Supporting Information

Anion drived Sn²⁺exchange reaction in CsPbBr₃ nanocrystals towards tunable and high photoluminescence

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Figure S1 Absorption (a) and PL spectra (b) of samples 1-6. Inset in (b) shows optical images of samples under 365 nm light irradiation.



Figure S2 XRD pattern of sample 6



Figure S3 XRD pattern of sample A6 with result of Rietveld refinement of the orthorhombic structure. The inset shows the structural data.



Figure S4 The enlarged XRD pattern between 20° and 30° in Fig. 1 (c). Blue line represented the standard PDF card of Cs₂SnI₆ (PDF#51-0466). The rhombus indicated the impurity peaks.



Figure S5 Time-resolved PL decay curves of sample A1-A6.



Figure S6 In situ PL evolution of CsPbBr₃NCs with 3mL of SnI₂ precursor solution.



Figure S7 TEM image of CsSnI₃NCs upon 2 min irradiation by 200 kV of incident electron energy.



Figure S8 (a) TEM image of sample A2. (b)The EDS quantification analysis of sample A2. The weight ratio is shown in the insert. Sample A2 crystallized in cube morphology with the average size of 15.15 nm.



Figure S9 LCMS mass spectra of SnI_2 (a) and $SnBr_2$ (b) precursor solution.



Figure S10 XPS C 1s spectrum of parent CsPbBr₃andCsPb_xSn_{1-x} $(Br_yI_{1-y})_3$ NCs after peak calibration at 285.0 eV.



Figure S11 Pb 4f spectrum of parent $CsPbBr_3$ and $CsPb_xSn_{1-x}(Br_yI_{1-y})_3$ NCs.

Sample	CsPbBr ₃ (µl)	CsPbCl ₃ (µl)	SnI ₂ (ml)	SnBr ₂ (ml)	SnCl ₂ (ml)
A1	100	N/A	N/A	N/A	N/A
A2	100	N/A	1.0	N/A	N/A
A3	100	N/A	1.5	N/A	N/A
A4	100	N/A	1.7	N/A	N/A
A5	100	N/A	2.5	N/A	N/A
A6	100	N/A	3.0	N/A	N/A
B1	100	N/A	N/A	1.0	N/A
B2	100	N/A	N/A	1.5	N/A
B3	100	N/A	N/A	3.0	N/A
С	100	N/A	N/A	N/A	1.0
D	N/A	100	N/A	N/A	3.0

Table S1 Preparation conditions of samples prepared by cation exchange

Table S2 Preparation conditions of samples prepared by one pot hot-injection method

Sample	n (PbBr ₂) (×10 ⁻⁴)	n (SnI ₂) (×10 ⁻⁴)	n (Pb): n (Sn)
1	1.25	0.63	2:1
2	0.94	0.94	1:1
3	0.63	1.25	1:2
4	0.47	1.41	1:3
5	0.38	1.50	1:4
6	N/A	1.88	N/A

Sample	Absorption peak (nm)	PL peak (nm)	Fwhm (nm)
A1	504.0	524.6	25.3
A2	506.6	527.6	25.9
A3	532.9	554.6	30.8
A4	559.4	585.1	35.3
A5	607.9	644.6	42.0
A6	629.1	657.6	42.4

Table S3 Information of absorption and PL spectra in Fig. 1 (a)

Table S4 Components B_1 and B_2 , time constants τ_1 and τ_2 , and average lifetime τ of parent CsPbBr₃ NCs with different amount of SnI₂

Sample	B1(%)	τ_1/ns	B ₂ (%)	τ_2/ns	τ/ns
A1	49.91	5.73	50.09	25.63	22.00
A2	29.95	5.47	70.05	21.72	20.14
A3	29.79	8.69	70.21	32.15	33.61
A5	31.90	10.68	68.10	40.72	37.44
A6	45.57	17.08	54.43	46.04	39.18

Table S5 Molar ratio of CsPbBr3 and CsPbxSn1-x(BryI1-y)3 NCs from XPS analysis

Sample	Pb	Sn	Br	I
CsPbBr ₃	2.37	N/A	7.06	N/A
CsPb _x Sn _{1-x} (Br _y I _{1-y}) ₃	0.59	0.13	1.26	0.38