Supporting information

$CsPbX_3/SiO_x$ (X=Cl, Br, I) Monoliths Prepared via a Novel Sol-gel route Starting from Cs_4PbX_6 Nanocrystals

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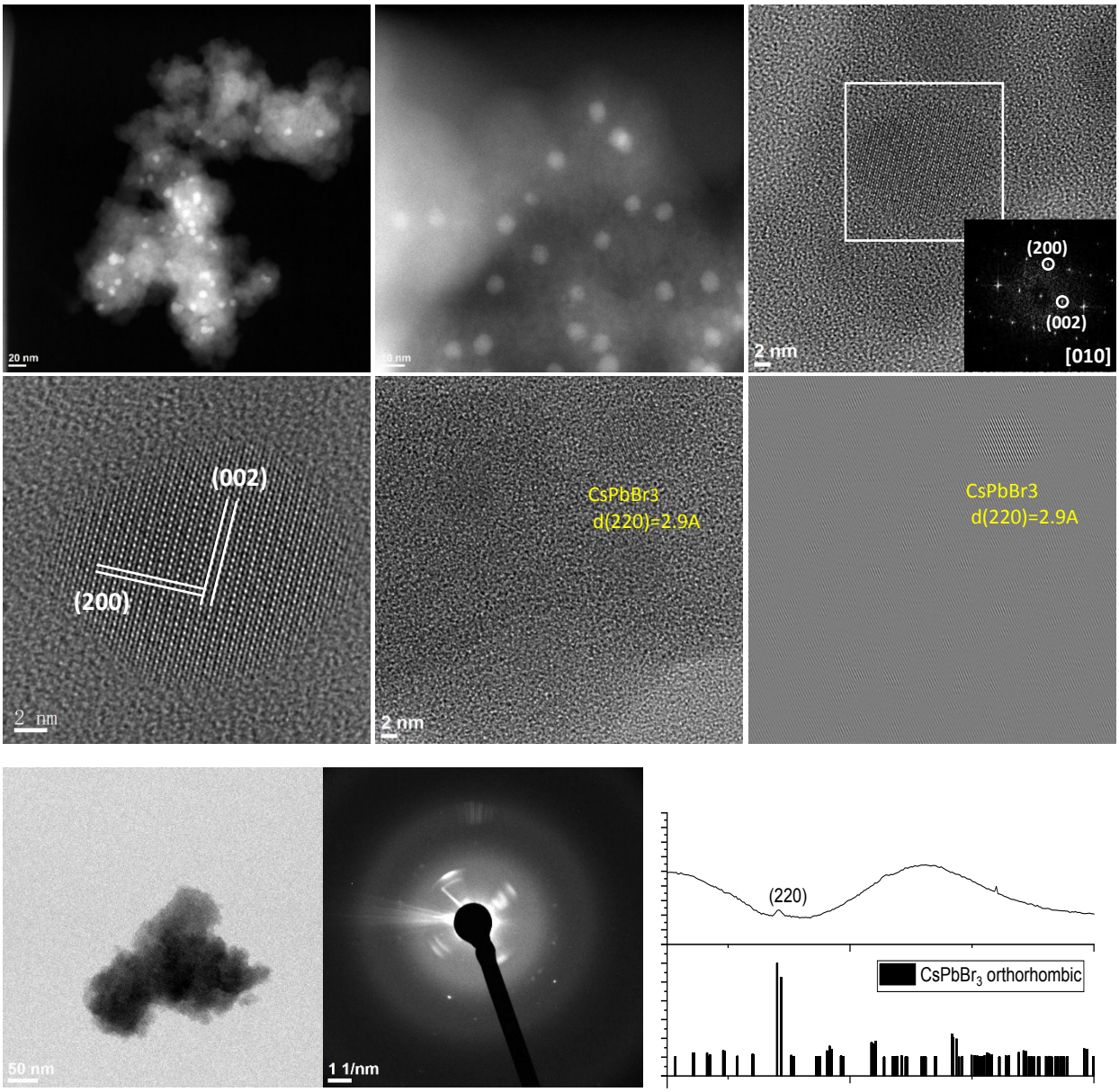


Fig. S1. HAADF-STEM images, HR-TEM images (inset shows the FFT analysis) and filtered HR-TEM image, SAED pattern and corresponding Azimuthal integration in comparison with reference cards for the orthorhombic $CsPbBr_3$ phase of $CsPbBr_3/SiO_x$ composite.

