

Stabilizing Red-emissive All-inorganic Perovskite Nanocrystal by Ligands-mediated Room-temperature Procedure

Ling Li^a, Hao Dong^a, Yongfei Hu^a, Tao Zeng^b, Yunxia Chen^b, Kwadwo Mensah-Darkwa^c,
Emmanuel Tsiwah Acheampong^c, Ghafar Ali^d, Yi Xie^{a,*}

^aState Key Laboratory of Silicate Materials for Architectures, Wuhan University of Technology (WUT), No. 122, Luoshi Road, Wuhan 430070, P. R. China.

^bSchool of Materials Science and Engineering, Jingdezhen Ceramic Institute (Xianghu Campus), Xianghu Road, Jingdezhen, Jiangxi 333403, P.R. China.

^cDepartment of Materials Engineering, Faculty of Mechanical and Chemical Engineering College of Engineering, Kwame Nkrumah University of Science and Technology. Kumasi – Ghana.

^dNanomaterials Research Group (NRG), Physics Division, PINSTECH, Nilore, Islamabad, Pakistan.

Email: xiey@whut.edu.cn

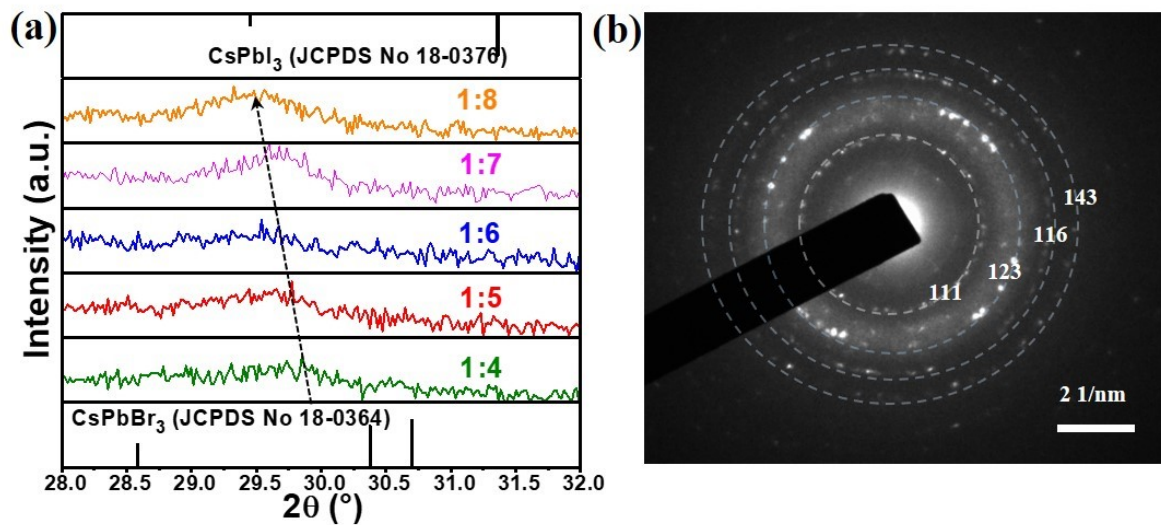


Fig. S1 (a) XRD patterns of the various $\text{CsPbBr}_x\text{I}_{3-x}$ nanocrystals synthesized in the presence of 0.05 mL MPA and different $\text{PbBr}_2:\text{PbI}_2$ precursor ratios as dictated. (b) The selective area electron diffraction (SAED) pattern of the typical sample achieved in the presence of 0.05 mL of MPA, confirming a well-defined crystal structure of the as-formed nanocrystals.

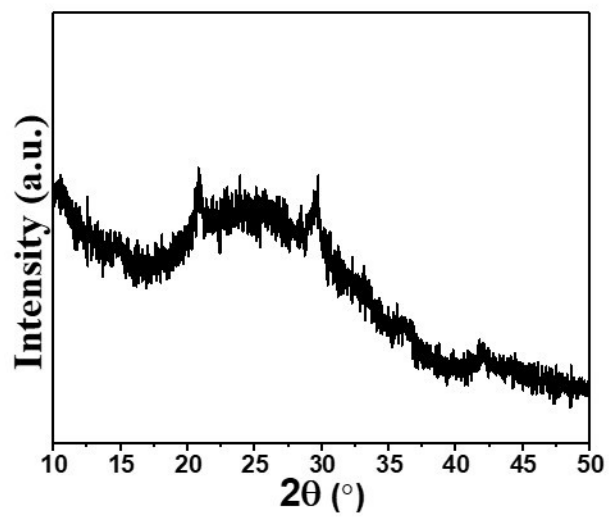


Fig. S2 XRD pattern the scaled-up (by a factor of 80) synthesized red-emissive $\text{CsPbBr}_x\text{I}_{3-x}$ perovskite NCs obtained in the presence of $\text{PbBr}_2:\text{PbI}_2$ precursor ratio of 1:5.

