Electronic Supplementary Information

Continuous-flow synthesis of $CsPbI_3/TiO_2$ nanocomposites with enhanced water and thermal stability

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Experimental details

Precursor preparation

Precursor 1 (Cs-oleate): 2.5 mmol of Cs_2CO_3, 2.5 mL of OA and 40 mL of ODE were loaded into a 3-necked flask of 100 mL, dried for 1 h at 120 ℃ under N_2, and then heated to 150 ℃ until all Cs_2CO_3 reacted with OA. Because Cs-oleate precipitates from ODE at room temperature, the Cs-oleate solution needs to be preheated to 120 ℃ before injection. The oleic acid Cs-oleate precursor was diluted with ODE at a volume ratio of 1:20 and rapidly stirred for 10 min at 120 ℃, until the solution was clear, then the 10 mL solution was loaded into a 10 ml closed syringe for subsequent microfluidic synthesis.

Precursor 2 (PbI_2): 1.88 mmol of PbI_2, 5 mL of OA, 5 mL of OAm, and 50 mL of ODE were loaded into a three-necked flask of 100 mL, and the mixed solution was magnetically stirred at 120 °C under N_2 for 0.5 min, until the solution was clear, then the 10 mL solution was loaded into a 10 ml closed syringe for subsequent microfluidic synthesis.

Precursor 3 (PbI_2/TiO_2): 1.88 mmol of PbI_2, 0.5 g TiO_2, 5 mL of OA, 5 mL of OLA, and 50 mL of ODE were loaded into a three-necked flask of 100 mL, and the mixed solution was magnetically stirred at 120 °C under N_2 for 0.5 min, until PbI_2 completely reacted with OA and OAm and TiO_2 was uniformly dispersed in the solvent, then the 10 mL solution was loaded into a 10 ml closed syringe for subsequent microfluidic synthesis.

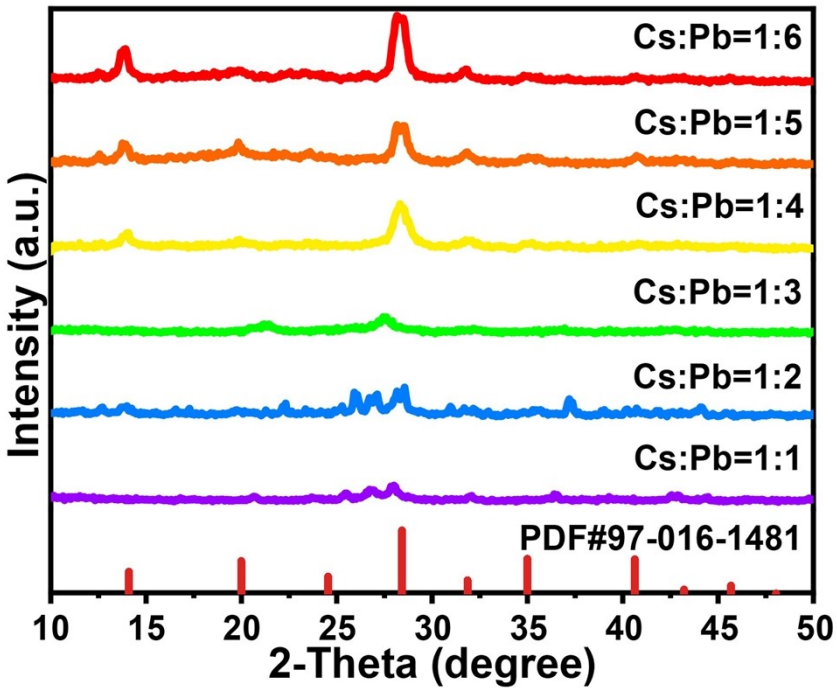

Fig. S1 XRD pattern of $CsPbI_3$ with different Cs and Pb ratios.

