

Supplementary Information

Do the Halide Ions Exchange and Mix the Same Way in Fresh and Aged CsPbI₃ and CsPbBr₃ Perovskite Nanocrystals mixture?

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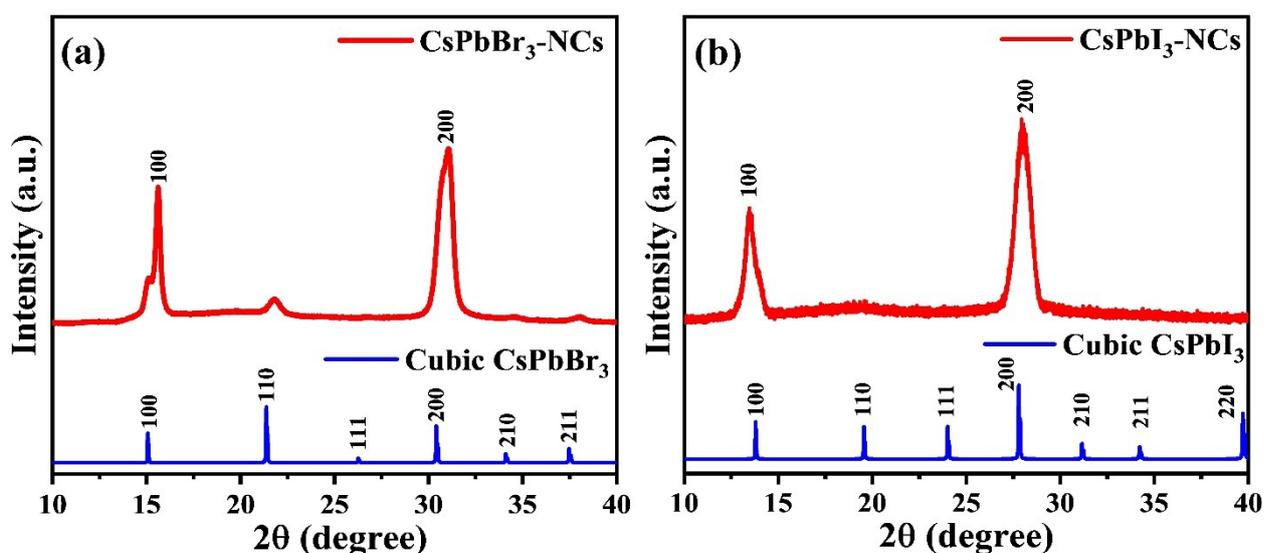


Figure S1. X-ray diffraction pattern for (a) CsPbBr₃-NCs and (b) CsPbI₃-NCs drop casted on Si (100) substrate. The standard X-ray diffraction peak positions for cubic CsPbBr₃ and CsPbI₃ phase is shown.