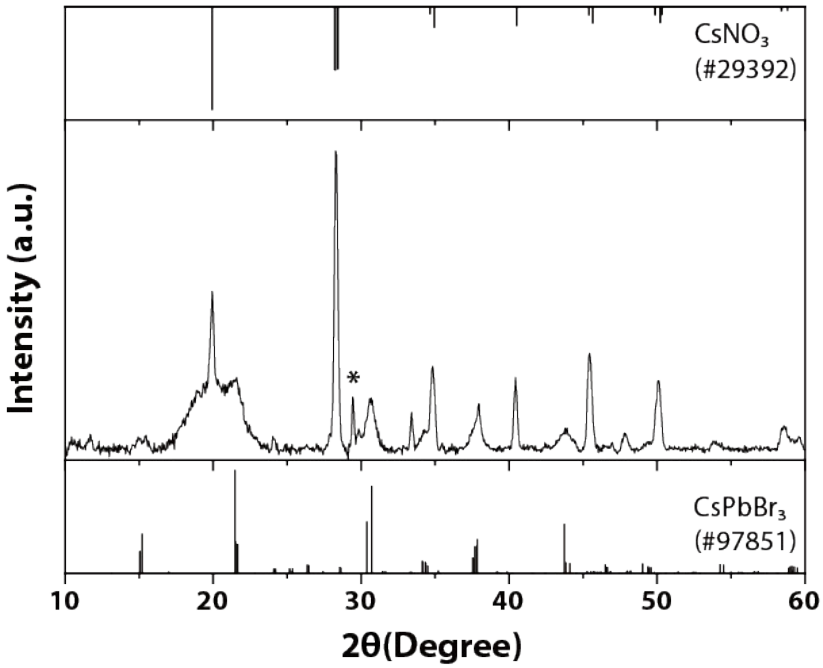
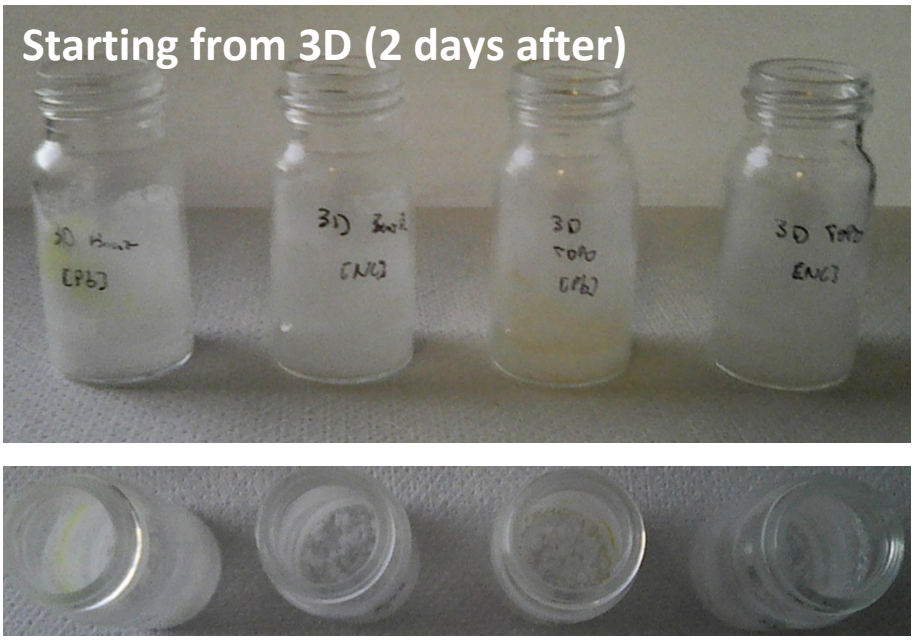
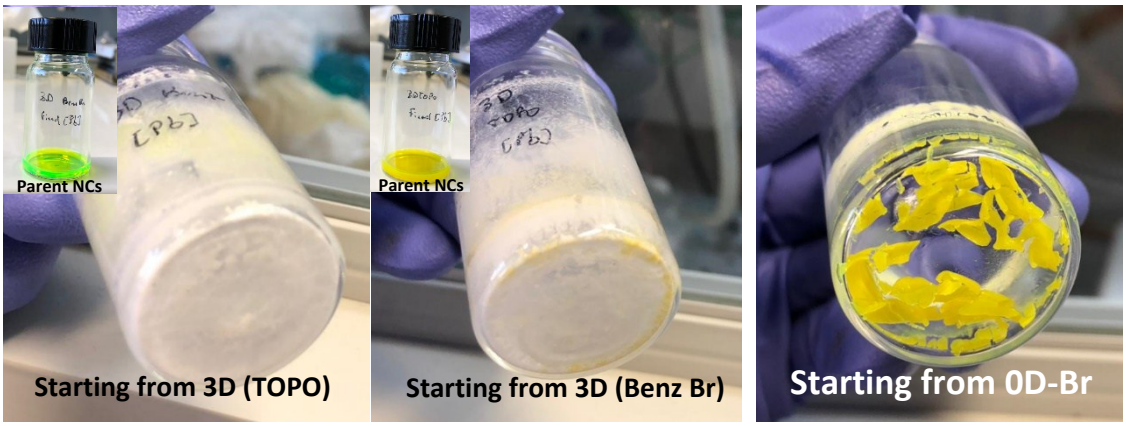


