Supplementary Information (SI) for Journal of Materials Chemistry C.

Suppprting information

Dual Ligand Modification Enabling Bright and Stable $CsPbBr_{2.8}Cl_{0.2}$ Nanoplatelets in Polar Solvents

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Experimental section

Materials

n-octylamine (OcAm, 99%), propionic acid (PrAc, 99.5%), lead bromide ($PbBr_2$, 99.99%) were purchased from Macklin. Cesium carbonate (Cs_2CO_3, 99.9%), n-butanol (BuOH, 99%), trimethylbromosilane (TMSBr, 98%), glacial acetic acid (HAc, 99.9%), hydrobromic acid (HBr, 48%) and ethyl acetate (EA, 99.5%) were purchased from Aladdin. Hydrochloric acid (HCl, 38%) was purchased from Tianjin Chemical Reagent Co., LTD. Tert-butylamine (TBAm, 99%) and 2-bromoacetophenone (99%) were purchased from Innochem. O-Diphenylphosphinylhydroxylamine (DPH, 98%), were provided by Bidepharm. All materials were used directly without further purification.

Preparation of precursor

Pb precursor: 0.1835 g of $PbBr_2$ was dissolved into 1 mL of tert-butylamine, n-butanol, and propionic acid (1:1:1) and ultrasounded for 30 min. Finally, a clear and transparent Pb precursor solution was obtained.

Cs precursor: 0.0815 g of Cs_2CO_3 was dissolved into 1 mL of glacial acetic acid and vortexed for 5 minutes until the solution turned clear and transparent, namely the Cs precursor solution.

Synthesis of $CsPbBr_3$ NPLs

10 μL octylamine, 5 μL Pb precursor and 5 μL Cs precursor were added to 10 mL of ethyl acetate and their mixture was thoroughly mixed for 1 minute. Subsequently, the solution immediately began to exhibit blue emission as soon as we introduced bromine sources (HBr, TMSBr and 2-bromoacetophenone) to the mixture. In addition, the corresponding processed samples can be obtained by adding an additional amount of HCl (0.8 μL) and DPH (0-4 mg) before injecting the bromine sources.

Characterization

Transmission electron microscopy (TEM) and corresponding elemental mapping images were measured using JEM-2800 at an acceleration voltage of 200 kV. X-ray diffraction (XRD) patterns were obtained by Rigaku Smart Lab 3kW in the 2θ ranging from 3 to 20 degrees operating with Cu kα (λ = 1.5406 Å). The absorption spectra was obtained by UV-2600. The photoluminescence (PL) emission spectra, photoluminescence quantum yield (PLQY) and time-resolved photoluminescence (TRPL) decay of NPL solution were acquired via FS5. Transient absorption (TA) measurements were recorded on a Time-Tech Spectra transient absorption spectrometer (TA100). Fourier transform infrared spectroscopy (FTIR) was measured using TENSOR 37. X-ray photoelectron spectroscopy (XPS) was measured using Thermo Scientific ESCALAB 250Xi. Temperature-Dependent PL was measured by Fiber Optic Spectrometer (GE-UV-NIR, Aurora 4000 detector) with a 365 nm ultraviolet lamp. And the temperature was initially decreased from room temperature to 98 K using a helium compressor, and gradually heated up to 350 K.

