

Supporting information

CsPbX₃/SiO_x (X=Cl, Br, I) Monoliths Prepared via a Novel Sol-gel route Starting from Cs₄PbX₆ Nanocrystals

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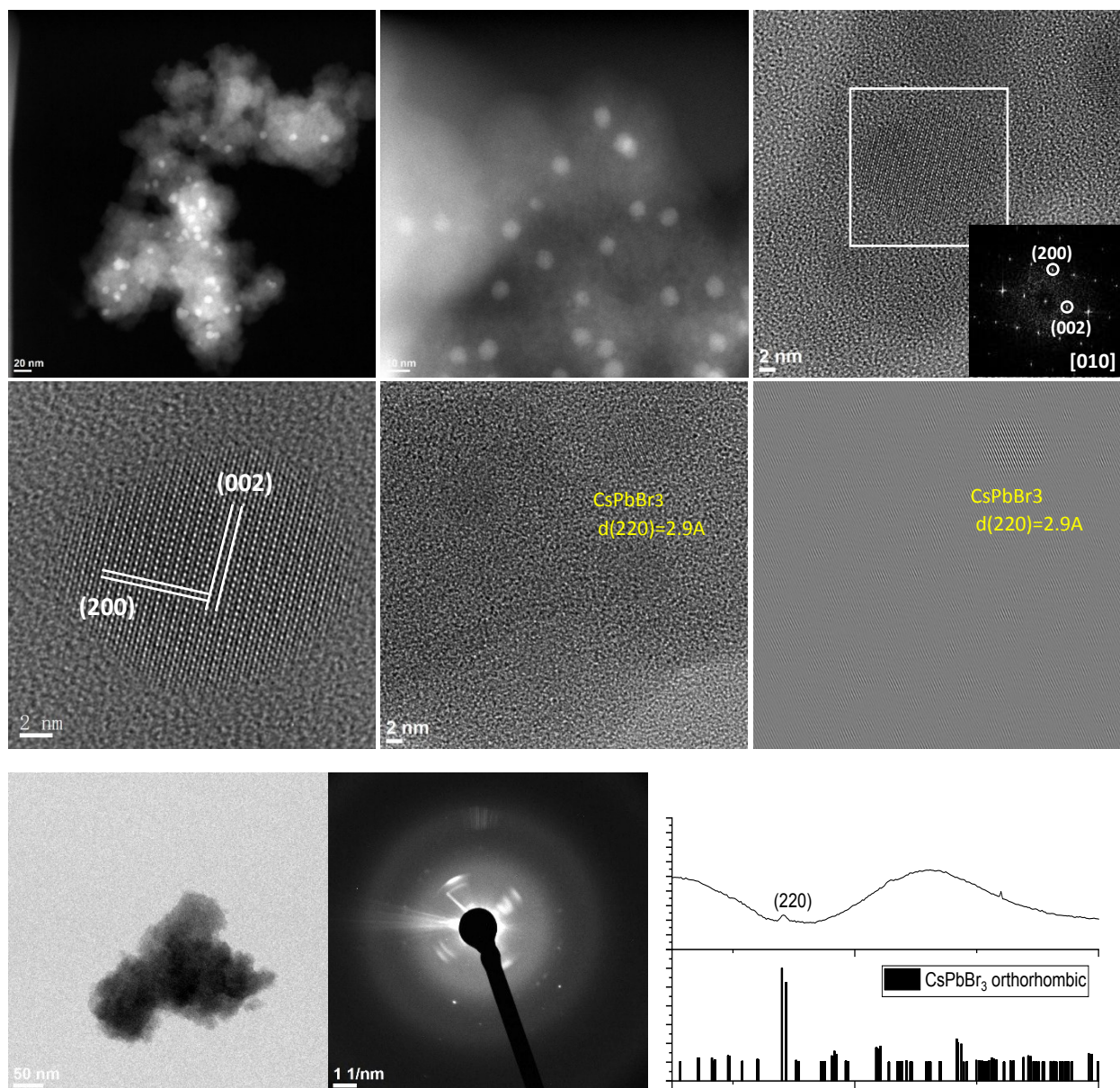


Fig. S1. HAADF-STEM images, HR-TEM images (inset shows the FFT analysis) and filtered HR-TEM image, SAED pattern and corresponding Azimuthal integration in comparison with reference cards for the orthorhombic CsPbBr_3 phase of $\text{CsPbBr}_3/\text{SiO}_x$ composite.

