Supplementary Information

Ultra-stable blue-emitting lead-free double perovskite Cs_2SnCl_6 nanocrystals enabled by an aqueous synthesis on a microfluidic platform

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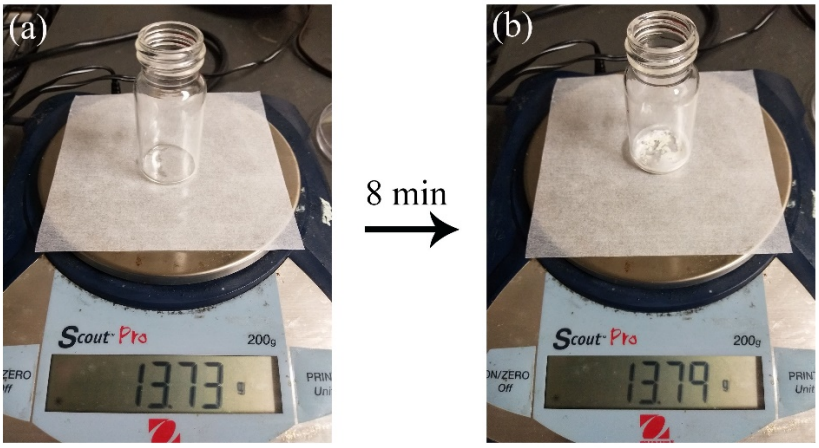

Figure S1. Optical images showing 0.06 g Cs_2SnCl_6 powder was produced within 8 min.

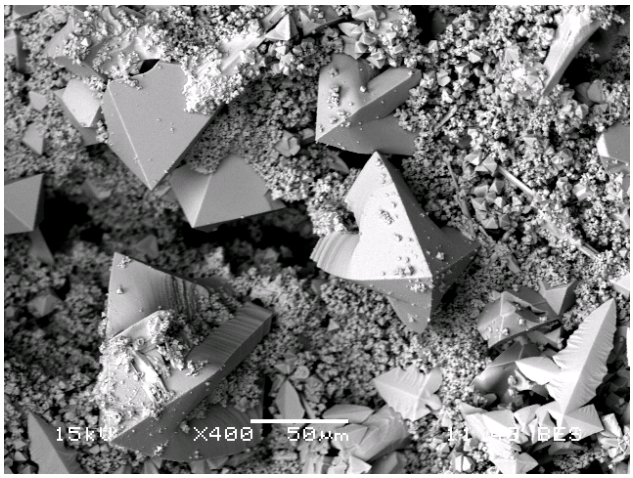

Figure S2. SEM image of as-prepared Cs_2SnCl_6 powder.

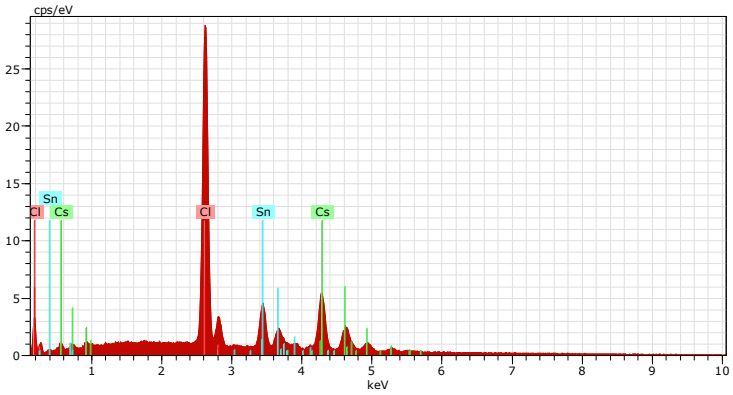

Figure S3. EDS spectrum of as-prepared Cs_2SnCl_6 powder.