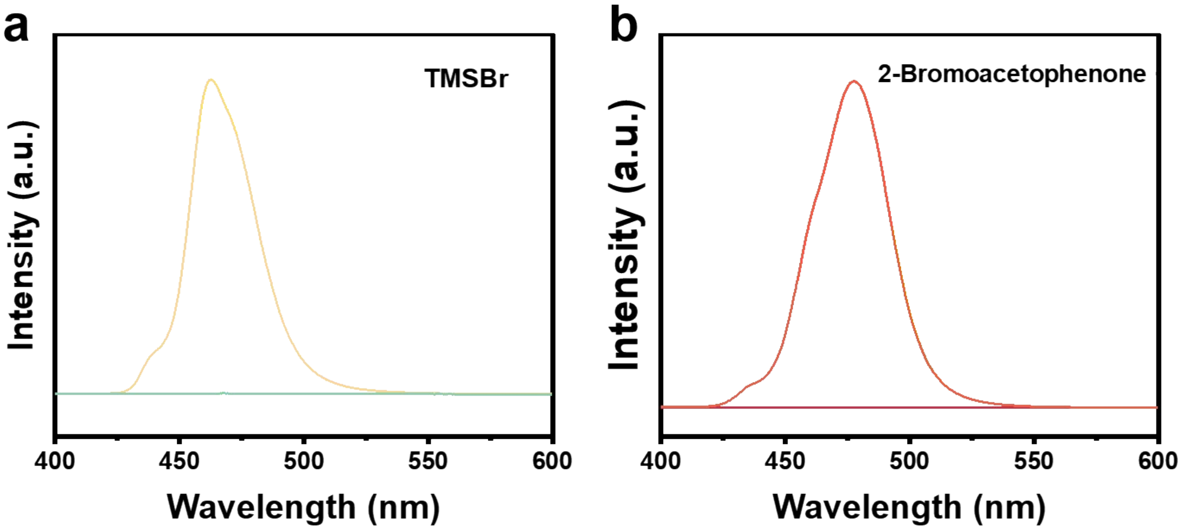

Figure S1. The PL spectra of the NPLs include a) TMSBr and b) 2-bromoacetophenone.

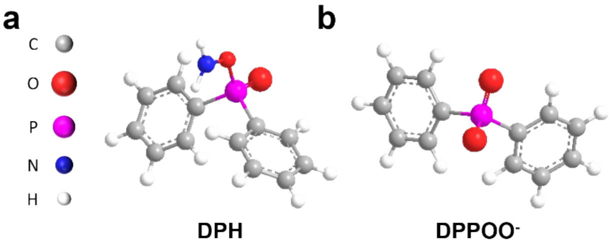

Figure S2. The chemical structure of DPH and DPPOO-.

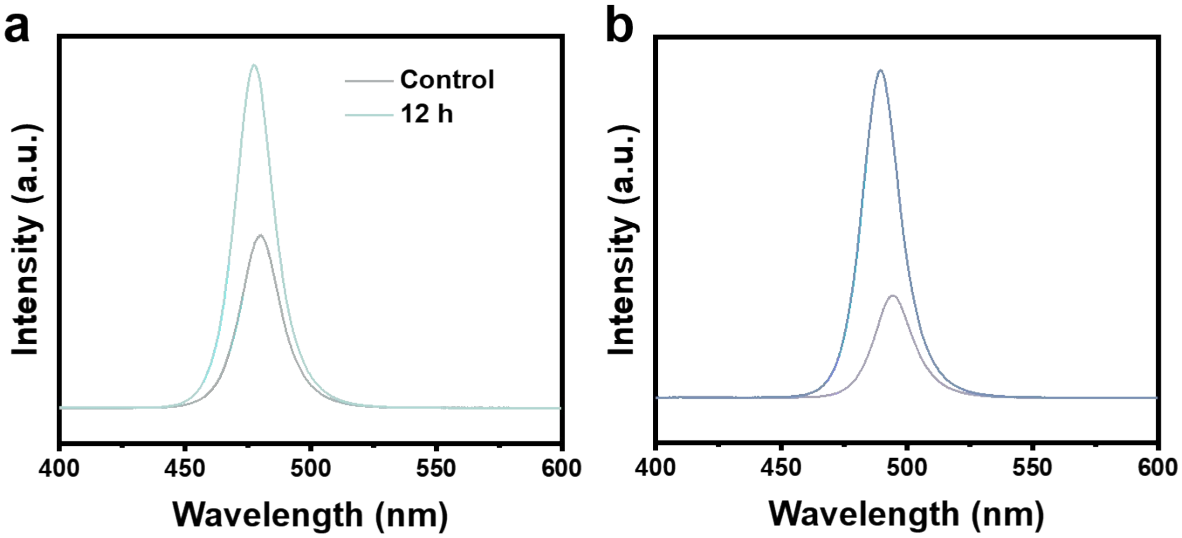

Figure S3. The change of fluorescence spectrum of the solution after one day of agitation.