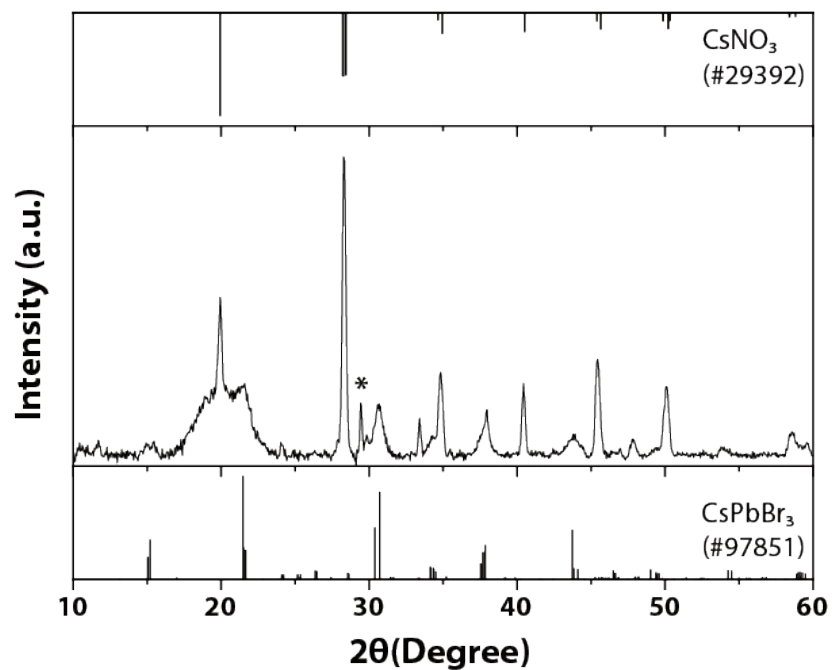
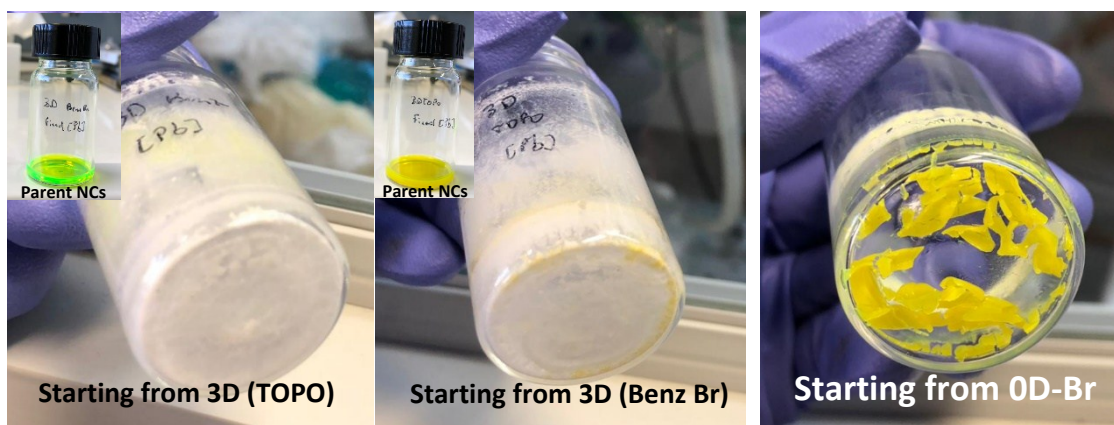
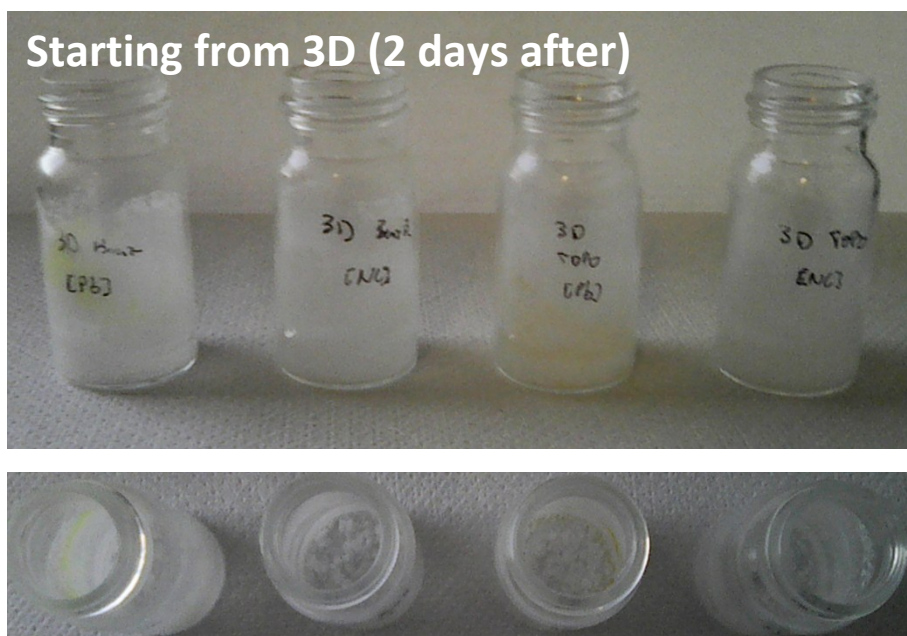


