mn²⁺ doped CsPbCl_{3-x}Br_x perovskite nanocrystals

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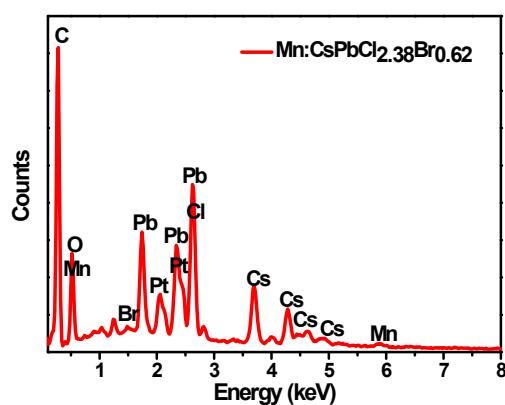


Fig. S1 The typical EDX spectra of $\text{Mn}^{2+}:\text{CsPbCl}_{2.38}\text{Br}_{0.62}$ NCs. The atomic ratios of Cl/Br in various $\text{Mn}^{2+}:\text{CsPbCl}_{3-x}\text{Br}_x$ NCs determined by EDX were summarized in Table S1.

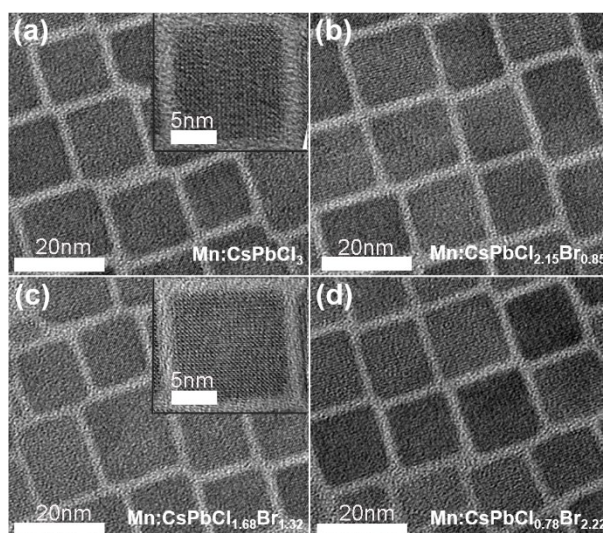


Fig. S2 Transmission electron microscope (TEM) and high-resolution transmission electron microscopy (HRTEM) images of Mn^{2+} doped CsPbCl_3 (a), $\text{CsPbCl}_{2.15}\text{Br}_{0.85}$ (b), $\text{CsPbCl}_{1.68}\text{Br}_{1.32}$ (c), $\text{CsPbCl}_{0.78}\text{Br}_{2.22}$ (d).