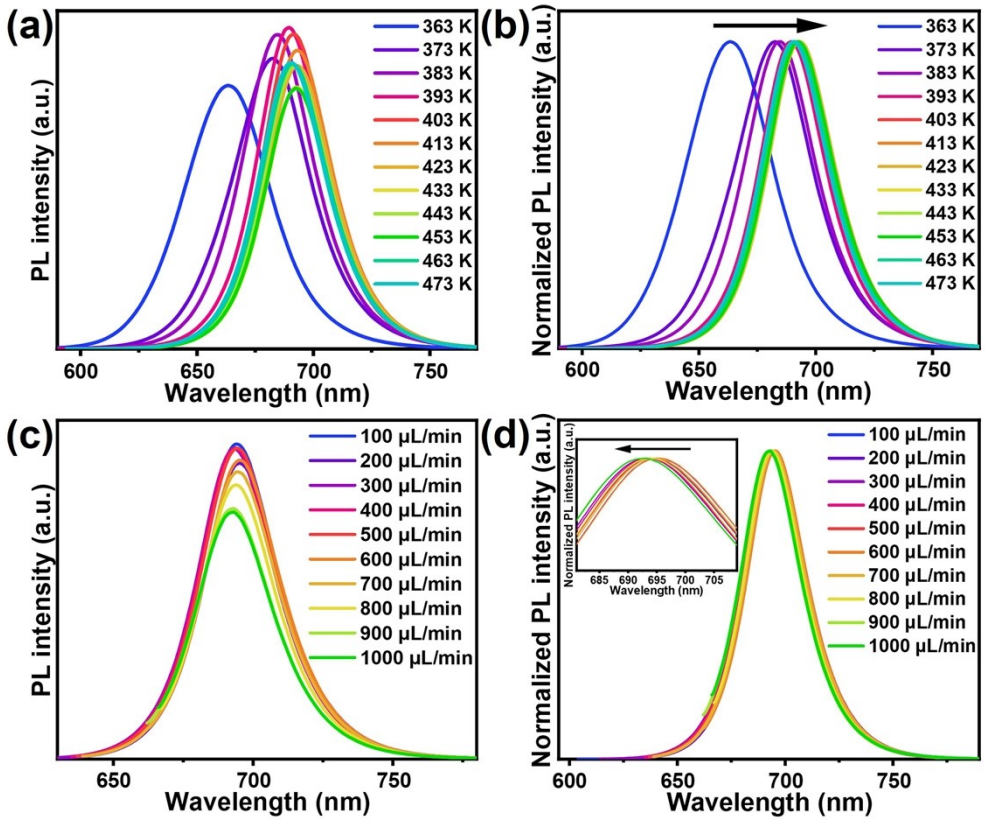

Fig. S2 PL spectra of $CsPbI_3$ nanocrystals prepared by microfluidic method at different temperatures (a and b) and different flow rates (c and d).

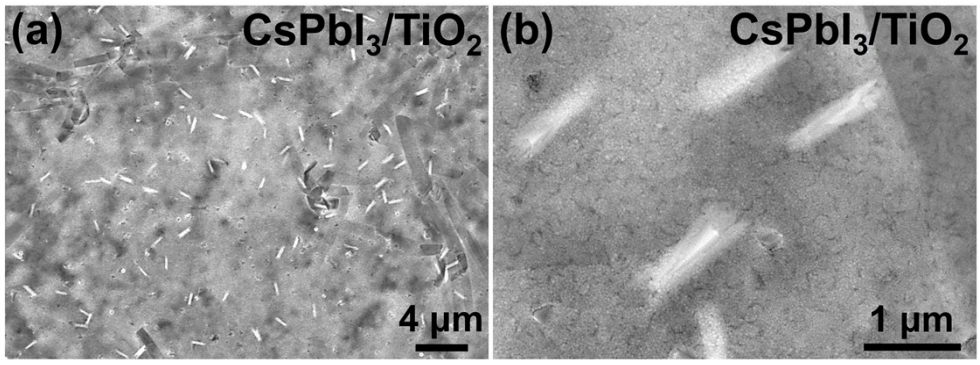

Fig. S3 SEM image of the $CsPbI_3/TiO_2$ nanocomposites.

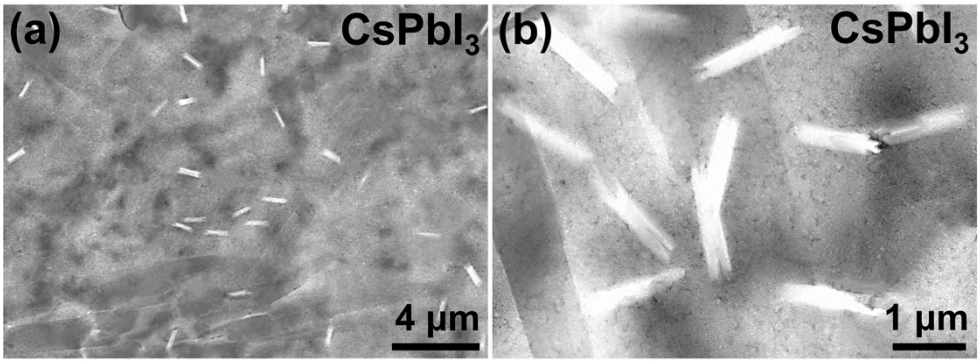

Fig. S4 SEM image of the $CsPbI_3$ nanorods.

