Supporting information

Synergistic Effect of Pseudo-Halide Thiocyanate Anion and Cesium Cation on Realizing High-Performance Pinhole Free MA-Based Wide-Band Gap Perovskites

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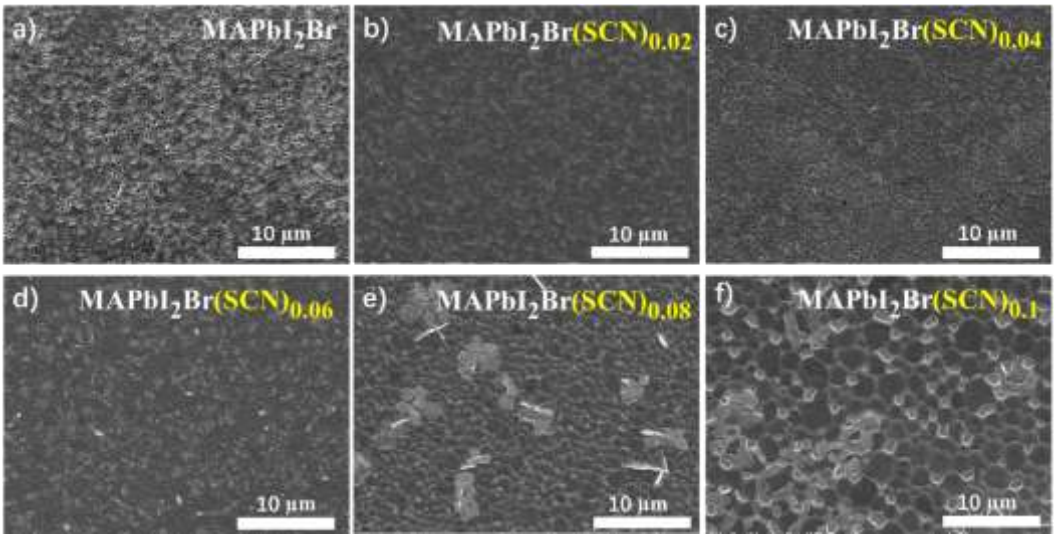

Figure S1. Large-scale SEM images of $MAPbI_2Br$ perovskites with the $Pb(SCN)_2$ additive ratio of a) 0, b) 1%, c) 2%, d) 3%, e) 4% and f) 5%, respectively.

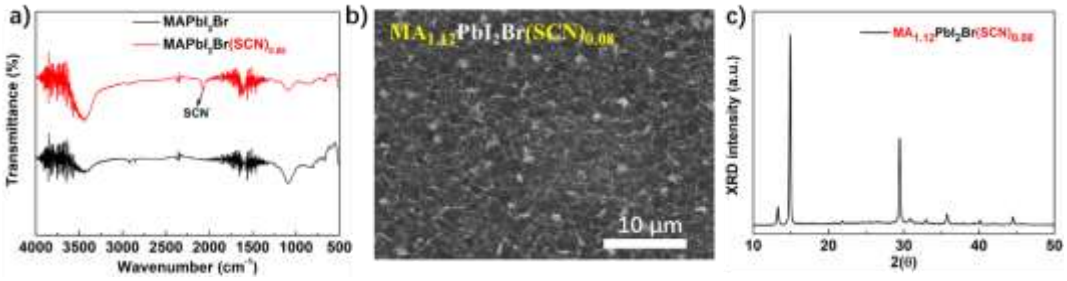

Figure S2. a) FTIR spectra of $MAPbI_2Br$ and $MAPbI_2Br(SCN)_{0.08}$, respectively. b-c) SEM and XRD results of film prepared with precursor solution of $MA_{1.12}PbI_2Br(SCN)_{0.08}$.