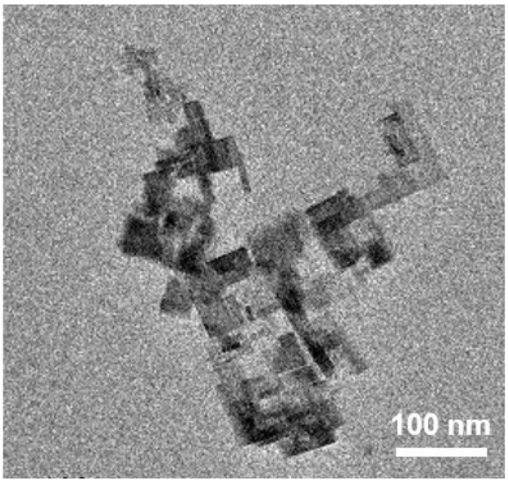

Figure S4. TEM image of the pristine NPLs.

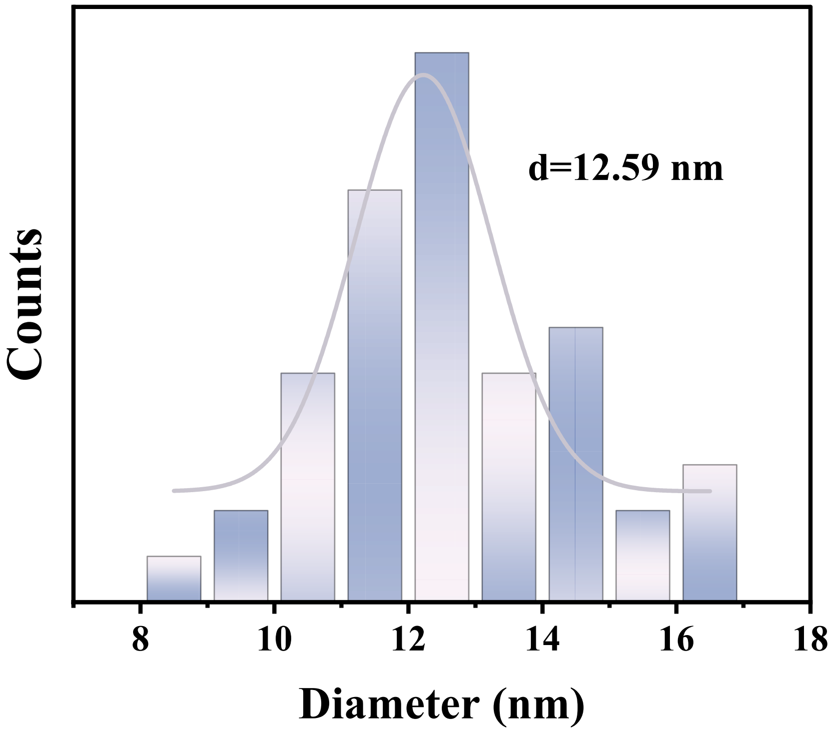

Figure S5. Size distribution of DPH-treated NPLs.

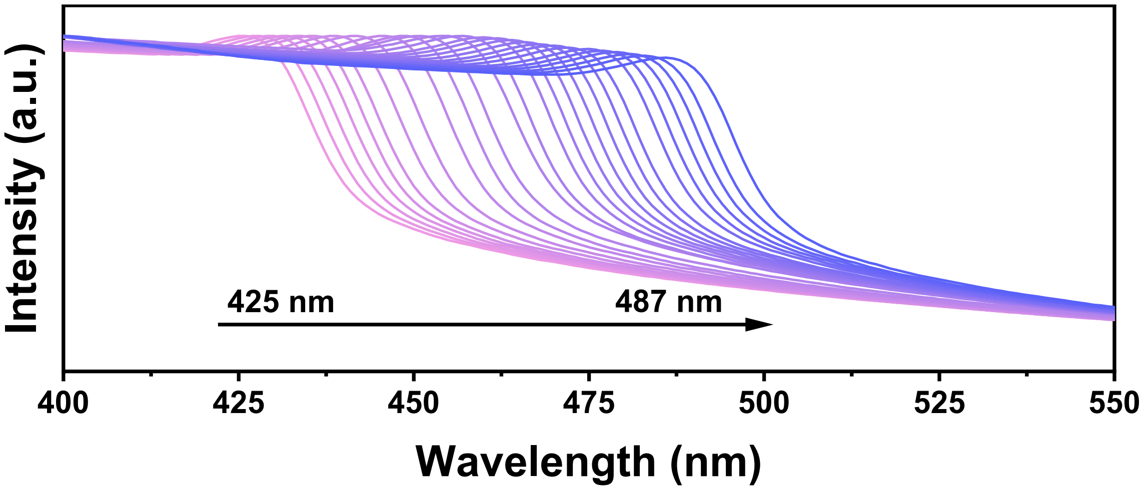

Figure S6. The absorption spectra of DPH-treated NPLs with different addition of HBr.