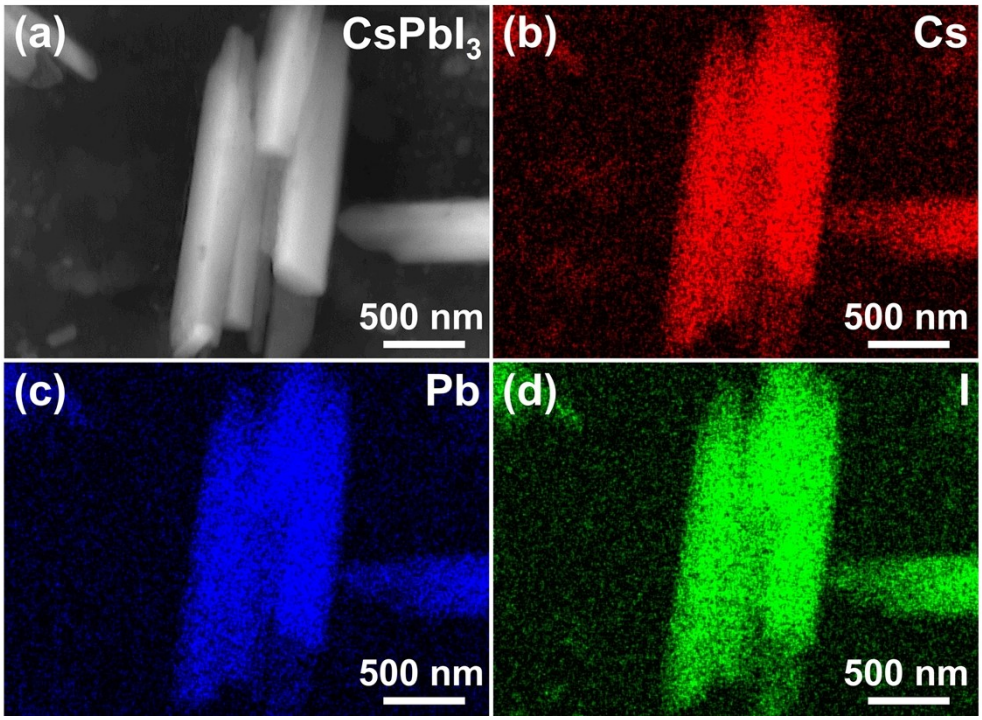

Fig. S5 (a) SEM image of the $CsPbI_3$ nanorods. (b, c and d) Elemental mapping images of Cs, Pb and I in $CsPbI_3$ nanorods.

