

Contributions of Cs and Rb on Inhibiting Photo-induced Phase Segregation and Enhancement Optoelectronic Performances of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ ($\text{X} = \text{Cs, Rb}$) Single Crystals

Qing Yao¹, Kaiyu Wang¹, Jie Zhang¹, Changqian Li¹, Chenyu Shang¹, Feitong Chen¹, Qi Huang¹, Qiqi Zhao¹, Weiwei Zhang¹, Xiaoyuan Zhan¹ and Jianxu Ding^{1*}

¹College of Materials Science and Engineering, Shandong University of Science and Technology, Qingdao 266590, China

*Corresponding author. Email: dingjianxu@sdust.edu.cn

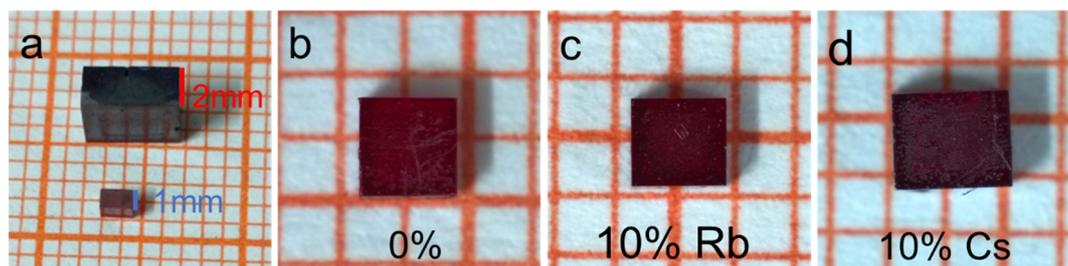
Photographs of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ SCs

Figure S1. (a) Photographs of $\text{MA}_{0.9}\text{Cs}_{0.1}\text{PbI}_{1.8}\text{Br}_{1.2}$ SCs grown at 2 and 5 days; (b-d) photographs of thinner $\text{MAPbI}_{1.8}\text{Br}_{1.2}$, $\text{MA}_{0.9}\text{Rb}_{0.1}\text{PbI}_{1.8}\text{Br}_{1.2}$ and $\text{MA}_{0.9}\text{Cs}_{0.1}\text{PbI}_{1.8}\text{Br}_{1.2}$ SCs (~ 1 mm thickness).

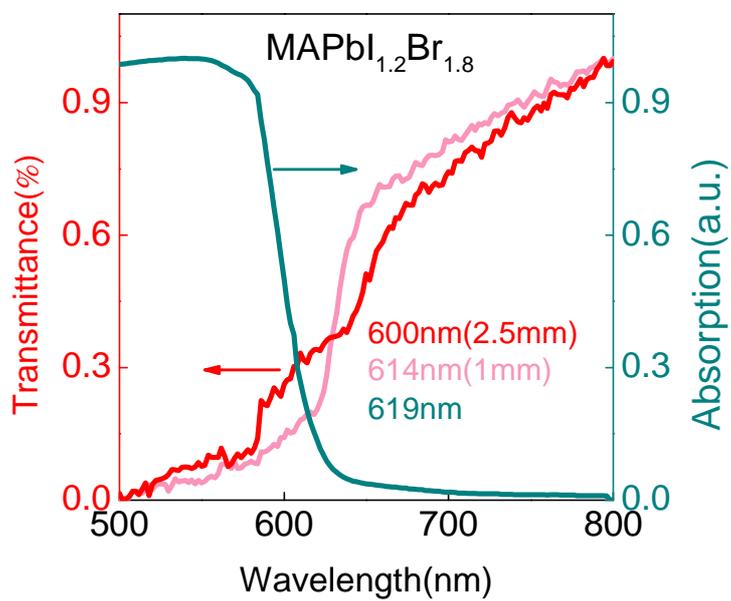
UV-absorption Spectra and Transmittance of Different Thicknesses of MAPb_{1.8}Br_{1.2} SCs

Figure S2. UV-absorption spectra and transmittance of different thicknesses of MAPb_{1.8}Br_{1.2} SCs.