Table S1. Chemical composition of the prepared Cs_2SnCl_6 powder

Element	Atomic No.	Series	Unn. (wt.%)	Norm. (wt.%)	Atom. (at.%)	Error (1 Sigma) (wt.%)
Cs	55	L	30.92	41.00	19.79	0.94
Cl	17	L	28.72	38.09	68.92	0.99
Sn	50	L	15.77	20.91	11.30	0.51
Total			75.41	100.00	100.00	

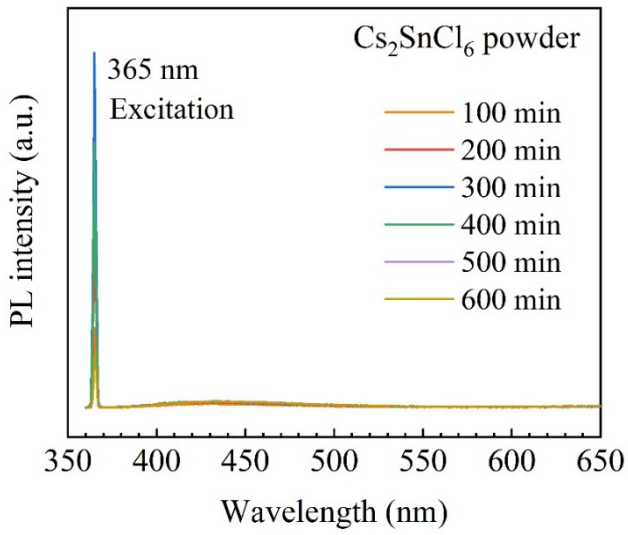

Figure S4. PL spectra of the Cs_2SnCl_6 NC solution derived from Cs_2SnCl_6 powder in 5 mL hexane with a mixture of OA and OAm (VR is 40:10) under ultrasonication for 100-600 min. The excitation wavelength is 365 nm.

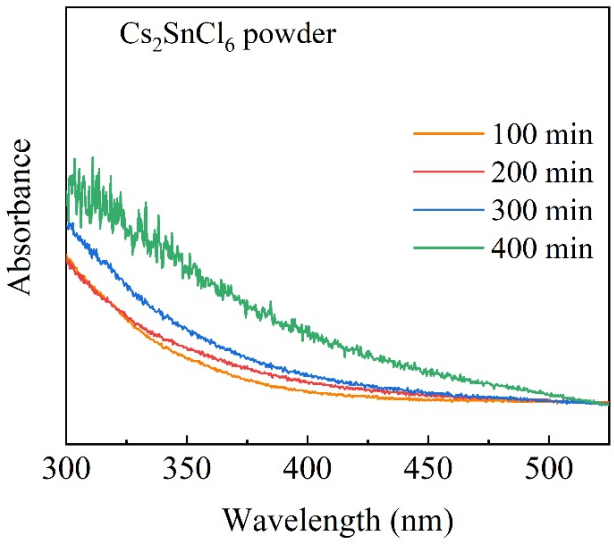

Figure S5. Absorbance spectra of the Cs_2SnCl_6 NCs solution derived from Cs_2SnCl_6 powder in 5 mL hexane with a mixture of OA and OAm (VR is 40:10) under ultrasonication for 100-400 min.