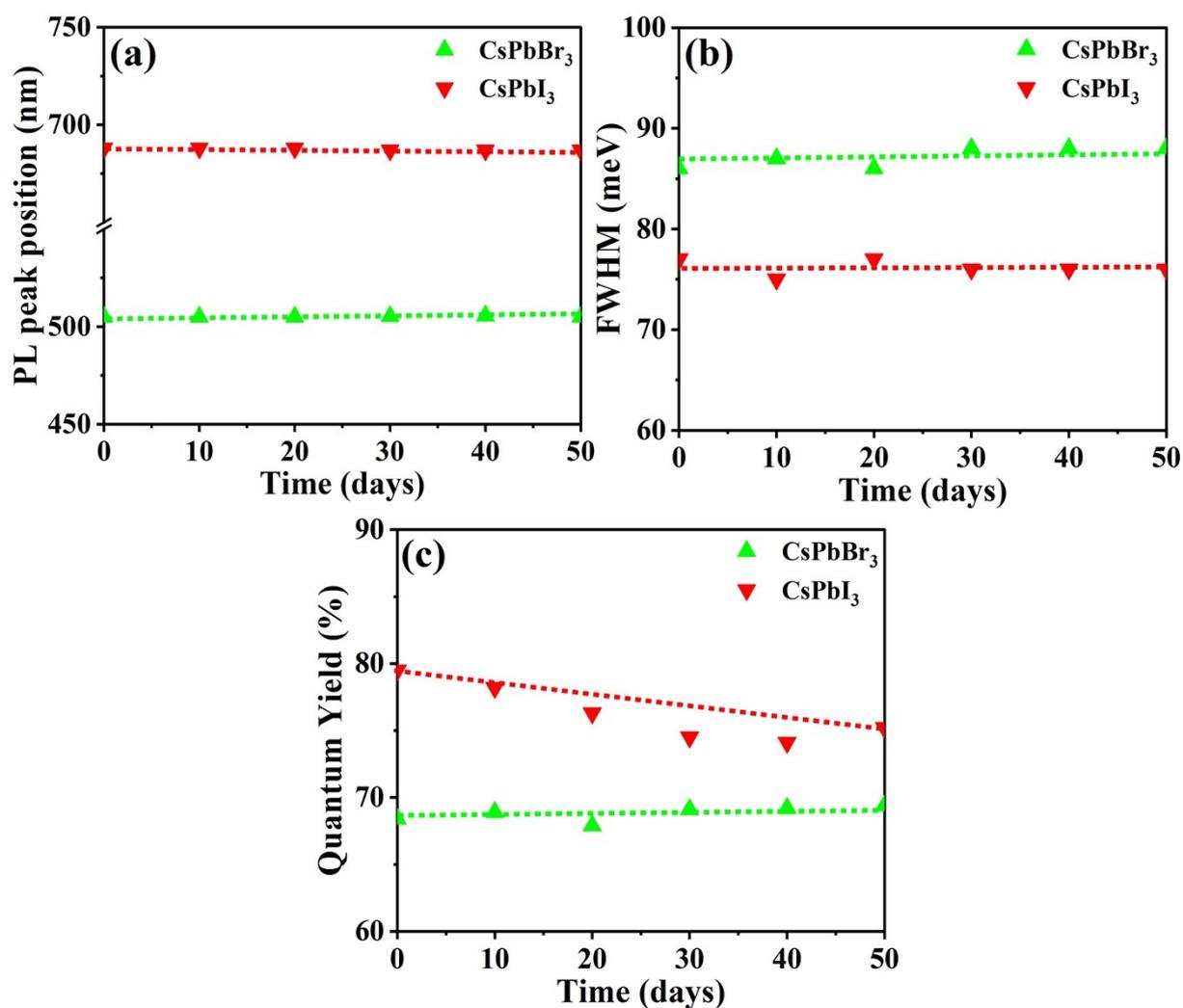


Figure S2. Time dependence of optical properties such as (a) PL emission peak, (b) Full width half maxima and (c) Quantum yield (%) in CsPbBr₃-NCs and CsPbI₃-NCs over a period of 50 days.