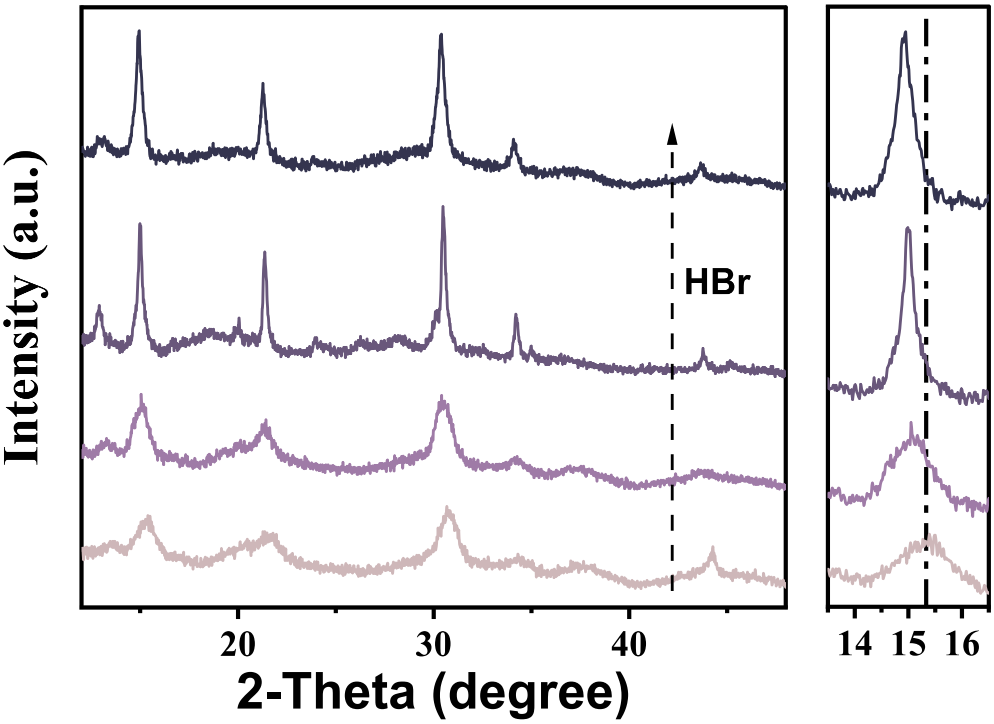

Figure S7. XRD patterns of the DPH-treated nanoplatelets with different HBr.