Fig. S2. XRD pattern of the product of the reaction between Cs_4PbBr_6 NCs and HNO_3. The sample consists of a mixture of CsPbBr , $CsNO_3$ and CsBr (The asterisk indicates the main peak of CsBr).





- 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 0D and 3D NCs.

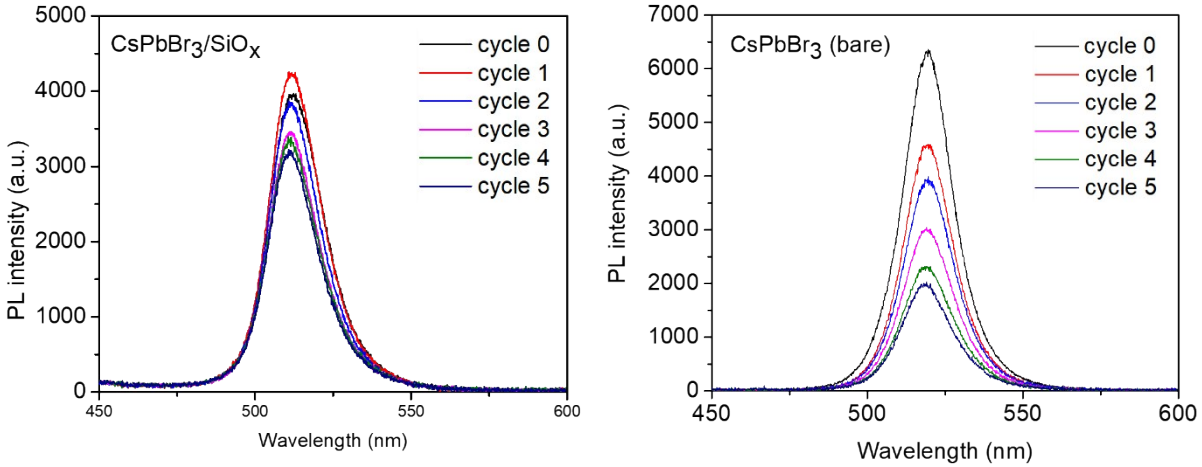
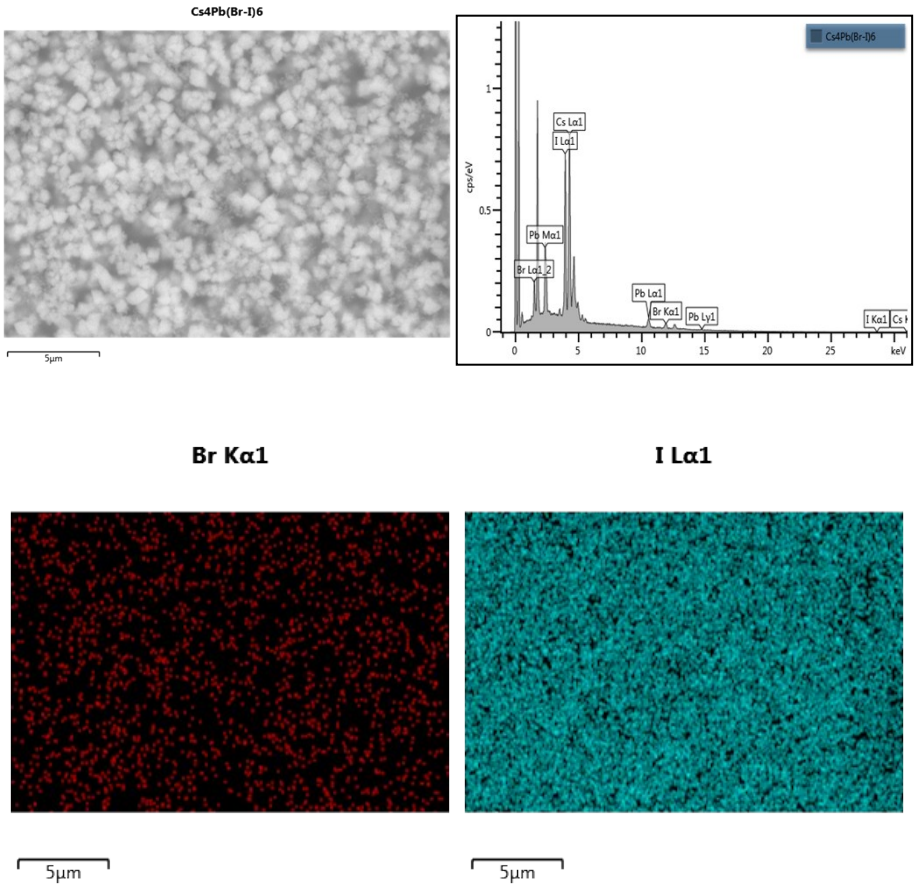