Table S1 *The summarization on the optical characterization of the nanocrystals achieved in the presence of different $PbBr_2:PbI_2$ precursor ratios.*

$PbBr_2:PbI_2$	PL Peak (nm)	FWHM (nm)
1:4	607 nm	40 nm
1:5	622 nm	38 nm
1:6	636 nm	40 nm
1:7	642 nm	35 nm
1:8	651 nm	34 nm

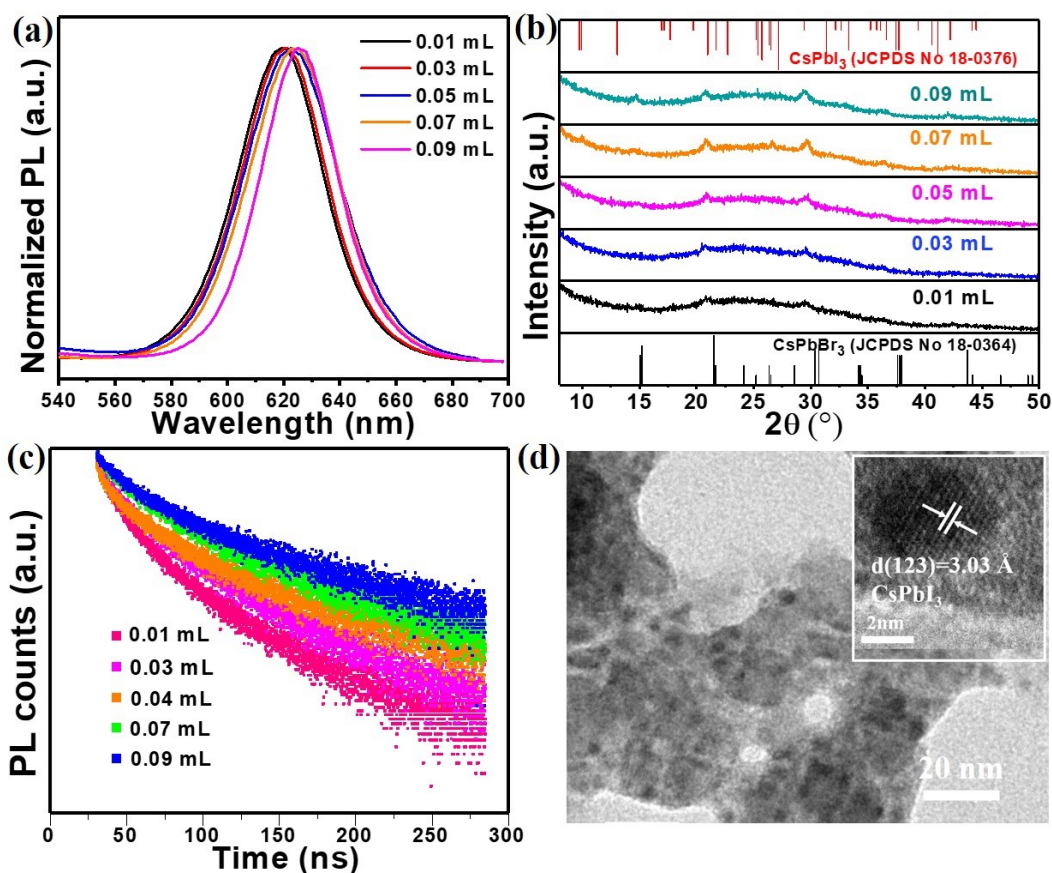


Fig. S3 PL spectra (a), XRD patterns (b), and time-resolved PL decays curves (c) of the various CsPbBr_xI_{3-x} nanocrystals synthesized in the presence of different amounts of MPA as dictated in each panel. (d) TEM images of the representative CsPbBr_xI_{3-x} nanocrystals formed in the presence of 0.07 mL of MPA. The PbBr₂:PbI₂ precursor ratio for all the samples is fixed as 1:5.