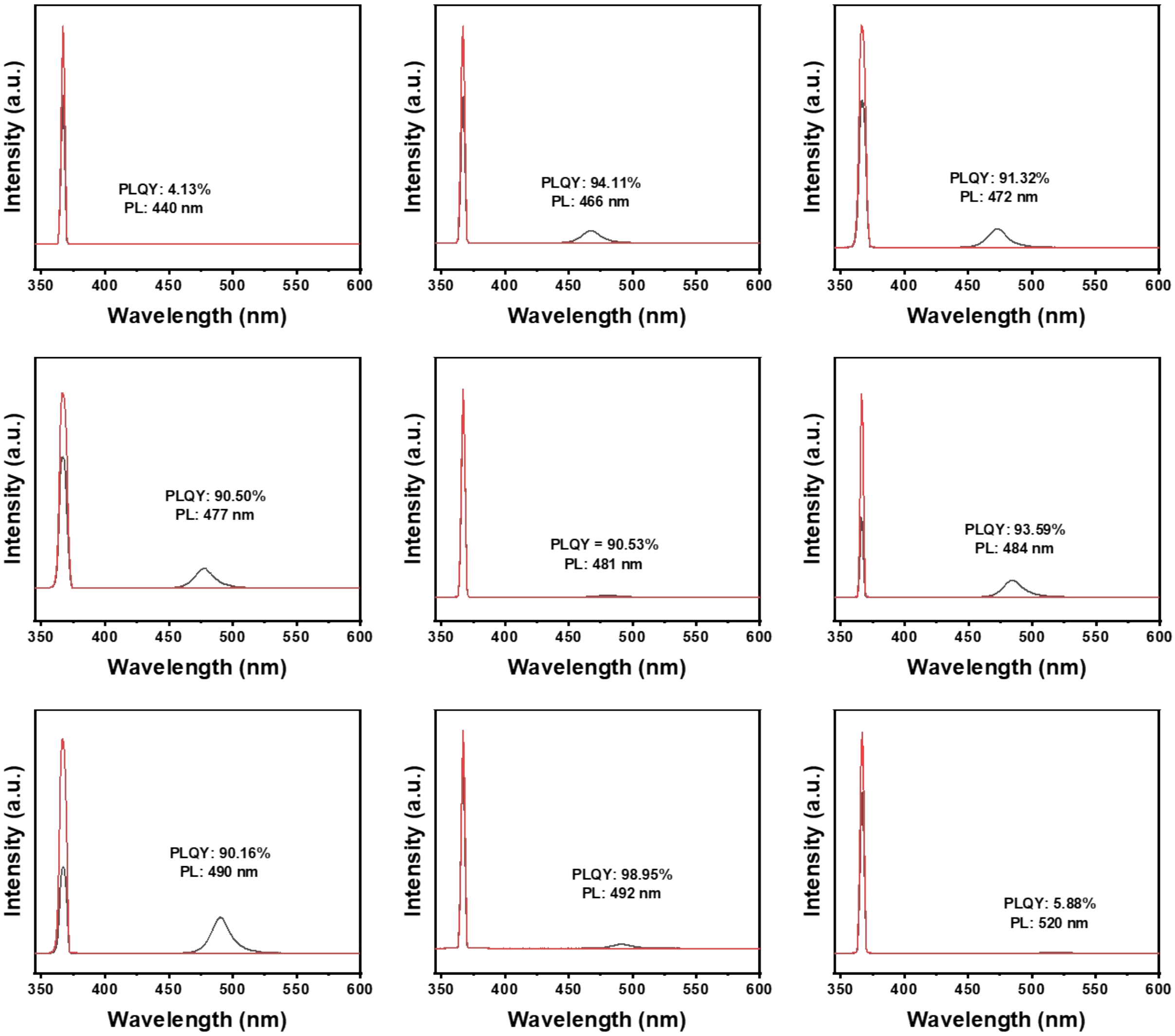

Figure 8. PLQY of DPH-treated NPLs at different wavelength.

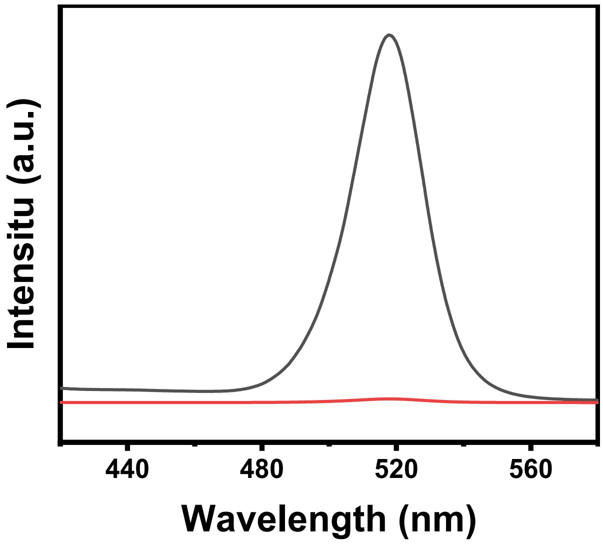

Figure S9. PL spectra of the NPLs with excess HBr.

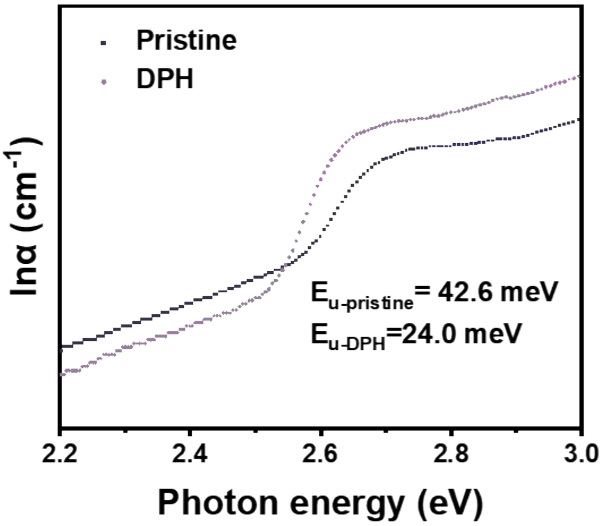

Figure S10. Urbach energies of DPH-treated NPLs with 0 mg and 4 mg.