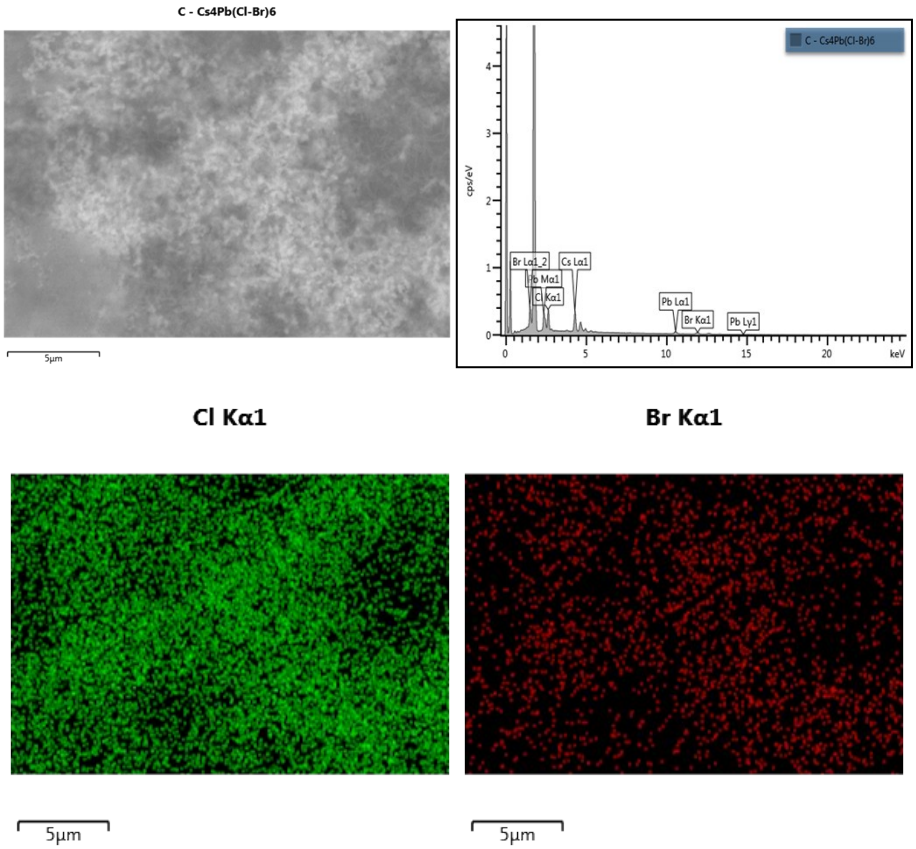


Fig. S4. Thermal stability test: PL spectrum of $CsPbBr_3$/SiOx composite (left) and bare $CsPbBr_3$ NCs (right) were recorded at RT after each heat-up/cool-down cycle



Cs4Pb(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 $Cs_4Pb(Br,I)_6$ system. The bromine and iodine distribution was visualized.