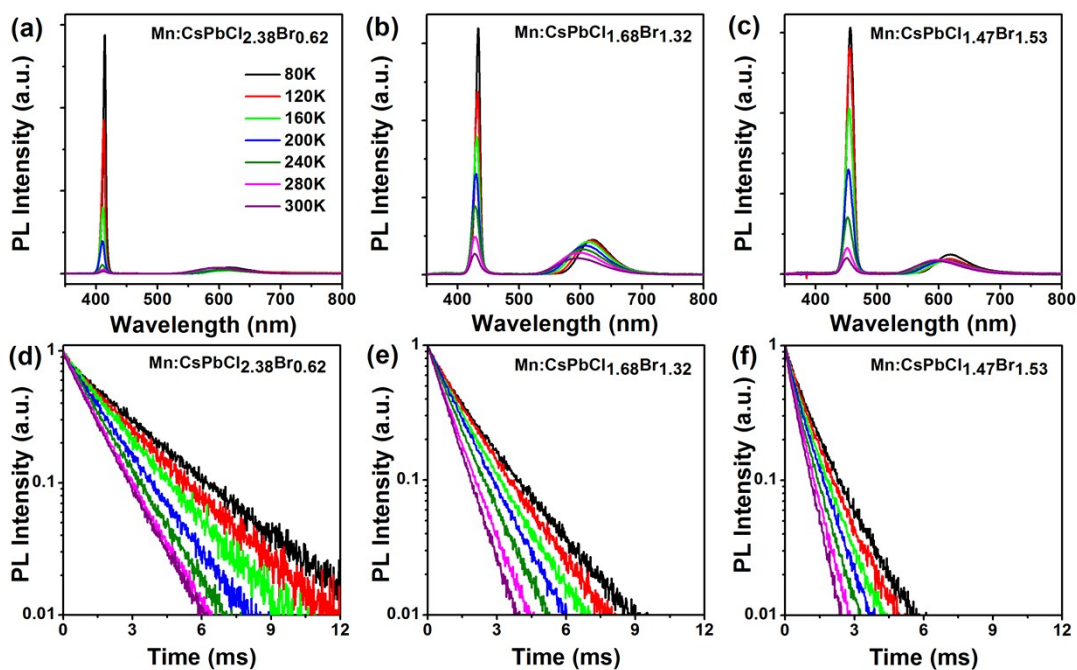


Fig. S3 Temperature-dependent PL spectra of $\text{Mn}^{2+}:\text{CsPbCl}_{2.38}\text{Br}_{0.62}$ (a) and $\text{Mn}^{2+}:\text{CsPbCl}_{1.68}\text{Br}_{1.32}$ (b) and $\text{Mn}^{2+}:\text{CsPbCl}_{1.47}\text{Br}_{1.53}$ NC films (c). PL decay curves of Mn^{2+} in $\text{Mn}^{2+}:\text{CsPbCl}_{2.38}\text{Br}_{0.62}$ (d) and $\text{Mn}^{2+}:\text{CsPbCl}_{1.68}\text{Br}_{1.32}$ (e) and $\text{Mn}^{2+}:\text{CsPbCl}_{1.47}\text{Br}_{1.53}$ NC films (f).

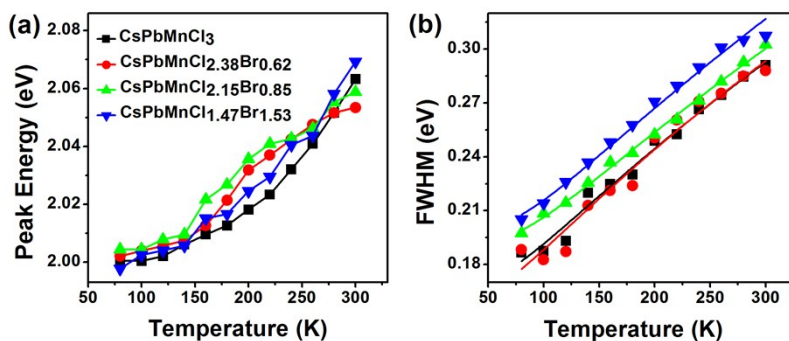


Fig. S4 Temperature dependent peak energy (a) and linewidth (b) of Mn^{2+} emissions in $\text{Mn}^{2+}:\text{CsPbCl}_{3-x}\text{Br}_x$ NC films.

Table S1 Atomic ratios of Cl/Br in various $\text{Mn}^{2+}:\text{CsPbCl}_{3-x}\text{Br}_x$ NCs determined by EDX. The composition x of Br anions was varied by Cl-to-Br anion exchange strategy by adding different volume of PbBr_2 precursor solution into $\text{Mn}^{2+}:\text{CsPbCl}_3$ NC solution.

| Volume of PbBr_2 precursor solution | Atomic ratio of Cl/Br | Element composition |
|--|-----------------------|---|
| 0.2 mL | 3.84 | $\text{Mn}^{2+}:\text{CsPbCl}_{2.38}\text{Br}_{0.62}$ |
| 0.6 mL | 2.53 | $\text{Mn}^{2+}:\text{CsPbCl}_{2.15}\text{Br}_{0.85}$ |
| 1.0 mL | 1.27 | $\text{Mn}^{2+}:\text{CsPbCl}_{1.68}\text{Br}_{1.32}$ |
| 1.6 mL | 0.96 | $\text{Mn}^{2+}:\text{CsPbCl}_{1.47}\text{Br}_{1.53}$ |
| 2.0 mL | 0.35 | $\text{Mn}^{2+}:\text{CsPbCl}_{0.78}\text{Br}_{2.22}$ |
| 4.0 mL | 0.12 | $\text{Mn}^{2+}:\text{CsPbCl}_{0.32}\text{Br}_{2.68}$ |

Table S2 Analytical Mn^{2+} concentrations (relative to Pb^{2+} ions) in various $\text{Mn}^{2+}:\text{CsPbCl}_{3-x}\text{Br}_x$ NCs, determined by ICP-MS.

| Element composition | Mn^{2+} concentration |
|---|--------------------------------|
| $\text{Mn}^{2+}:\text{CsPbCl}_{2.38}\text{Br}_{0.62}$ | 2.5% |
| $\text{Mn}^{2+}:\text{CsPbCl}_{2.15}\text{Br}_{0.85}$ | 2.2% |
| $\text{Mn}^{2+}:\text{CsPbCl}_{1.68}\text{Br}_{1.32}$ | 2.5% |
| $\text{Mn}^{2+}:\text{CsPbCl}_{1.47}\text{Br}_{1.53}$ | 2.9% |
| $\text{Mn}^{2+}:\text{CsPbCl}_{0.78}\text{Br}_{2.22}$ | 2.8% |
| $\text{Mn}^{2+}:\text{CsPbCl}_{0.32}\text{Br}_{2.68}$ | 2.2% |