Supporting Information

Mn derived Cs_4PbX_6 nanocrystals with stable and tunable wide luminescence for white light-emitting diodes

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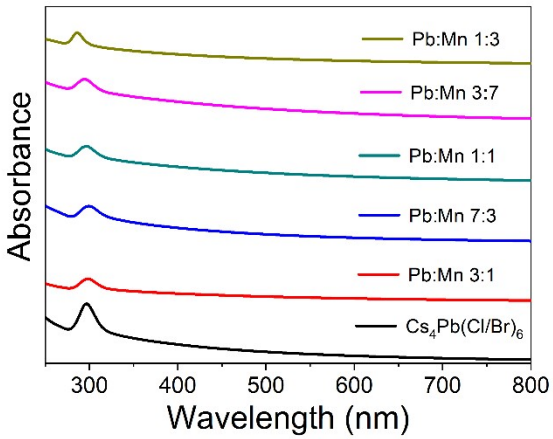

Fig. S1 Absorption spectra of Mn:$Cs_4Pb(Cl/Br)_6$ NCs.

Table S1. Atomic ratio of Mn:Cs_4PbCl_6 NCs from XPS analysis.

Sample	Cs (%)	Pb (%)	Mn (%)	Cl (%)	C (%)
Mn:Cs_4PbCl_6	7.09	1.72	0.66	15.3	75.2

Table S2 Pb^{2+} Lifetime parameters of Mn:Cs_4PbCl_6 NCs

Sample	τ_1 (ns)	B_1 (%)	τ_{ave}(ns)
Pb:Mn 1:0	2.7	100	2.7
Pb:Mn 3:1	2.6	100	2.6
Pb:Mn 7:3	1.5	100	1.5
Pb:Mn 1:1	1.1	100	1.1
Pb:Mn 3:7	0.6	100	0.6
Pb:Mn 1:3	0.5	100	0.5

A single exponential function was applied to fit the decay curves:

$F(t) = B_1 \exp(-t/\tau_1)$ (1)

in which B_1 is the normalized amplitudes of component. τ_1, represent the time constants. The average lifetime (τ_{ave}) was calculated by:

$\tau_{ave} = B_1\tau_1^2/B_1\tau_1$ (2)

Table S3 Mn^{2+} Lifetime parameters of Mn:Cs_4PbCl_6 and Mn:$Cs_4Pb(Cl/Br)_6$ NCs.

Sample	Cs_4PbCl_6 τ (ns)	$Cs_4Pb(Cl/Br)_6$ τ (ns)
Pb:Mn 3:1	17.1	5.1
Pb:Mn 7:3	16.7	5.3
Pb:Mn 1:1	16.3	6.7
Pb:Mn 3:7	11.1	5.9
Pb:Mn 1:3	8.8	4.4

The PL lifetime decay data from Mn luminescence were measured by Hitachi-U4600 spectrometer.

The calculation formula is as follows:

Equation: $y = y_0+A_1*\exp(-(x-x_0)/t_1)$