C - Cs4Pb(Cl-Br)6	Line Type	Wt%	Wt% Sigma	Atomic %
Cl	K series	49.34	1.71	68.70
Br	K series	50.66	1.71	31.30
Total		100.00		100.00

Fig. S6. EDS elemental mappings of the halide anions of $Cs_4Pb(Cl,Br)_6$ system. The chlorine and bromine distribution was visualized.

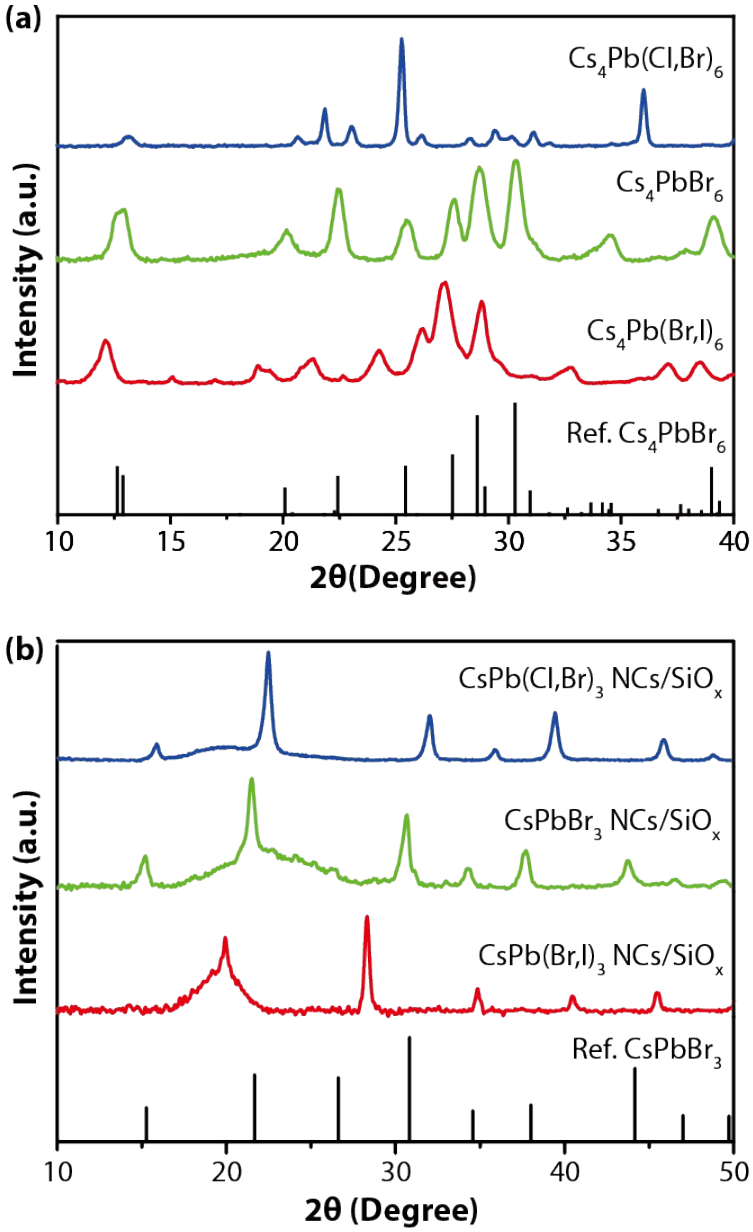
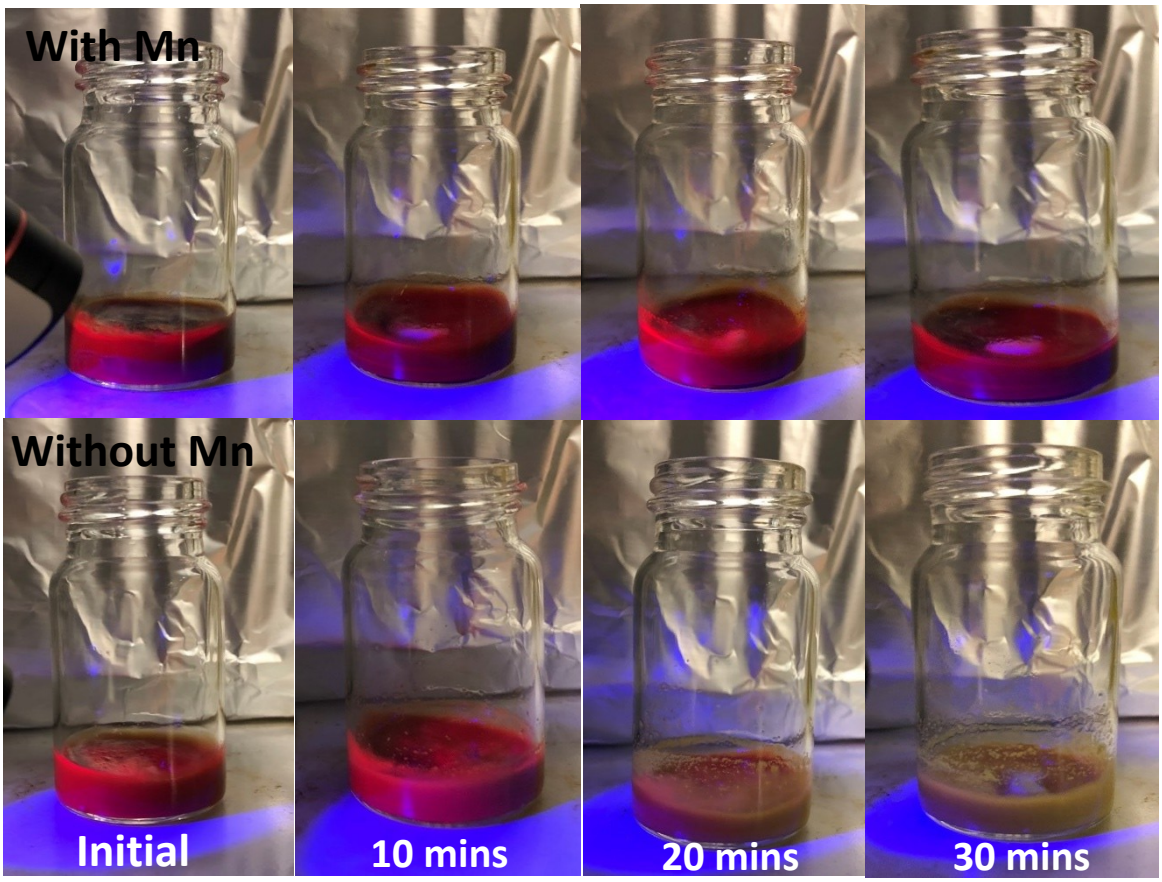