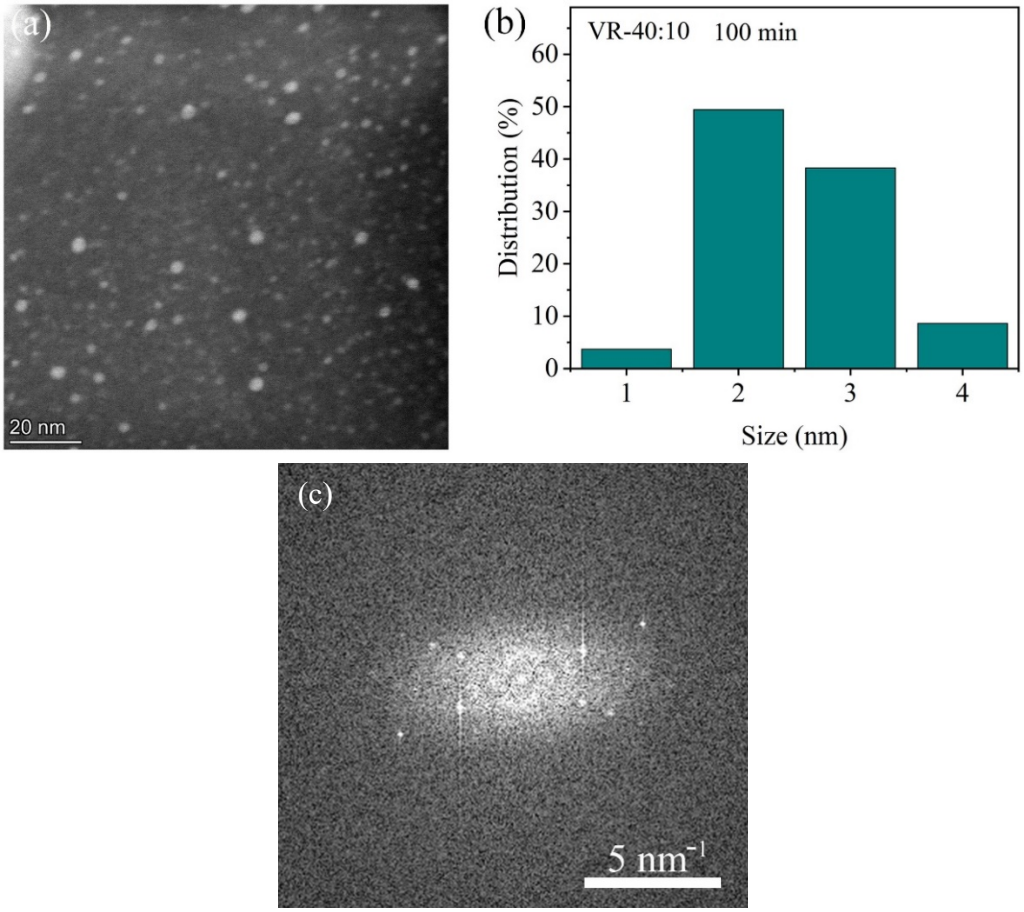

Figure S6. (a) A HAADF-STEM image of Cs_2SnCl_6 NCs prepared with OA to OAm volume ratio of 40:10 after an ultrasonication of 100 min, and (b) size distribution of the Cs_2SnCl_6 NCs in (a); (c) SAED pattern of Cs_2SnCl_6 NCs prepared with 40:10 of the volume ratio of OA to OAm after an ultrasonication of 400 min

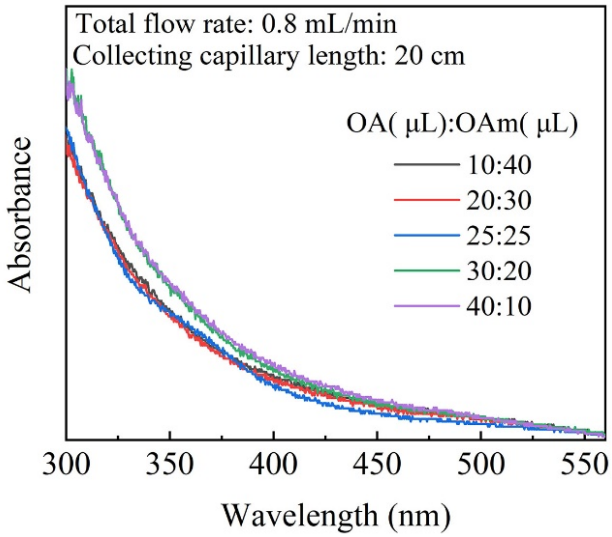

Figure S7. Absorbance spectra of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm after an ultrasonication of 400 min.