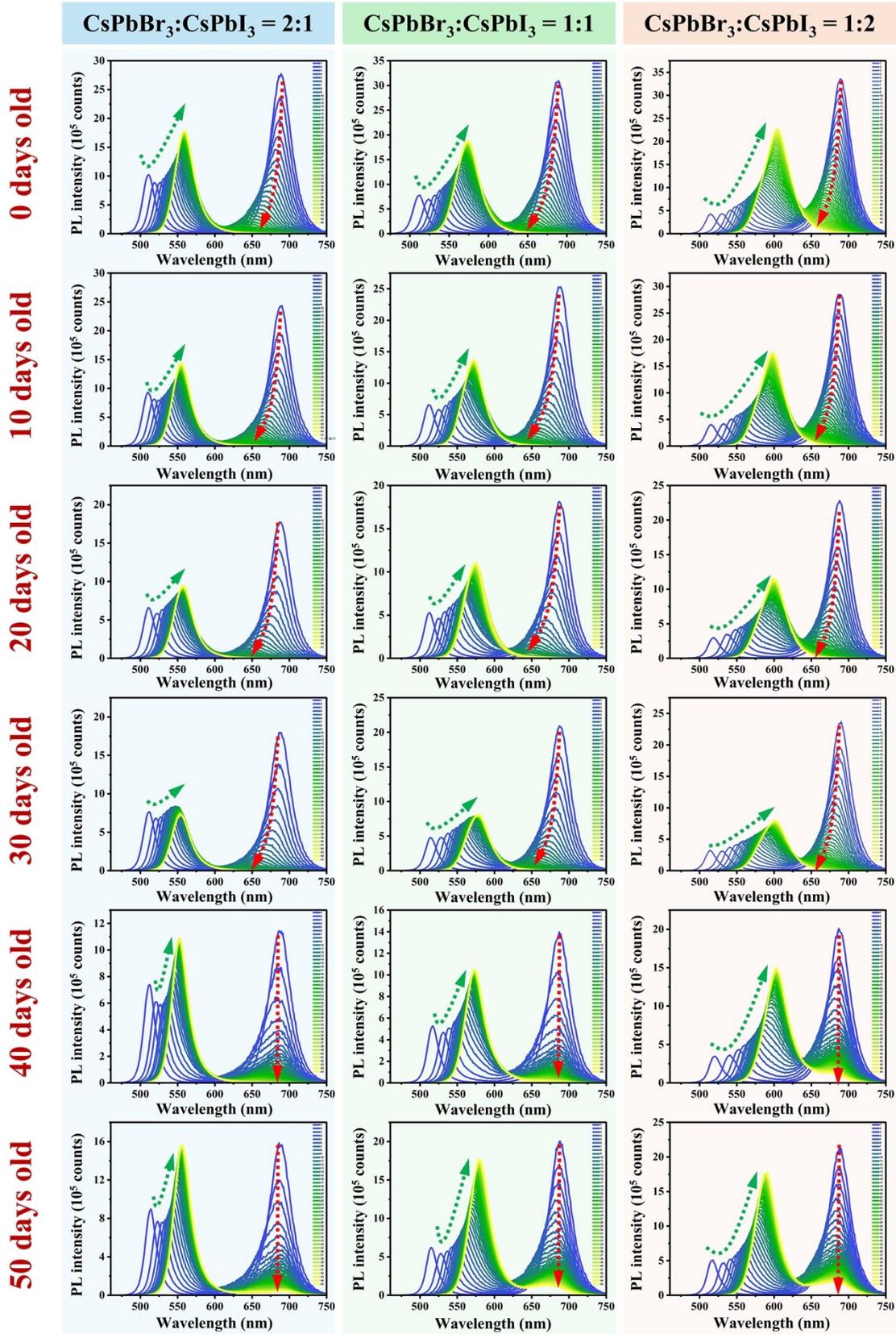


Figure S3. Ion mixing experiments carried out at an interval of 10 days, starting from 0 d to 50d old samples