Table S2 *The summarization on the optical characterization of the CsPbBr_xI_{3-x} nanocrystals achieved in the presence of different amounts of MPA.*

MPA (mL)	PL Peak (nm)	FWHM (nm)	PL decay lifetime (ns)
0.01	620 nm	34 nm	15.2
0.03	621 nm	35 nm	24.6
0.05	622 nm	38 nm	31.3
0.07	623 nm	36 nm	36.8
0.09	625 nm	32 nm	59.6

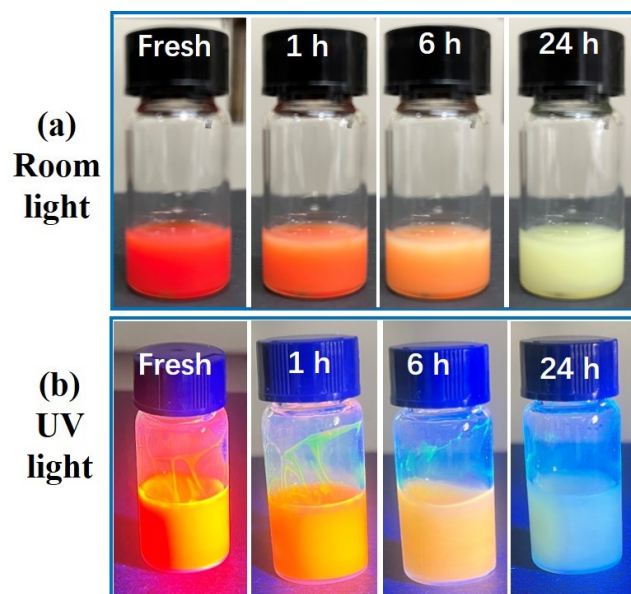


Fig. S4 Photographs of the various NC dispersions synthesized in the absence of MPA, followed by exposure to air for different time.

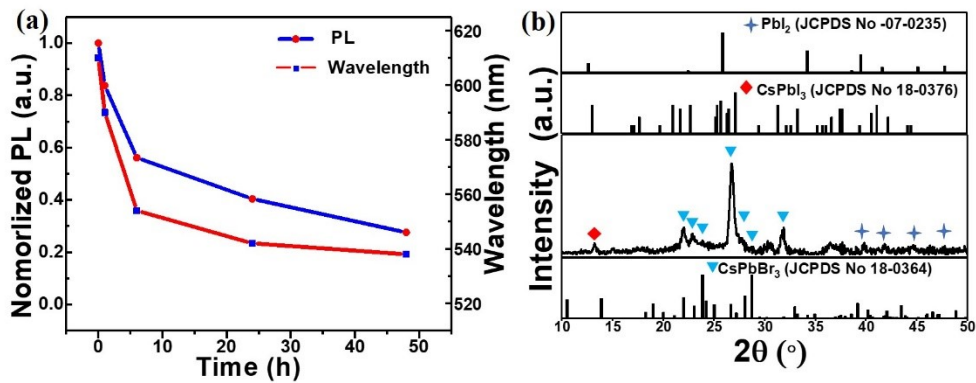


Fig. S5 (a) Evolution of the normalized PL intensity of the various NC dispersions synthesized in the absence of MPA, followed by exposure to air for different time. (b) XRD pattern of the NCs synthesized in the absence of MPA, followed by exposure to air for 24 h.