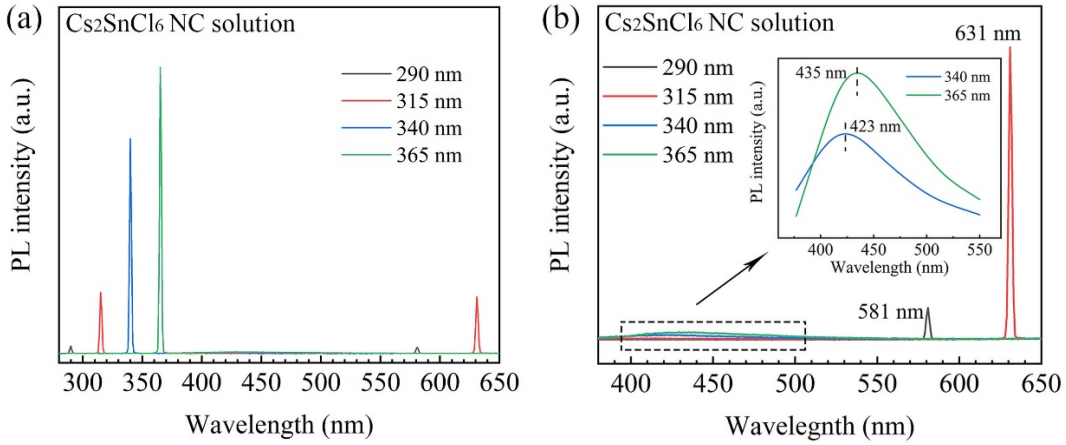

Figure S8. PL spectra of the Cs_2SnCl_6 NC solution excited by lights of various wavelengths: (a) with and (b) without showing the excitation wavelengths.

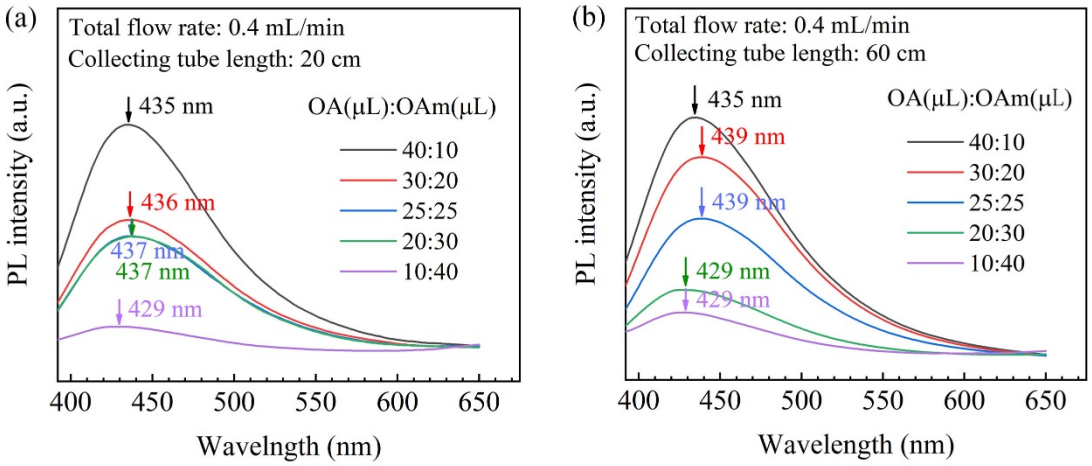

Figure S9. PL spectra of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm under a total flow rate of 0.4 mL/min and a capillary length of (a) 20 cm and (b) 60 cm.

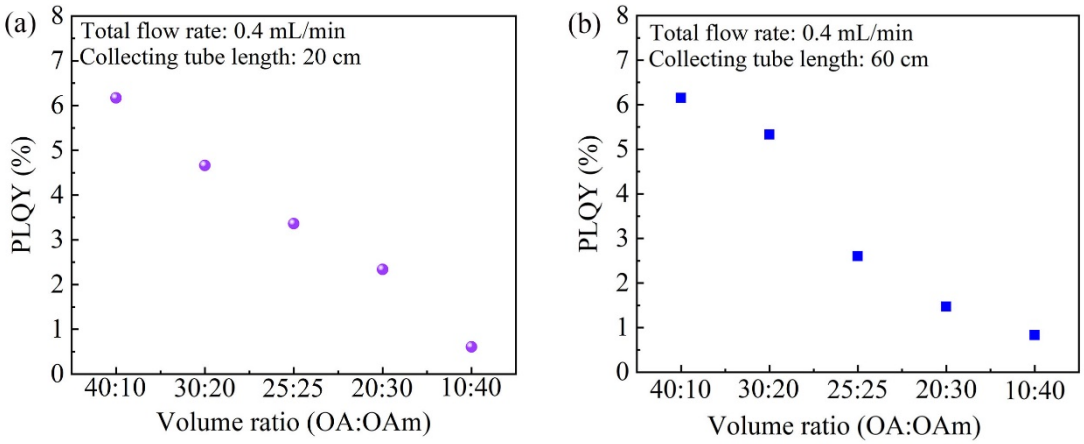

Figure S10. PLQY of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm under a total flow rate of 0.4 mL/min and a capillary length of (a) 20 cm and (b) 60 cm.