Fig. S7. XRD patterns of (a) Cs_4PbX_6 NCs and (b) $CsPbBr_3$/SiOx matching with the Cs_4PbBr_6 (98-002-5124) and $CsPbBr_3$ reference patterns (98-018-1287).



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

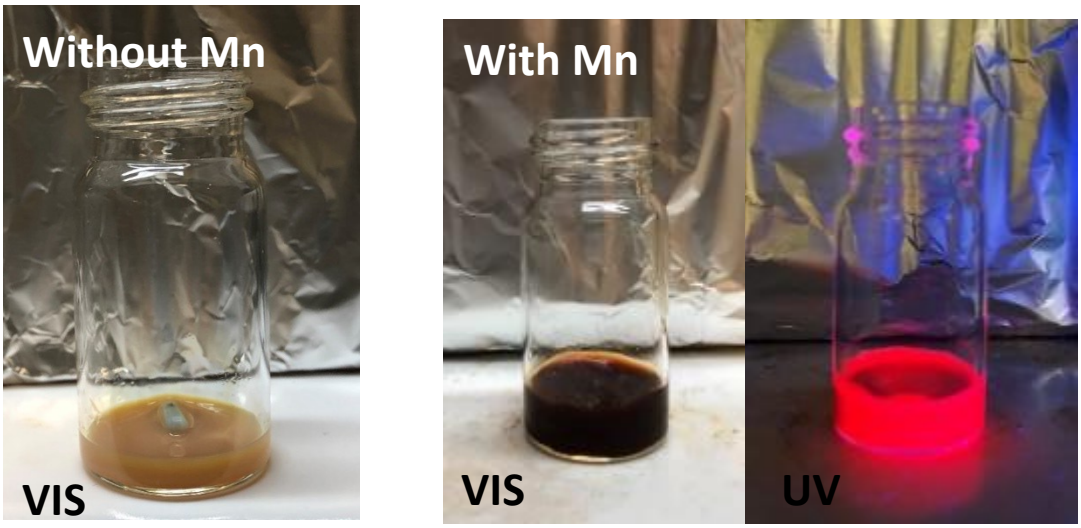


Fig. S8. Visualization of Mn-doped/non-doped $CsPb(Br,I)_3/SiO_x$ gelation process.