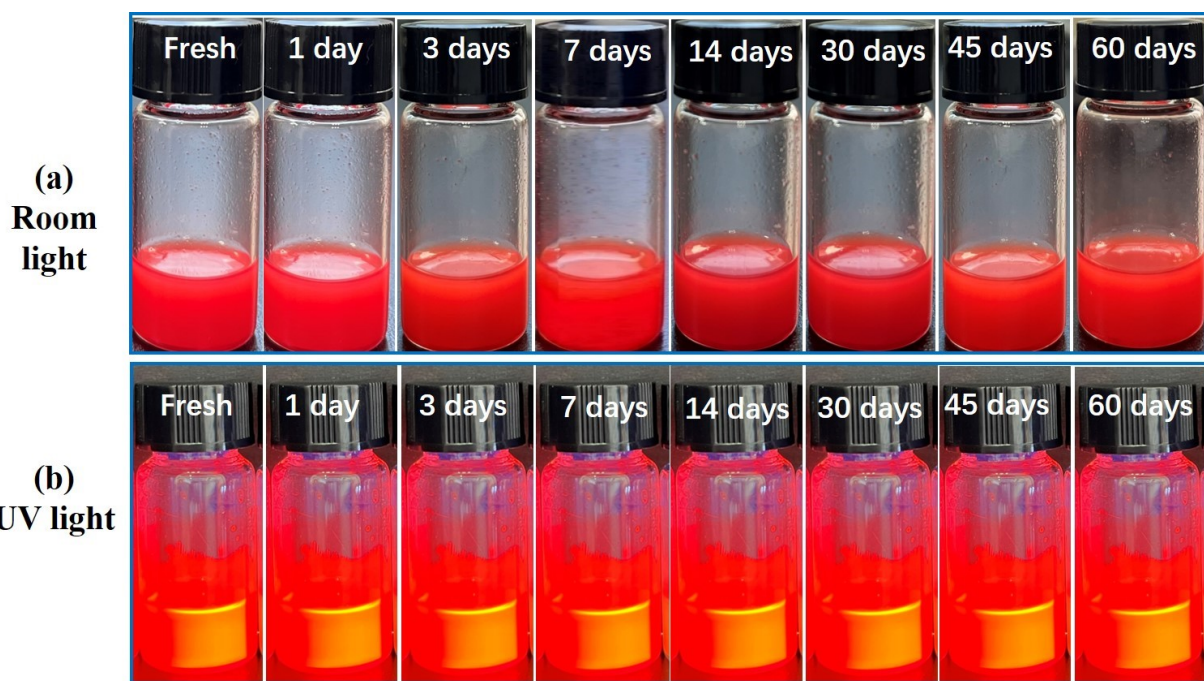


Fig. S6 Digital photographs of the representative CsPbBr_{3-x}I_x NCs achieved in the presence of MPA, and upon aging under ambient environment for different time as dictated in each panel. The pictures were taken under room light (a) and UV light (b), respectively.

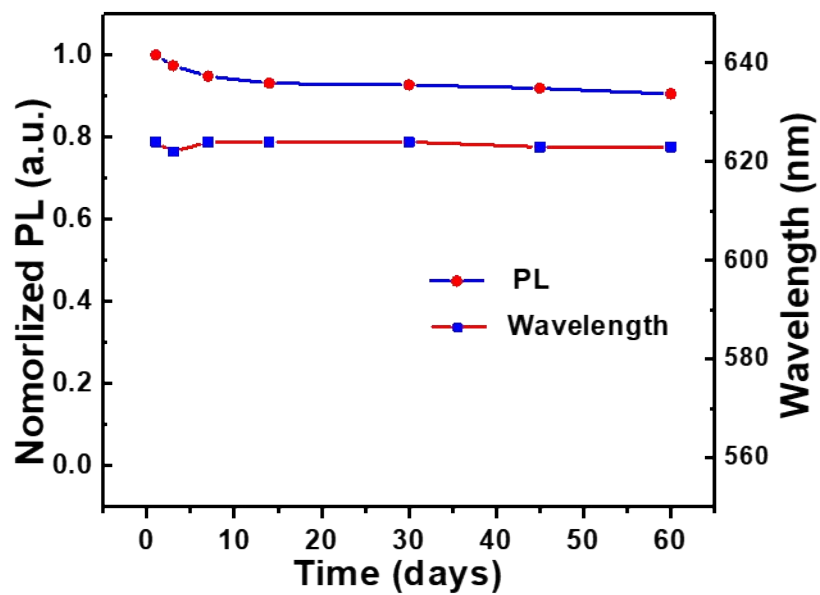


Fig. S7 Evolution of the normalized PL intensity of the various MPA-capped NC dispersions over the exposure time to air.