Fig. S2. XRD pattern of the product of the reaction between Cs_4PbBr_6 NCs and HNO_3 . The sample consists of a mixture of CsPbBr_3 , CsNO_3 and CsBr (The asterisk indicates the main peak of CsBr).



- Only white powders (no emission) were obtained by using CsPbBr_3 NCs
- Homogenous green emitting gel was obtained by using Cs_4PbBr_6 NCs

Fig. S3. Comparative experiment of sol-gel process starting from oD and 3D NCs.

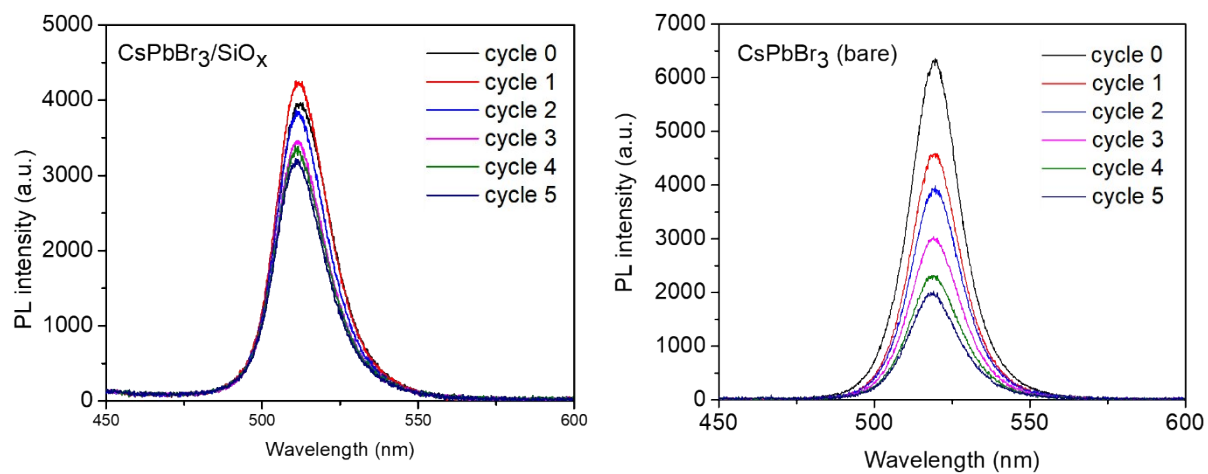
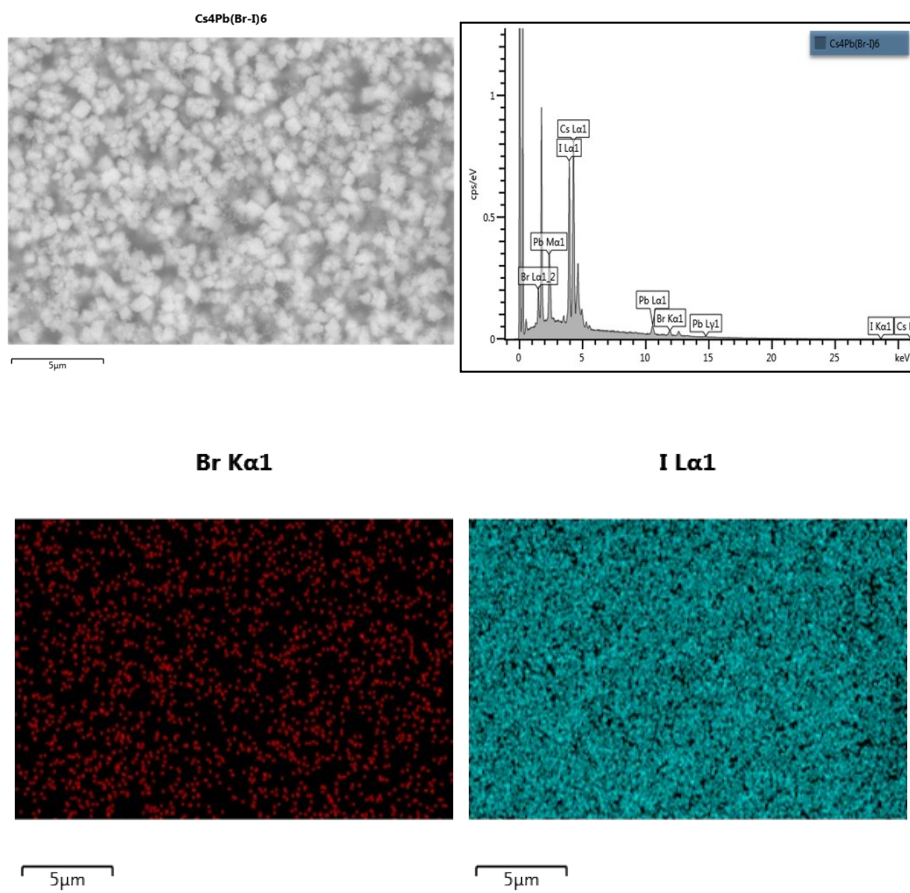


Fig. S4. Thermal stability test: PL spectrum of CsPbBr₃/SiO_x composite (left) and bare CsPbBr₃ NCs (right) were recorded at RT after each heat-up/cool-down cycle



Cs ₄ Pb(Br-I) ₆	Line Type	Wt%	Wt% Sigma	Atomic %
Br	K series	10.84	0.92	16.18
I	L series	89.16	0.92	83.82
Total		100.00		100.00

Fig. S5. EDS elemental mappings of the halide anions of Cs₄Pb(Br,I)₆ system. The bromine and iodine distribution was visualized.