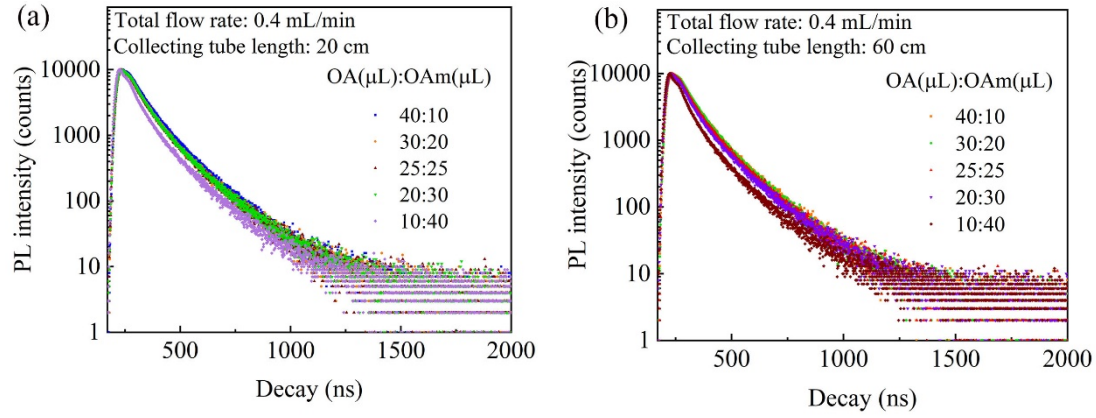

Figure S11. Lifetime of of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm under a total flow rate of 0.4 mL/min and a capillary length of (a) 20 cm and (b) 60 cm.

Table S2. Lifetimes of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm under a total flow rate of 0.4 mL/min and a capillary length of 20 cm

	Volume ratio				
	40 μL:10 μL	30 μL:20 μL	25 μL:25 μL	20 μL:30 μL	10 μL:40 μL
τ_1 (ns)	3.59	3.51	3.43	3.44	2.72
τ_2 (ns)	8.72	8.55	8.45	8.41	7.33

Table S3. Lifetimes of the $CsSn_2Cl_5$ NC solutions prepared with different volume ratios of OA to OAm under a total flow rate of 0.4 mL/min and a capillary length of 60 cm

	Volume ratio				
	40 μL:10 μL	30 μL:20 μL	25 μL:25 μL	20 μL:30 μL	10 μL:40 μL
τ_1 (ns)	3.59	3.65	3.36	3.02	2.53
τ_2 (ns)	8.72	8.70	8.34	7.84	7.21