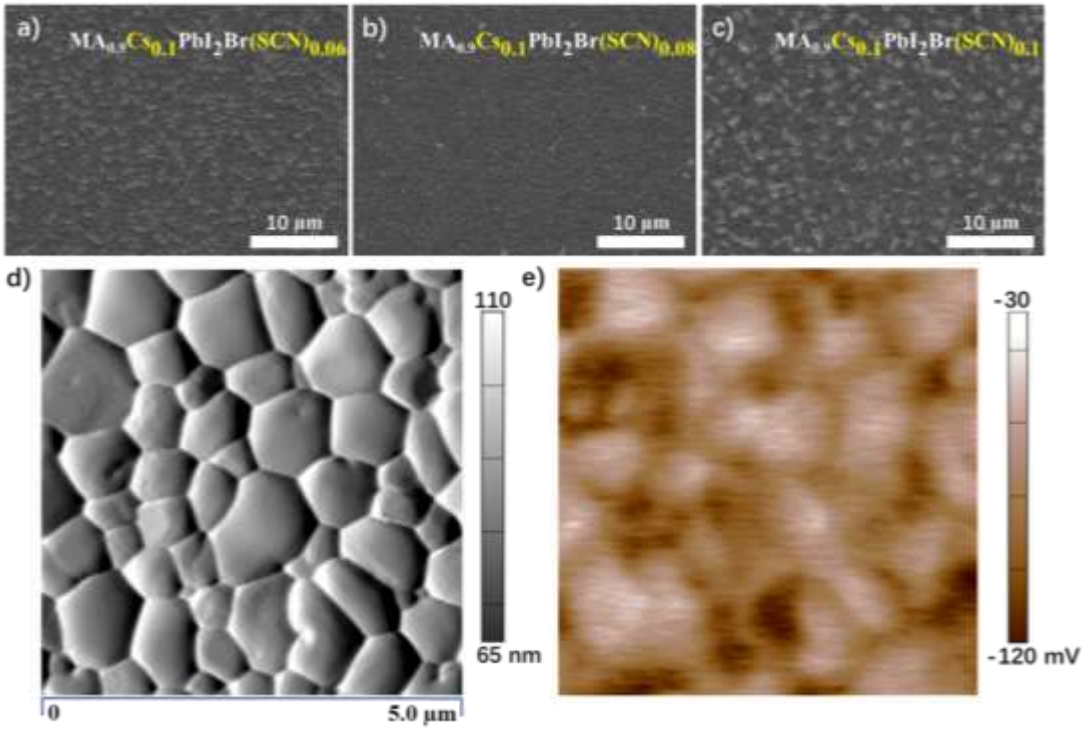

Figure S3. a-c) Large-scale SEM images of perovskite film prepared with precursor solution of $MA_{0.9}Cs_{0.1}PbI_2Br(SCN)_{0.06,}$ $MA_{0.9}Cs_{0.1}PbI_2Br(SCN)_{0.08}$ and $MA_{0.9}Cs_{0.1}PbI_2Br(SCN)_{0.1,}$ respectively. d) AFM topography and e) the contact potential difference (CPD) maps of film $MAPbI_2Br(SCN)_{0.08}$.

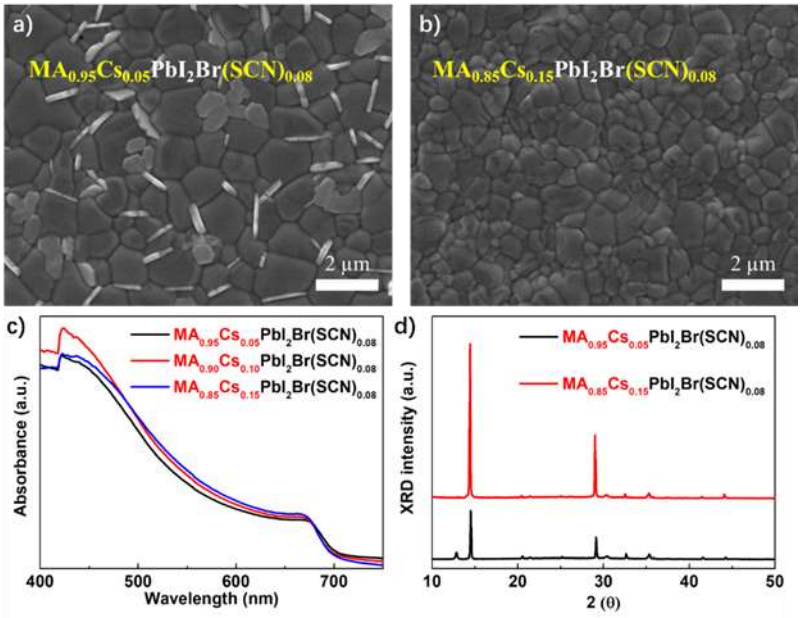

Figure S4. SEM images of perovskite films prepared with precursor solution of a) $MA_{0.95}Cs_{0.05}PbI_2Br(SCN)_{0.08}$ and b) $MA_{0.85}Cs_{0.15}PbI_2Br(SCN)_{0.08}$, respectively. c-d) UV-Vis absorption results of perovskite films prepared with precursor solution of $MA_{0.95}Cs_{0.05}PbI_2Br(SCN)_{0.08}$, $MA_{0.90}Cs_{0.10}PbI_2Br(SCN)_{0.08}$ and $MA_{0.85}Cs_{0.15}PbI_2Br(SCN)_{0.08}$, respectively. d) XRD results of the films prepared with precursor solution of $MA_{0.95}Cs_{0.05}PbI_2Br(SCN)_{0.08}$ and $MA_{0.85}Cs_{0.15}PbI_2Br(SCN)_{0.08}$, respectively.

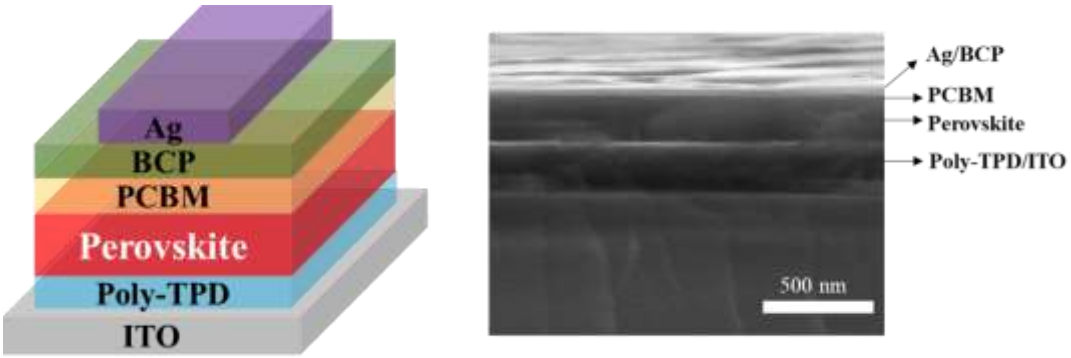

Figure S5. Device structure and corresponding cross-section SEM image of the perovskite solar cells in this work.