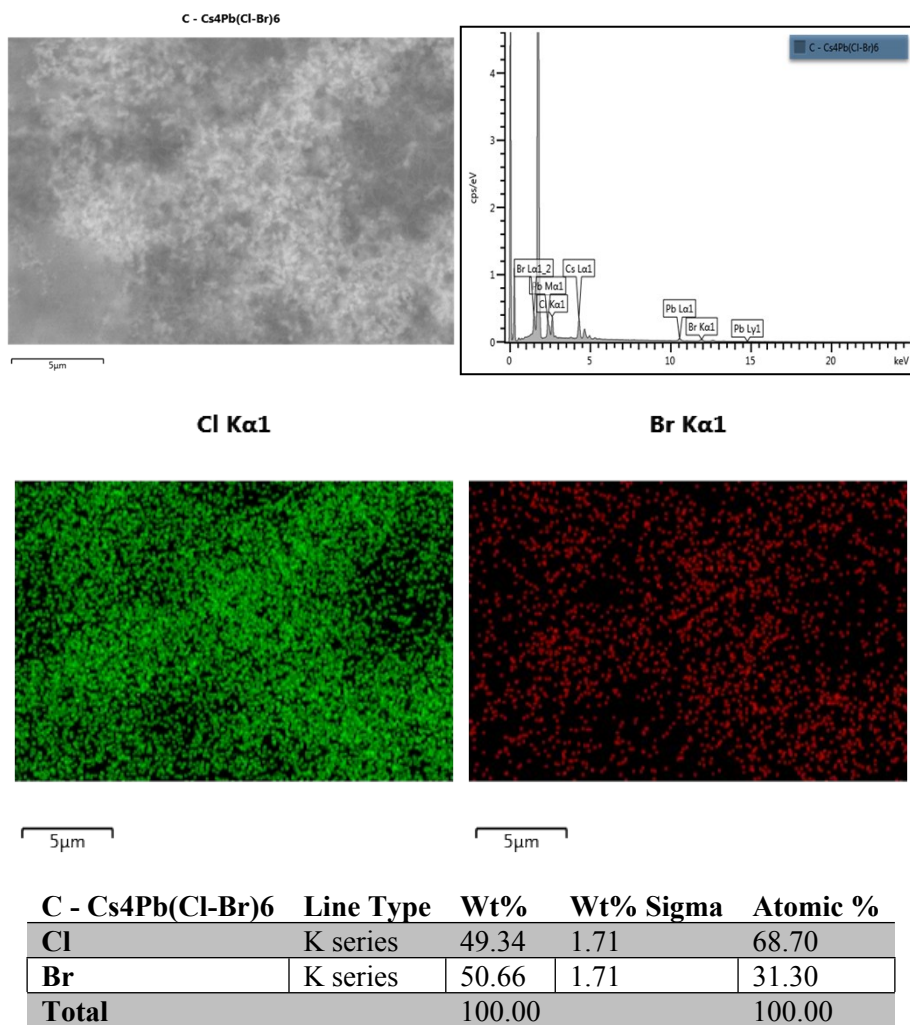


Fig. S6. EDS elemental mappings of the halide anions of Cs₄Pb(Cl,Br)₆ system. The chlorine and bromine distribution was visualized.