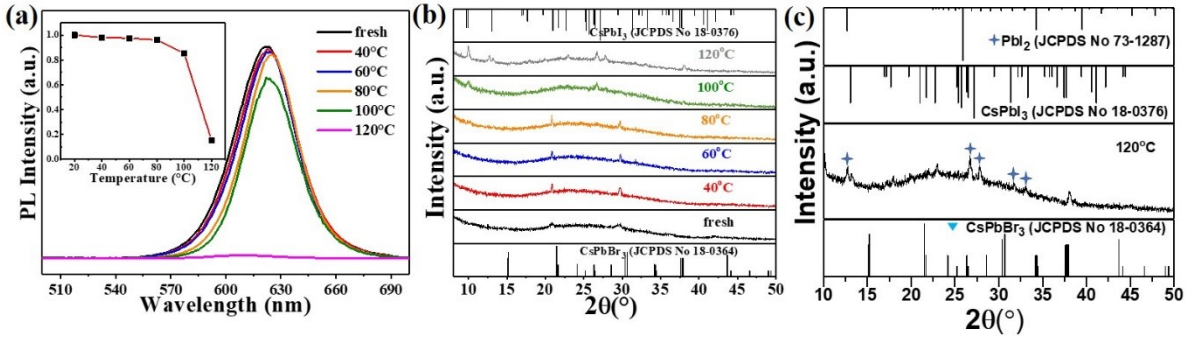


Fig. 8 PL spectra (a) and XRD patterns (b-c) of the representative MPA-capped $CsPbBr_{3-x}I_x$ NC films upon annealing at different temperatures for 2 h.

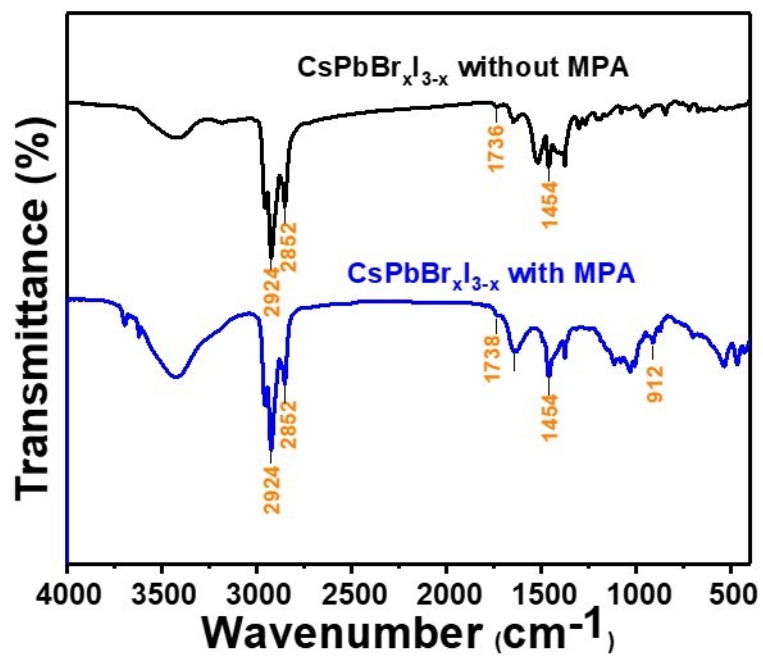


Fig. S9 FTIR spectra of the two representative CsPbBr_{3-x}I_x NCs synthesized in the absence (i.e., with only OA and OM) and presence of MPA, respectively.

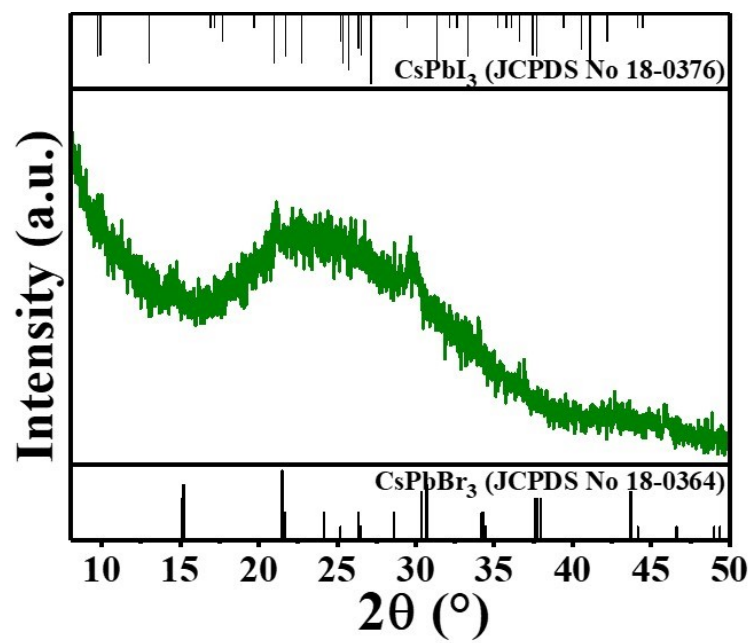


Fig. 10 XRD pattern of the representative CsPbBr_{3-x}I_x NCs achieved in the presence of TGA by fixing PbBr₂:PbI₂ precursor ratio as 1:5.