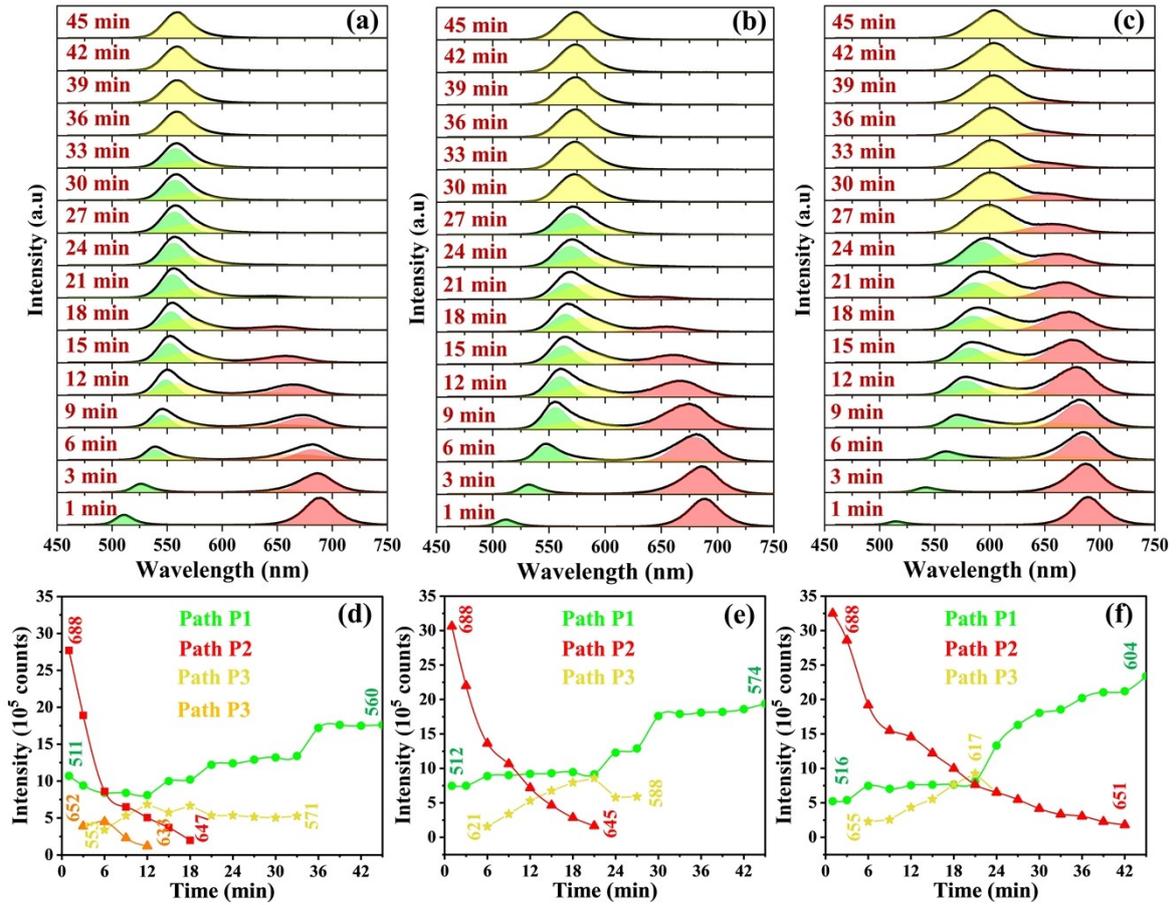


Figure S4. Deconvoluted PL plots of fresh CsPbBr₃:CsPbI₃ NCs samples mixed in various ratios (a) 2:1, (b) 1:1 and (c) 1:2. Panels (d–f) show the corresponding evolution of peak intensity and position for the three distinct emission pathways (P1, P2, and P3) over time for each respective mixing ratio. The initial and final PL peak positions are annotated with their corresponding emission wavelengths and marked in their respective colours.