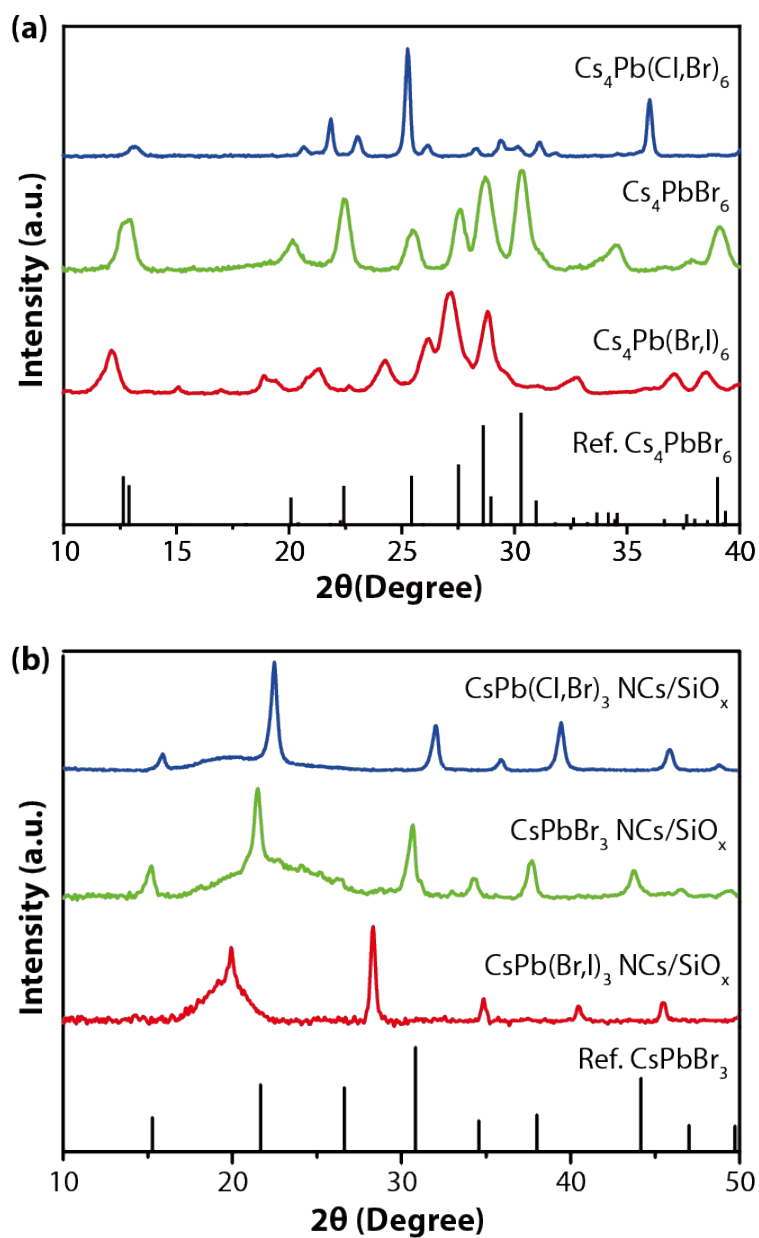