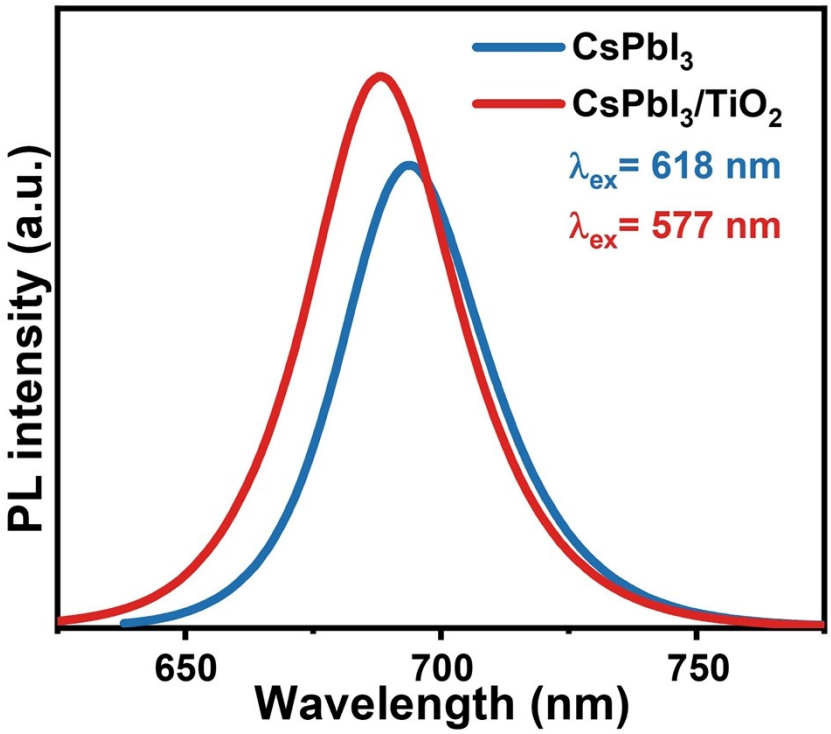

Fig. S6 PL intensity of $CsPbI_3$ nanorods and $CsPbI_3/TiO_2$ nanocomposites excited by 618 nm and 577 nm, respectively.

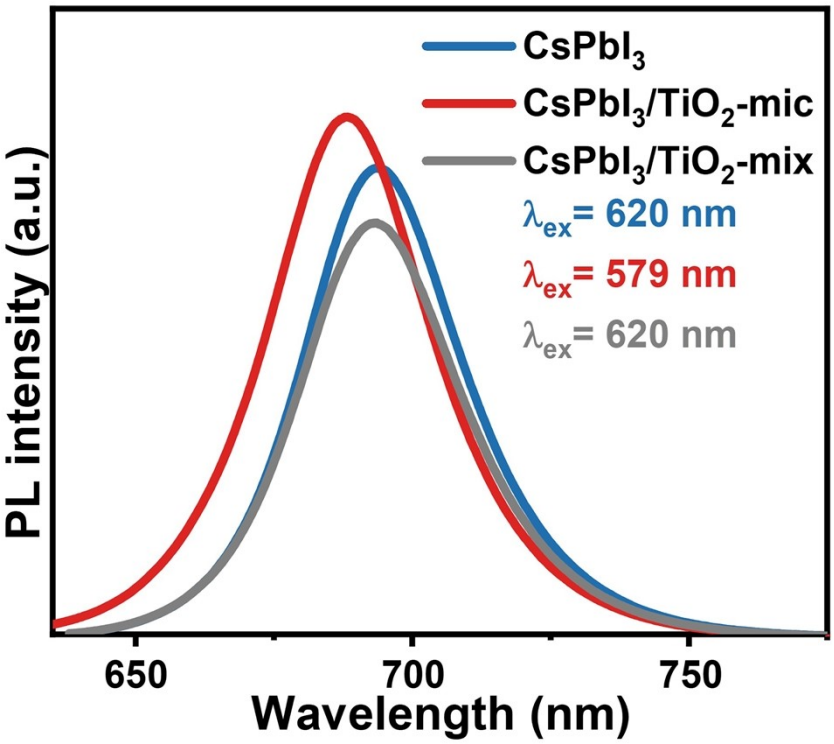

Fig. S7 PL spectra of $CsPbI_3$ nanorods (blue lines), $CsPbI_3/TiO_2$ nanocomposites prepared by microfluidic method ($CsPbI_3/TiO_2$-mic) (red lines) and composites directly mixed with $CsPbI_3$ nanorods and TiO_2 ($CsPbI_3/TiO_2$-mix) (gray lines).