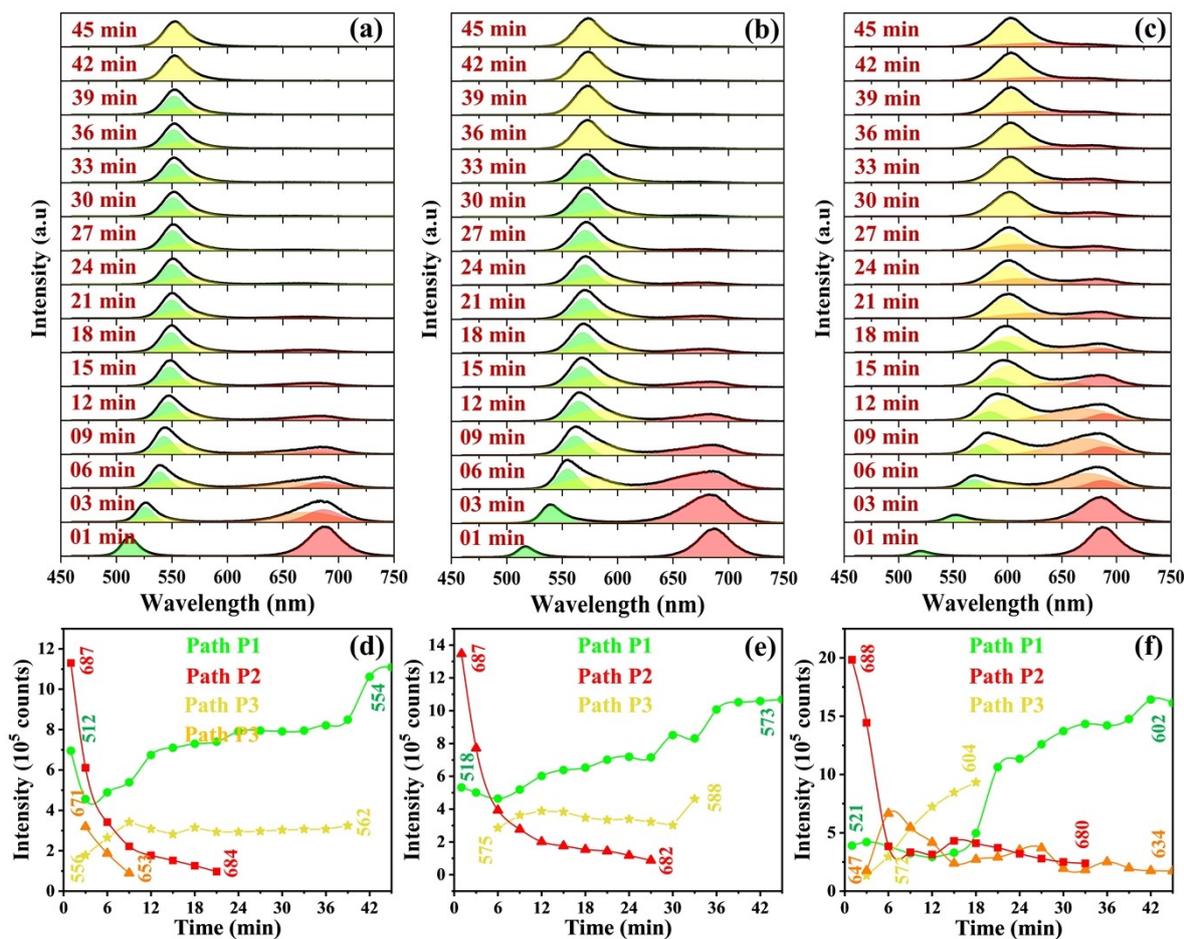


Figure S5. Deconvoluted PL plots of aged CsPbBr₃:CsPbI₃ NCs samples mixed in various ratios (a) 2:1, (b) 1:1 and (c) 1:2. Panels (d–f) show the corresponding evolution of peak intensity and position for the three distinct emission pathways (P1, P2, and P3) over time for each respective mixing ratio. The initial and final PL peak positions are annotated with their corresponding emission wavelengths and marked in their respective colours.

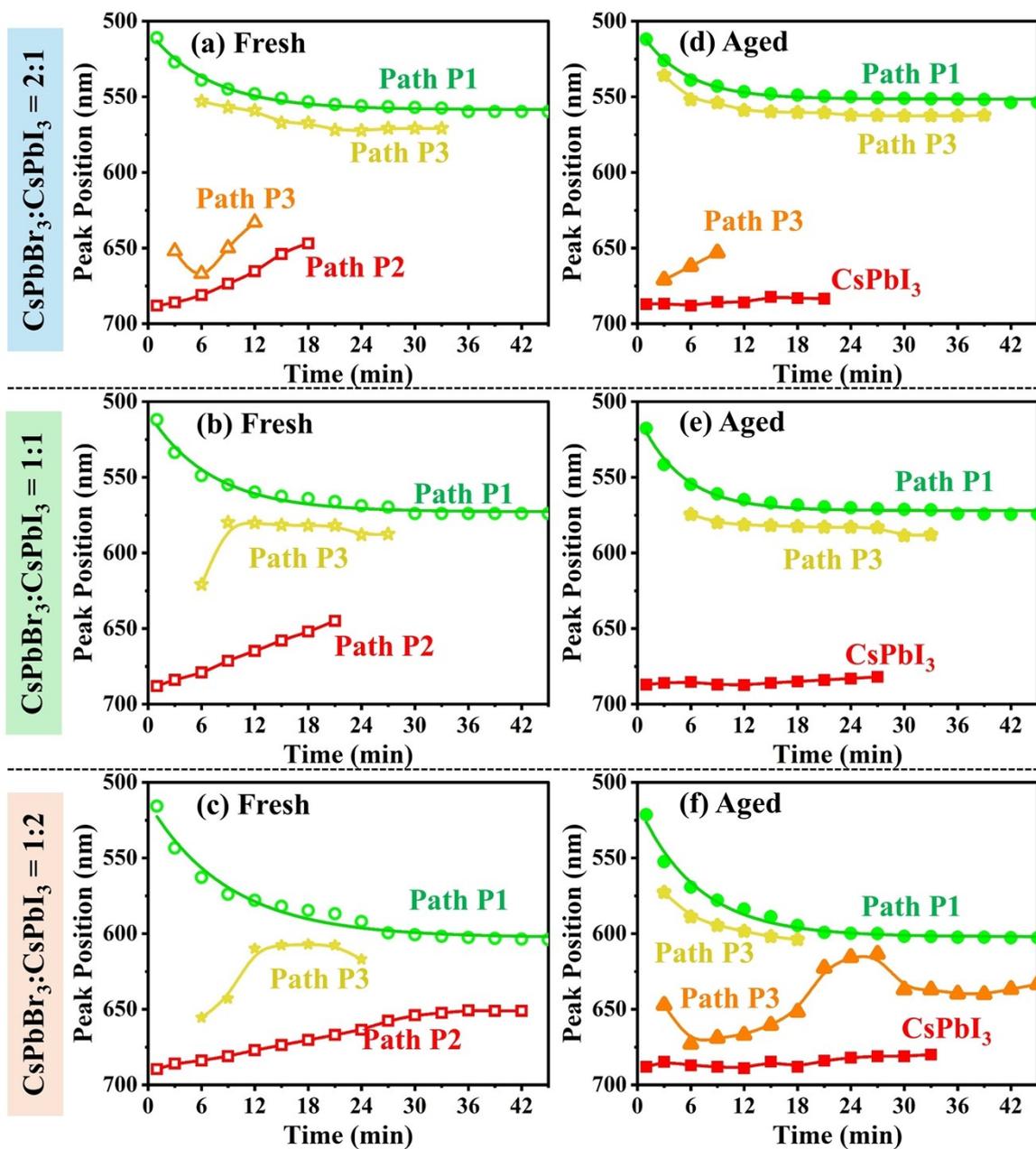
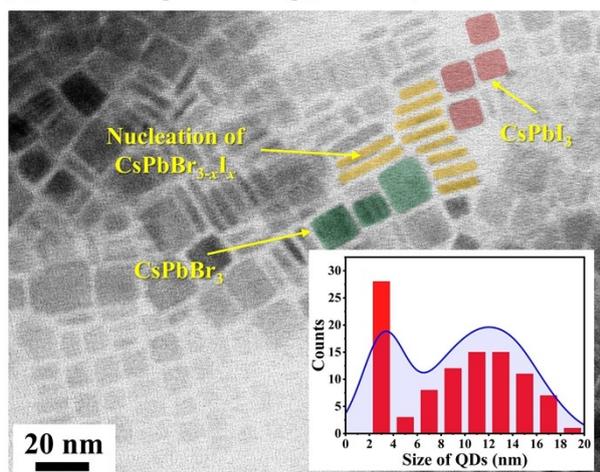