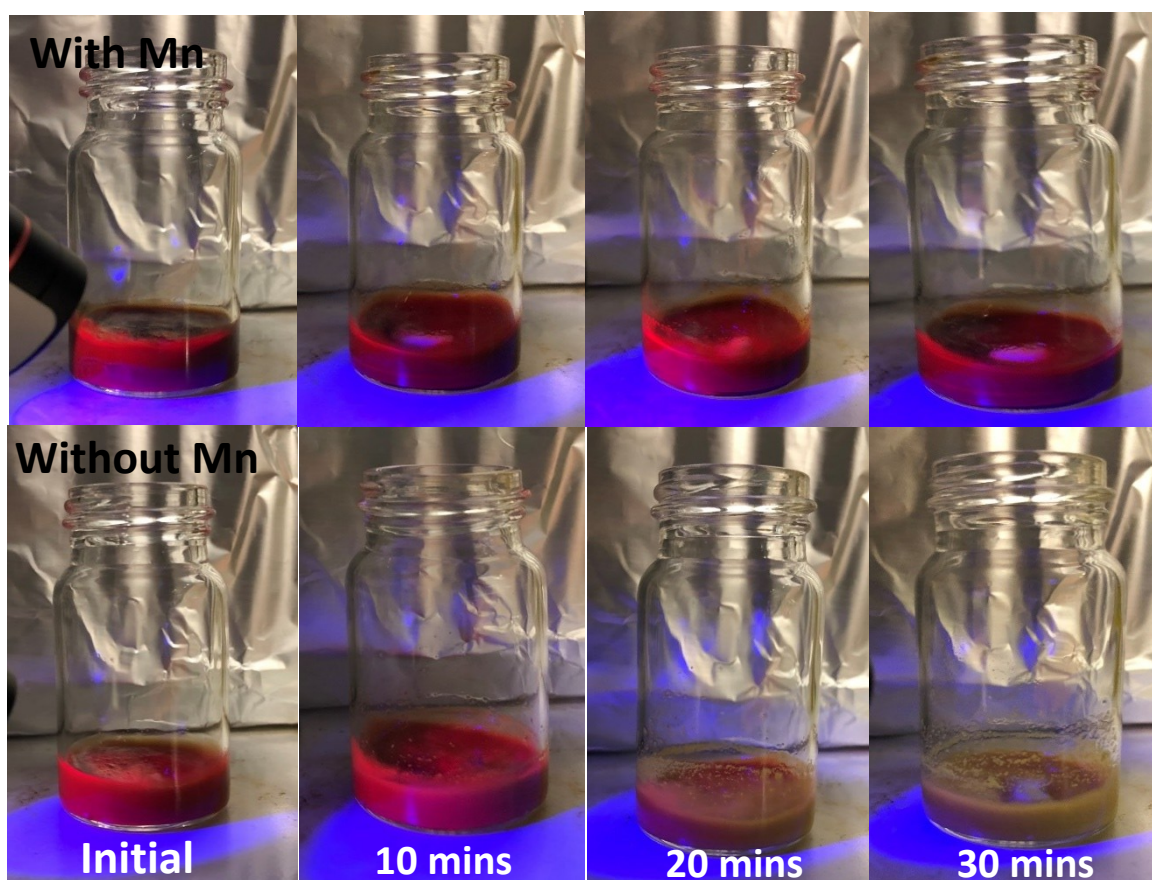