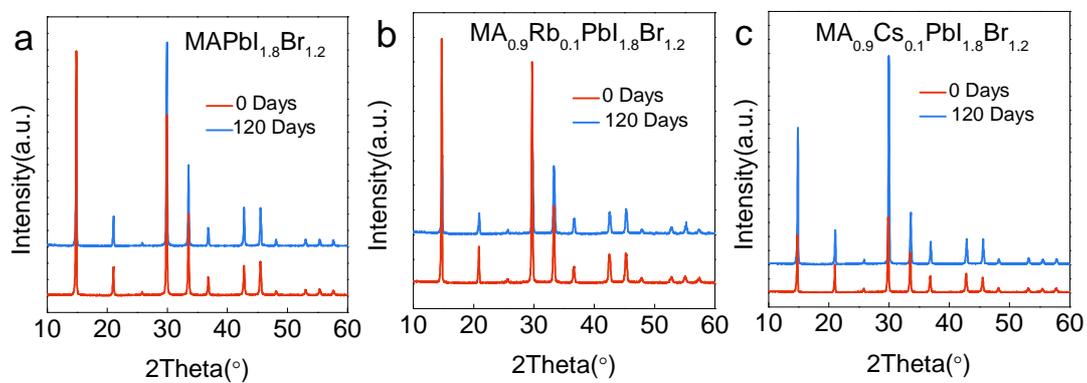
Stability of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ at Room Temperature

Figure S3. (a-c) Stability of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ at room temperature.

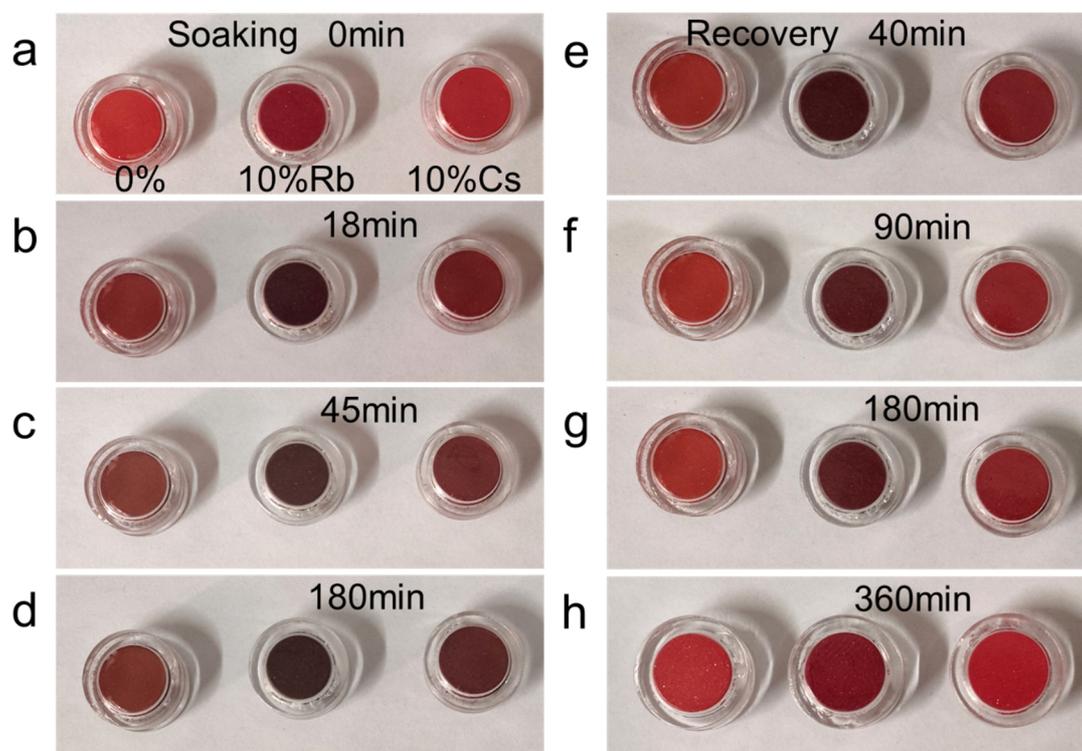
Photographs of $MA_{1-y}X_yPb_{1.8}Br_{1.2}$ Powders with Light and Recovery at Different Times

Figure S4. (a-d) Photographs of $MA_{1-y}X_yPb_{1.8}Br_{1.2}$ under continuous 365 nm light; (e-h) Photographs of $MA_{1-y}X_yPb_{1.8}Br_{1.2}$ recovered after room temperature.