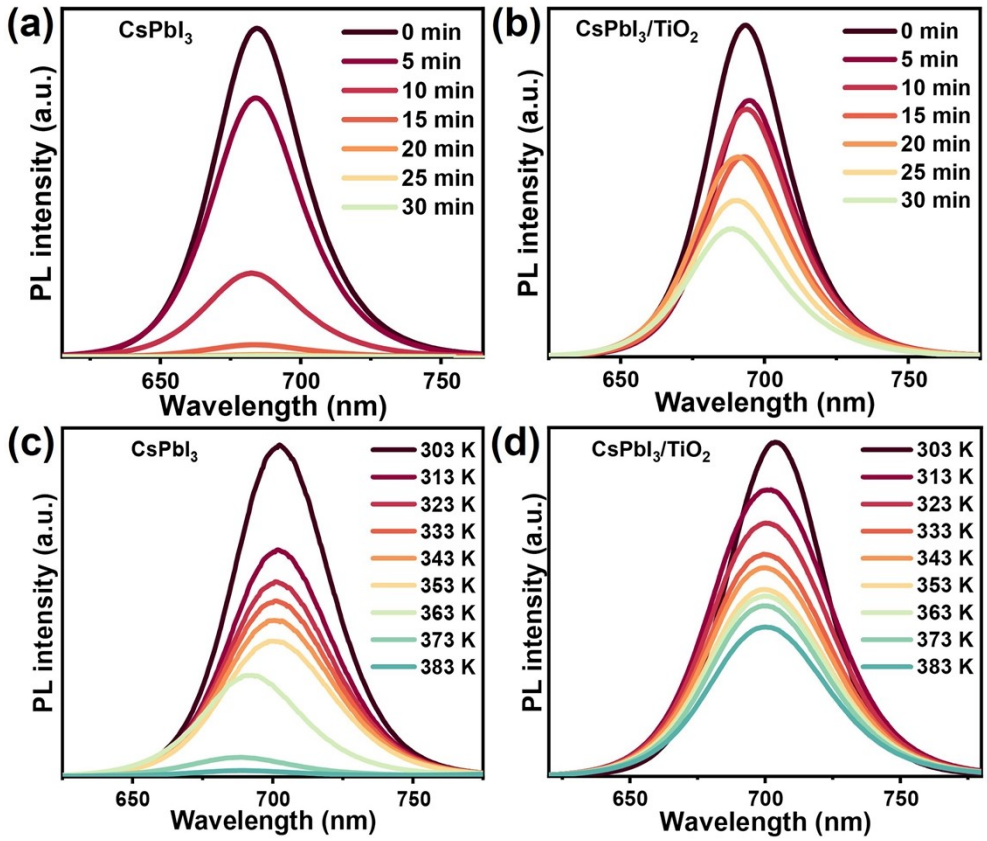

Fig. S8 (a) and (b) Water stability dependent PL spectra of $CsPbI_3$ nanorods and $CsPbI_3/TiO_2$ nanocomposites, (c) and (d) Temperature-dependent PL spectra of $CsPbI_3$ nanorods and $CsPbI_3/TiO_2$ nanocomposites.

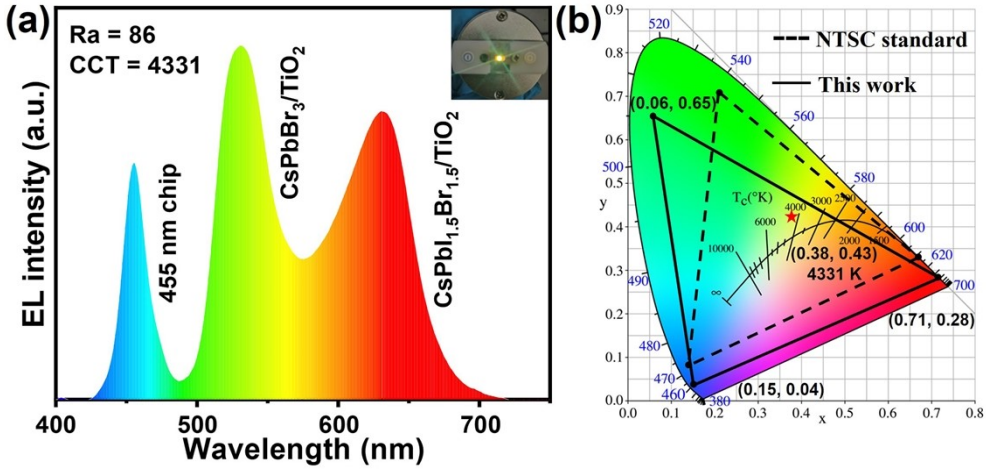

Fig. S9 (a) Emission spectra and corresponding photograph of the white $CsPbX_3/TiO_2$ LED at a driving current of 10 mA. (b) CIE color coordinates of the blue chip, green $CsPbBr_3/TiO_2$ nanocomposites, red $CsPbI_{1.5}Br_{1.5}/TiO_2$ nanocomposites, and the fabricated LED.

Table S1. PL lifetime for $CsPbI_3$ nanocrystals and $CsPbI_3/TiO_2$ nanocomposites. The PL lifetime is fitted by a biexponential decay function.

Material	A_1	A_2	τ_1	τ_2	Time (ns)
$CsPbI_3$	0.49	0.45	22.94	124.83	107.7
$CsPbI_3/TiO_2$	0.51	0.45	22.68	110.26	93.6