Figure S6. Time dependence of bromine side peak shift (Path P1, in green), new mixed halide phase peak shift (Path P2, in orange) and iodine side peak shift (Path P2, in red) after mixing of (a) fresh and (b) 40 days aged NCs. The paths P1, P2 and P3 in scheme 1 is discussed later.

(a) Initial Stage of mixing (t~ 3 min)



(b) Final Stage of mixing (t~ 30 min)

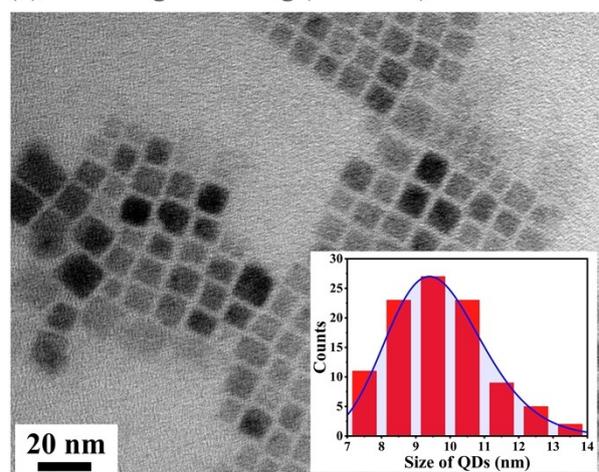


Figure S7. HRTEM images depicting the evolution of fresh NCs during halide mixing. (a) Initial stage showing distinct phases of CsPbBr₃ (green), CsPbI₃ (red), and the nucleation of intermediate mixed-halide CsPbI_{3-x}I_x (yellow) nanocrystals. (b) Final stage where the system reaches ion exchange equilibrium, resulting in uniformly mixed-halide perovskite quantum dots. Insets in both panels show the corresponding size distribution histograms of the NCs at each stage.