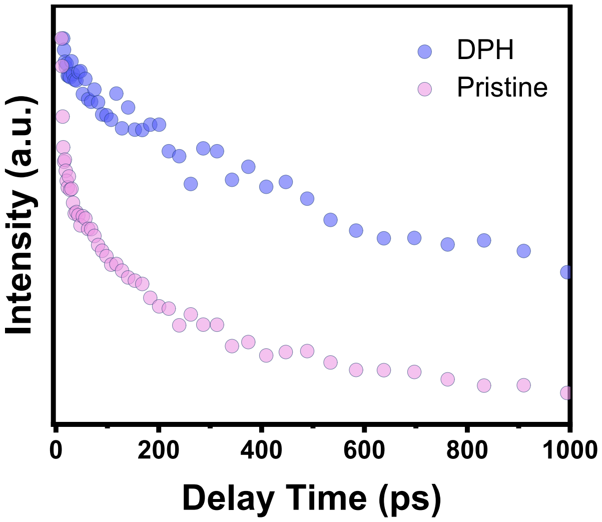

Figure S11. Comparison of the bleach recovery kinetics of DPH-treated NPLs and pristine NPLs.

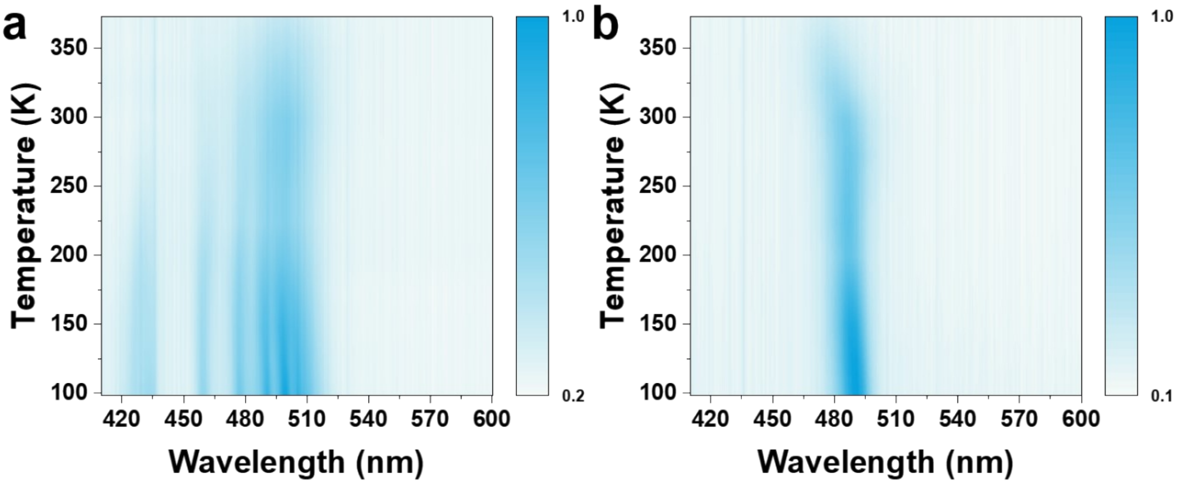

Figure S12. Pseudocolor spectral map of temperature-dependent PL measured from 98 K-373 K of a) pristine, b) DPH-treated NPLs.