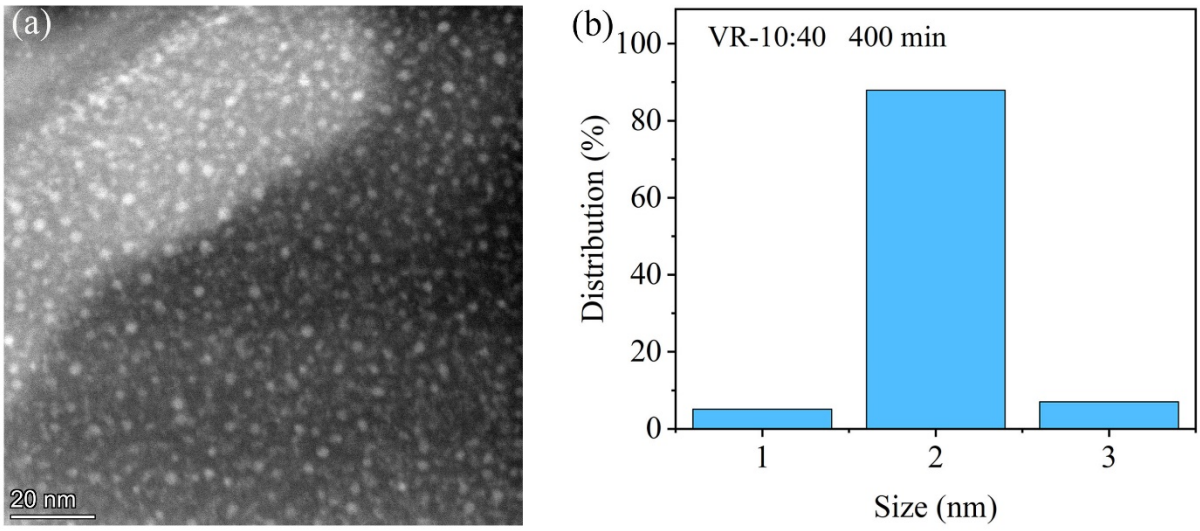

Figure S12. (a) A HAADF-STEM image of Cs_2SnCl_6 NCs prepared with OA to OAm volume ratio of 10:40 after an ultrasonication of 400 min, and (b) size distribution of the Cs_2SnCl_6 NCs in (a).

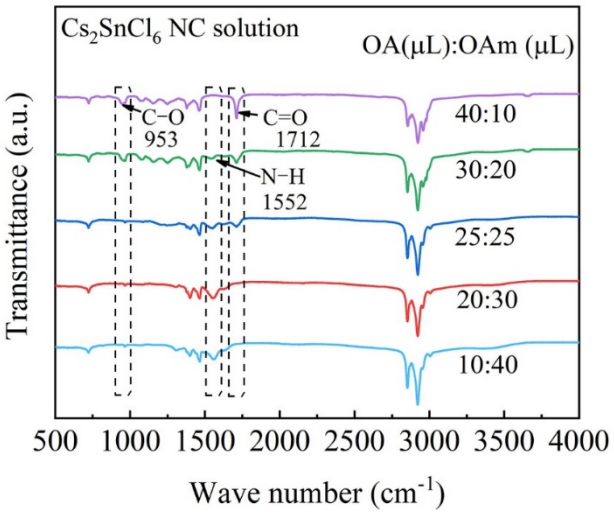

Figure S13. FTIR of the Cs_2SnCl_6 NC solutions prepared with different volume ratios of OA to OAm.

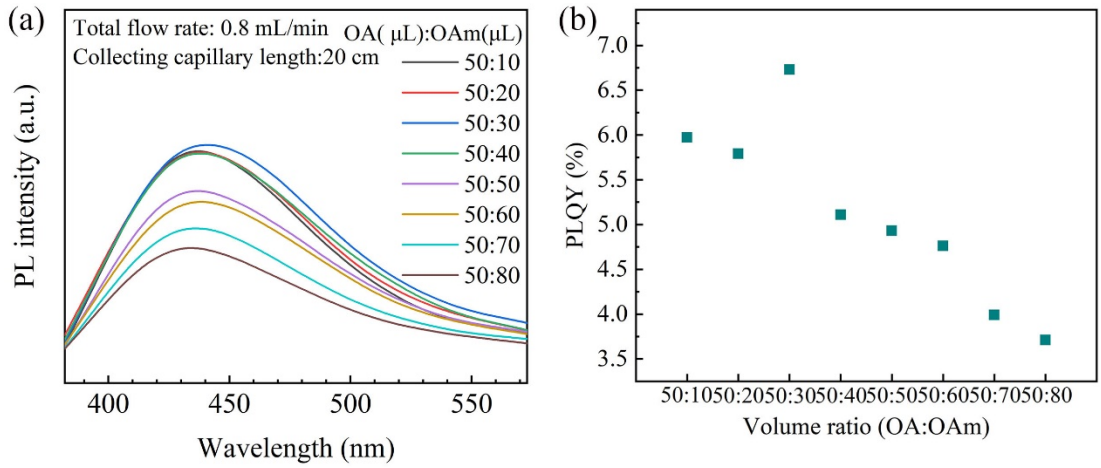

Figure S14. (a) PL spectra of the Cs_2SnCl_6 NCs solutions prepared with various VRs of OA to OAm with 50 μL OA, and (b) PLQY of the Cs_2SnCl_6 NCs solutions in (a).