Fig. S7. XRD patterns of (a) Cs_4PbX_6 NCs and (b) $\text{CsPbBr}_3/\text{SiO}_x$ matching with the Cs_4PbBr_6 (98-002-5124) and CsPbBr_3 reference patterns (98-018-1287).



- In the absence of Mn^{2+} ions the mixture solution turned into brown and did not exhibit any PL emission.

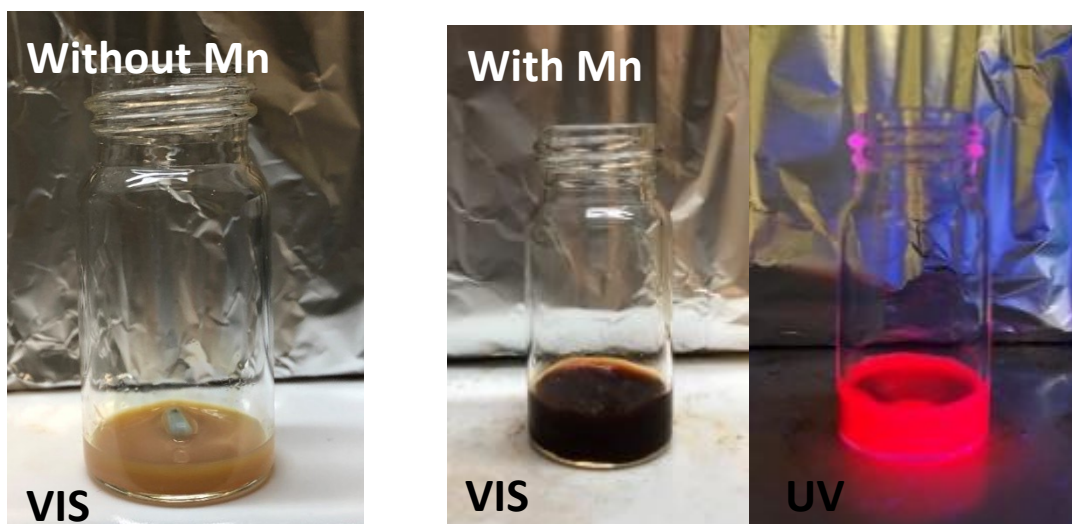


Fig. S8. Visualization of Mn-doped/non-doped $\text{CsPb}(\text{Br},\text{I})_3/\text{SiO}_x$ gelation process.