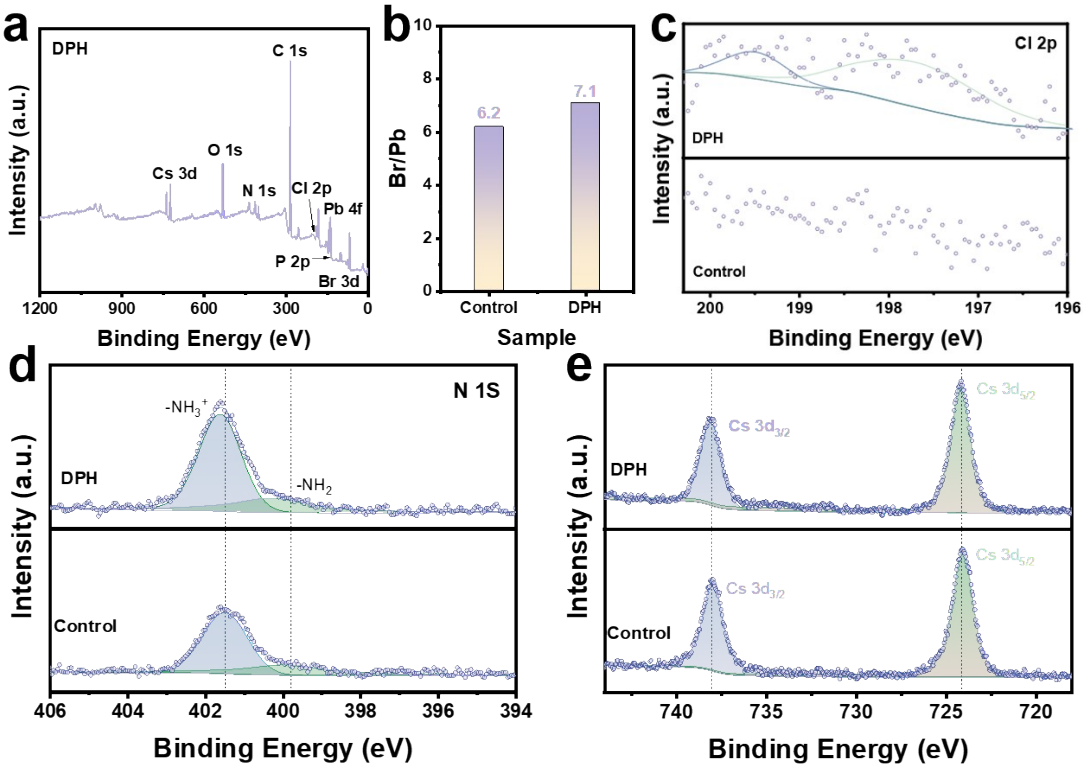

Figure S13. a) High-resolution XPS spectra of the DPH-treated NPLs for survey. b) Br/Pb of the DPH-treated NPLs. XPS spectra of the pristine and DPH-treated NPLs for c) Cl 2p, d) N1s, e) Cs 3d.