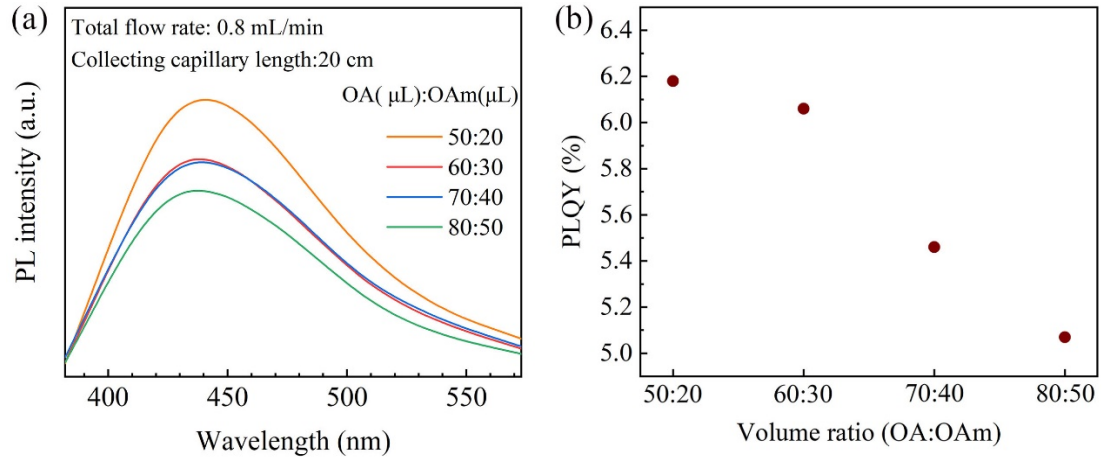

Figure S15. (a) PL spectra of the Cs_2SnCl_6 NCs solutions prepared with various VRs of OA to OAm, and (b) PLQY of the Cs_2SnCl_6 NCs solutions in (a).

Table S4. PL characteristics and PLQY of Cs_2SnCl_6 NCs prepared with conventional solvents used in antisolvent method

Solvent	Solvent polarity*	PL wavelength (nm)	PLQY (%)
Dichloromethane	0.309	446	3.02
IPA	0.546	442	7.96
Toluene	0.099	450	0.46

* The polarity[1] is relative to the polarity (which is 1) of water

Table S5. PLQY of Cs_2SnCl_6 NC solution by silicone elastomer base

Cs_2SnCl_6 NC solution	Silicone elastomer base (g)				
	0.01	0.02	0.03	0.04	0.05
PLQY (%)	0.53	1.33	2.49	4.23	2.86

Table S6. PLQY of Cs_2SnCl_6 NCs

Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
10.6%	10.2%	13.4%	10.7%	9.4%

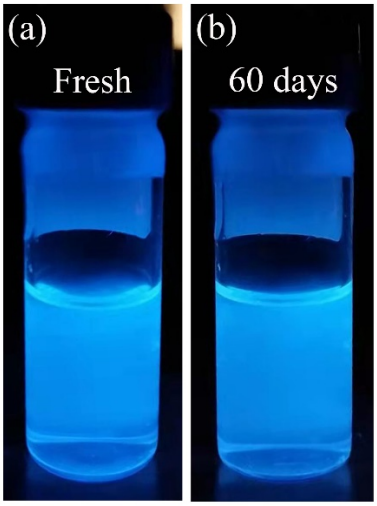

Fig. S16. Images of fresh (a) and 60-day's (b) Cs_2SnCl_6 NC solutions.

Reference:

1. C. Reichardt and T. Welton, *Solvents and solvent effects in organic chemistry*, John Wiley & Sons, 2010.