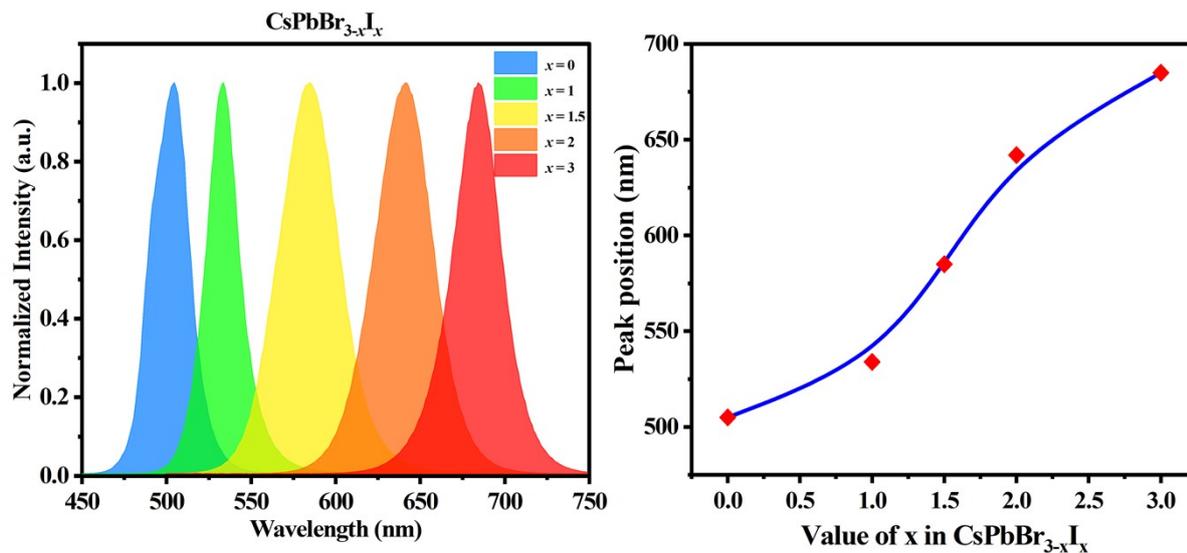


Figure S8. Photoluminescence spectra of $\text{CsPbBr}_{3-x}\text{I}_x$ -NCs directly obtained by hot injection method using precursors with required PbI_2 and PbBr_2 during the. The peaks position as a function of Br:I ratio are used as a calibration to infer the composition evolving during aging process.