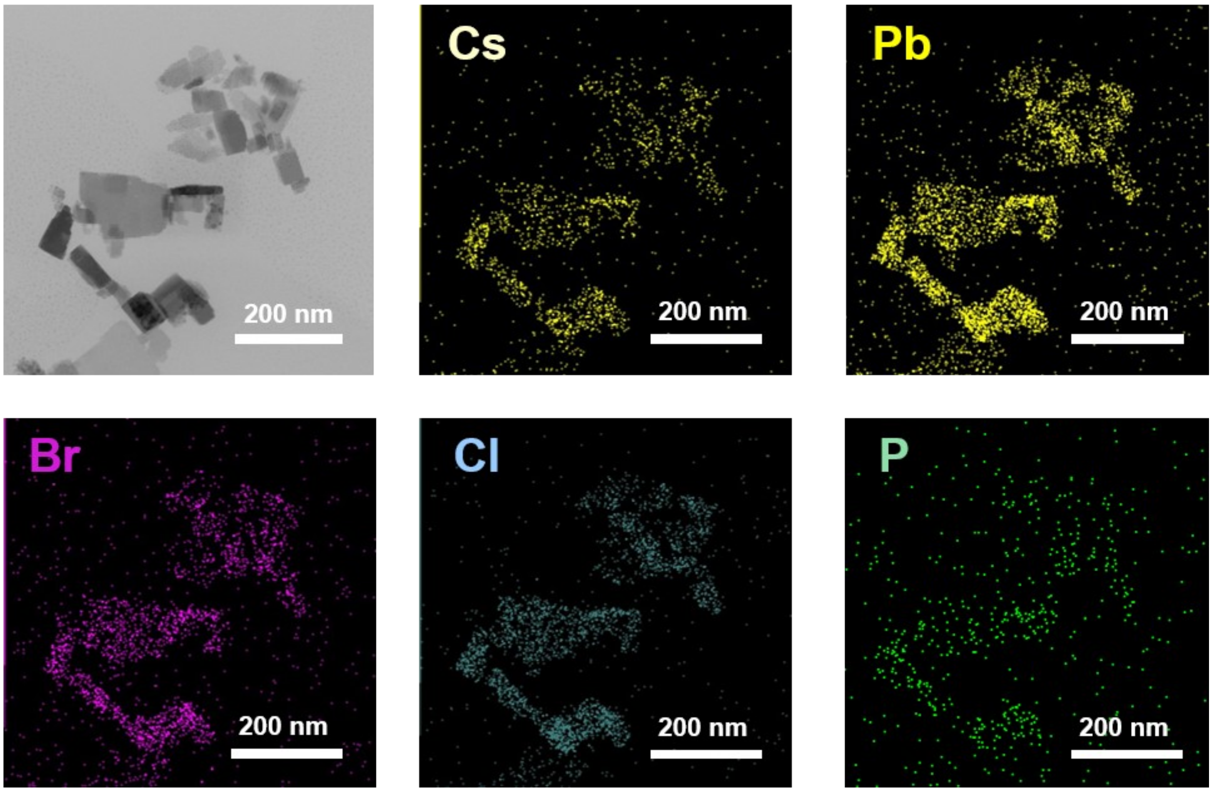

Figure S14. TEM images and corresponding elemental mapping of the DPH-treated NPLs at 440 nm.

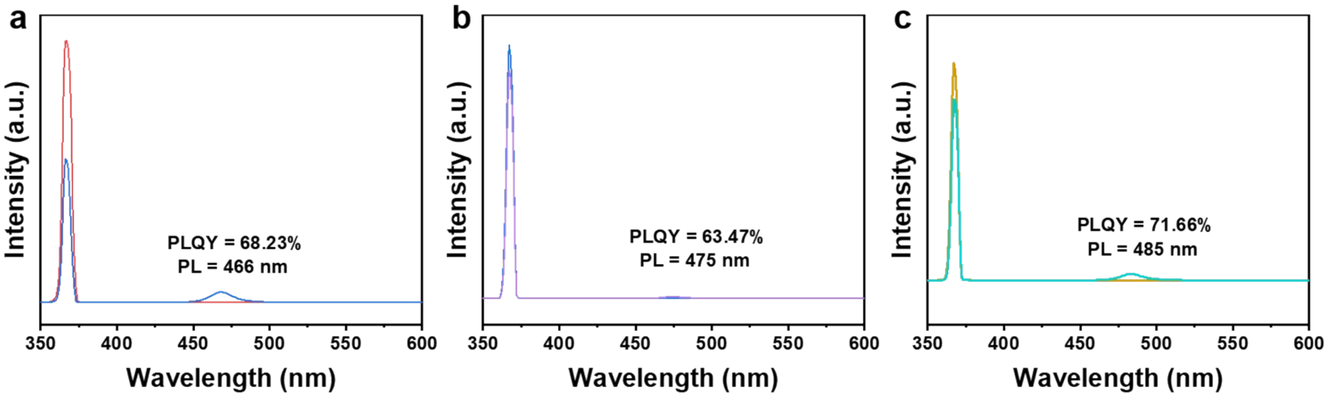

Figure S15. After UV irradiation 1 h, PLQY of DPH-treated NPLs at (a) 466 nm, (b)475 nm, (c) 485 nm.

Tabe S1. Summary of time-resolved PL fitting parameters of DPH-treated NPLs with different additions.

Sample	A_1	τ_1	A_2	τ_2	τ_{ave}	r_{non}	r
0 mg	2549	0.9	2281	4.3	3.7	202.1	67.7
2 mg	2871	1.9	2125	8.0	6.5	29.8	123.6
3 mg	3055	3.0	2015	9.0	7.0	17.4	125.4
4 mg	2817	2.5	2249	8.3	6.8	8.7	139.4

Table S2. Summary of the bleach recovery kinetics by fitting parameters of DPH-treated NPLs and pristine NPLs.

Sample	A_1	τ_1	A_2	τ_2	A_3	τ_3	τ_{ave}
Pristine	11.5	3.0	0.4	145.8	0.2	1328.2	1058.7
DPH	4.0	3.8	0.3	261.0	0.4	2113.2	1912.0

Tabe S3. The elemental contents of DPH-treated NPLs by EDS.

Sample	Cs	Pb	Br	Cl
precursor	66.93	25.37	1.81	5.89
430 nm	17.97	21.30	28.01	32.72
475 nm	14.22	15.56	64.76	5.46
485 nm	16.38	15.24	66.55	1.83