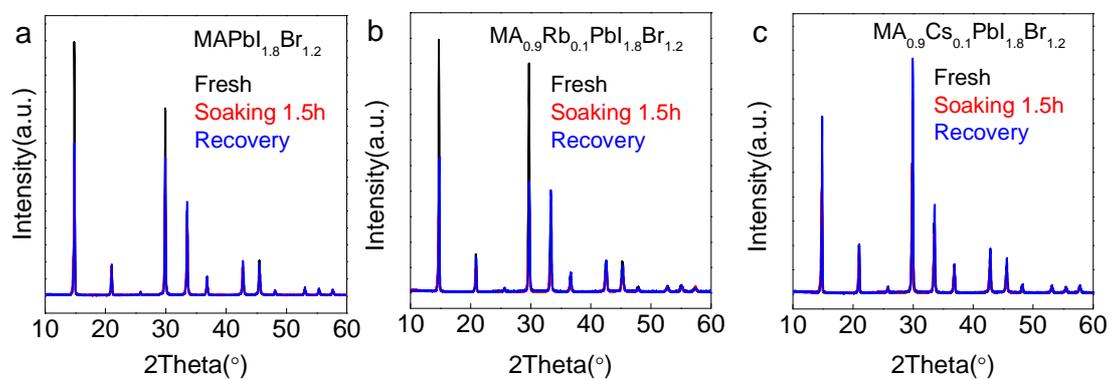
XRD Patterns of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ Samples before Illumination, after Blue-violet Light Illumination and after Recovery

Figure S5. (a-c) XRD patterns of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ samples before illumination, after blue-violet light illumination of 1.5 h, and after ~3 days of relaxation at room temperature.

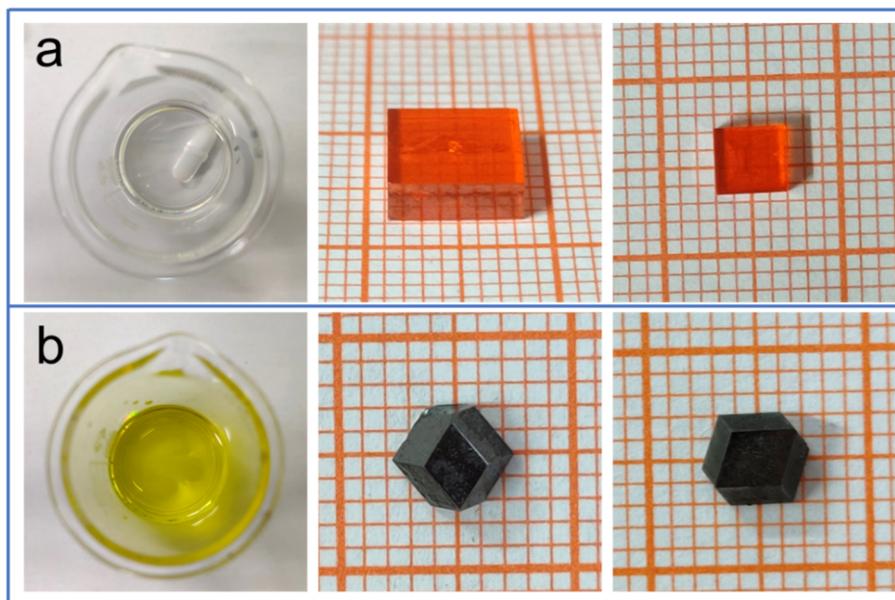
Growth of MAPbI_3 and MAPbBr_3 SCs

Figure S6. (a) Precursor solutions dissolved with MAPbBr_3 and photographs of MAPbBr_3 SCs; (b) Precursor solutions dissolved with MAPbI_3 and photographs of MAPbI_3 SCs.

Growth Process and Photographs of Thinner $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ SCs

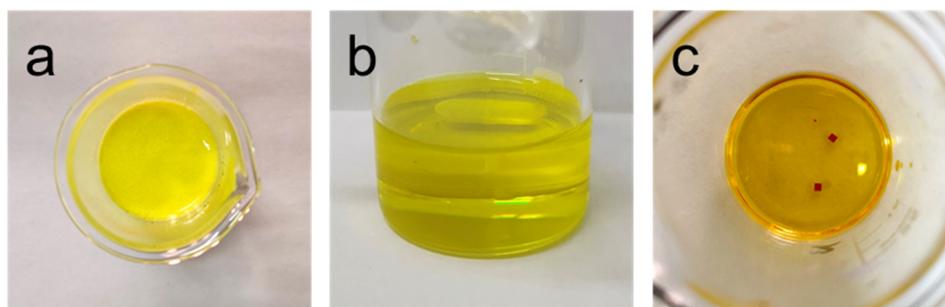


Figure S5. (a-c) Growth process of $\text{MA}_{1-y}\text{X}_y\text{PbI}_{1.8}\text{Br}_{1.2}$ SCs.