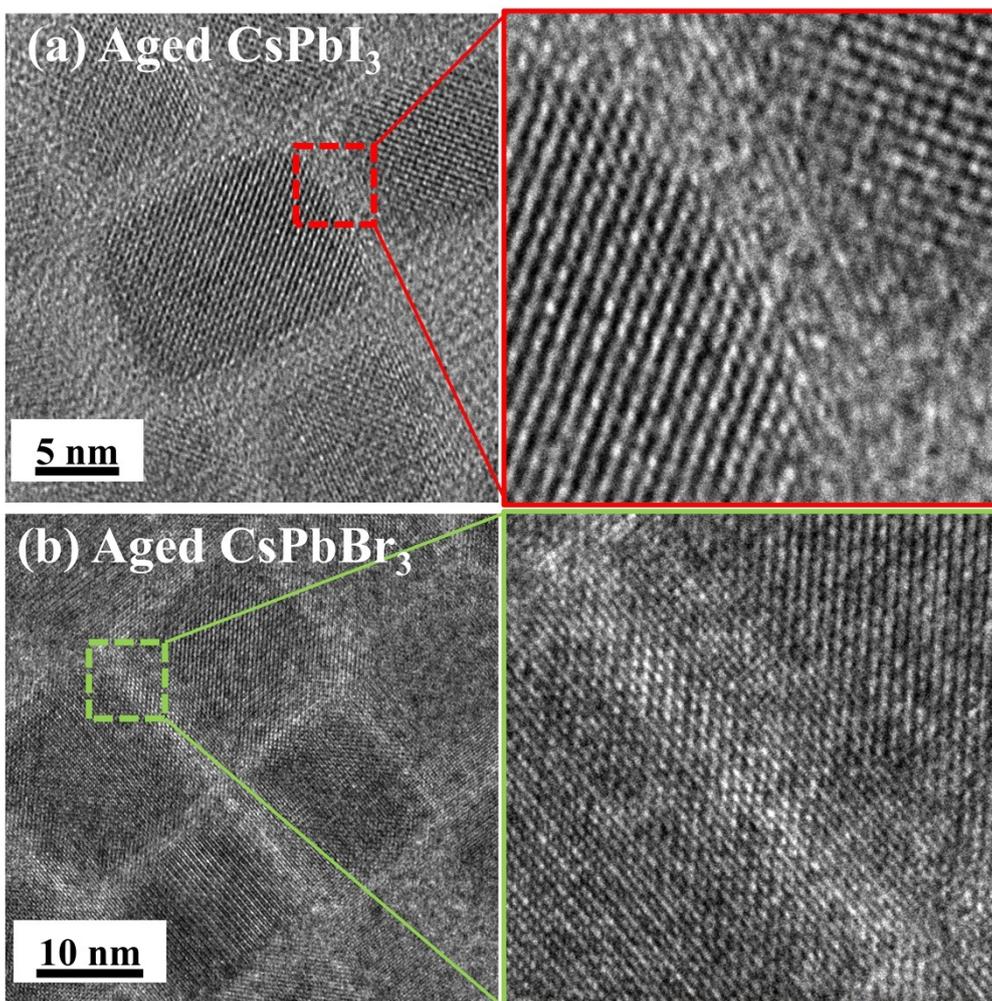


Figure S9. The HRTEM images of aged (a) CsPbI_3 and (b) CsPbBr_3 NCs.

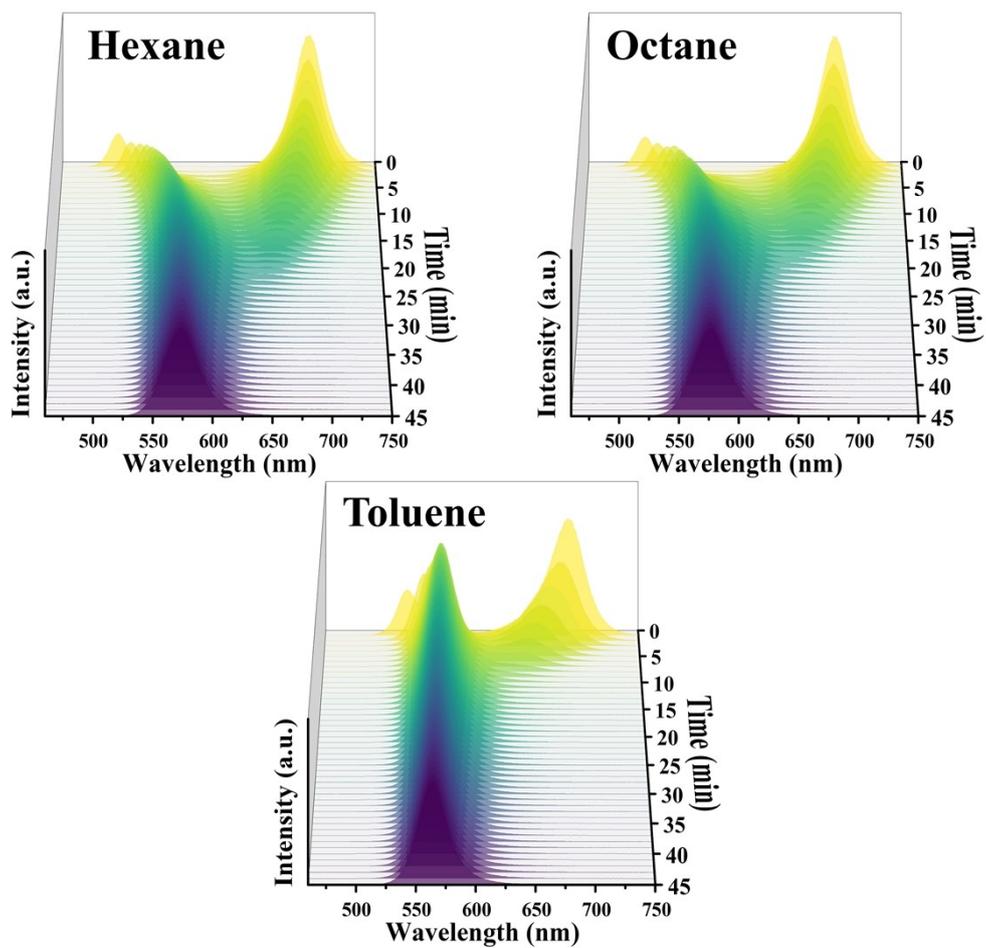


Figure S10. The halide ion mixing and its dependence on the solvents