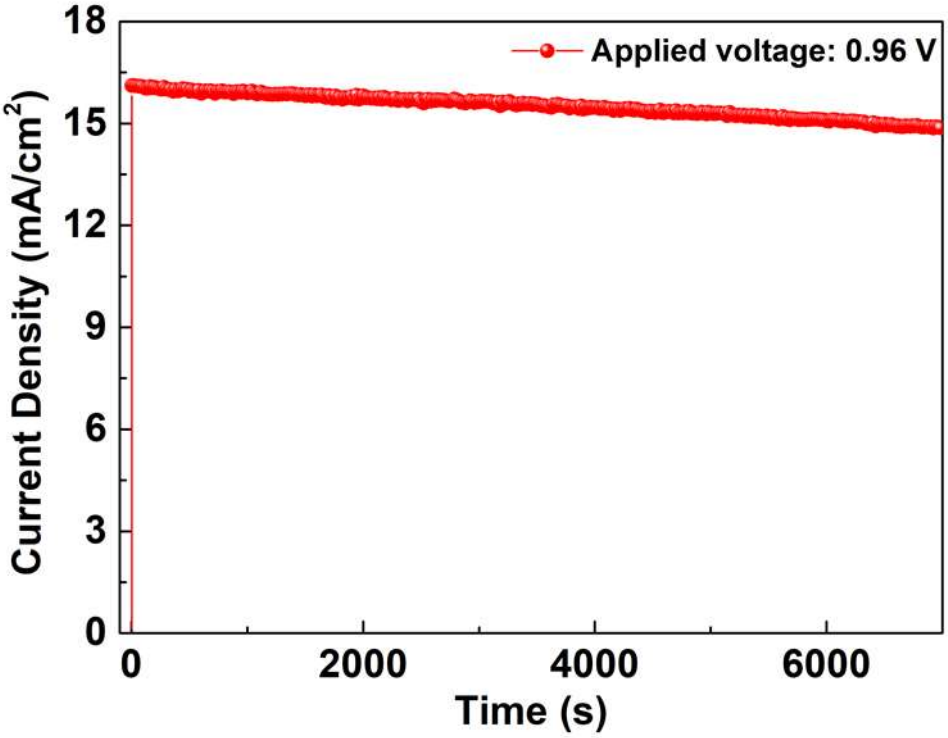

Figure S6. Steady-state current density (J_{sc}) under AM1.5 illumination at the applied voltage corresponding to the maximum power point (0.96 V) tested under ambient atmosphere without encapsulation.

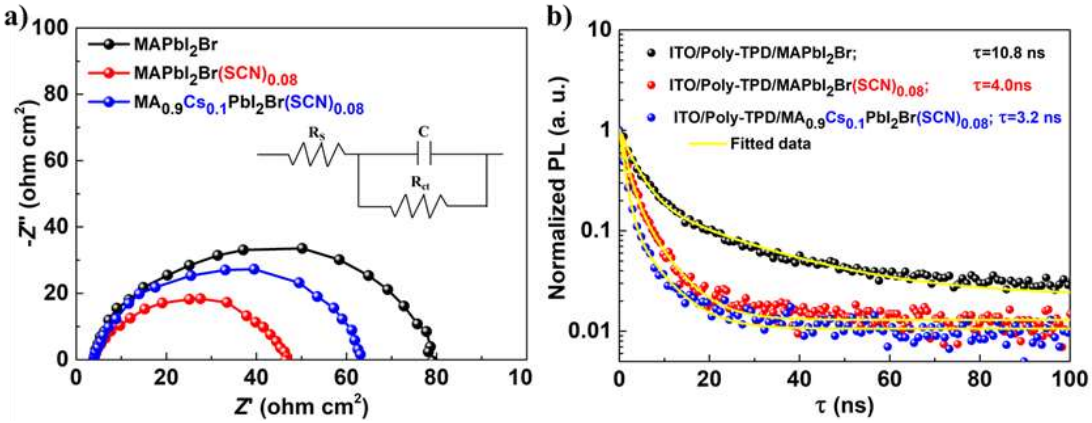

Figure S7. EIS spectra of $MA_{0.9}CS_{0.1}PbI_2Br(SCN)_{0.08}$, $MA_{0.9}CS_{0.1}PbI_2Br(SCN)_{0.08}$ and $MA_{0.9}CS_{0.1}PbI_2Br(SCN)_{0.08}$ based PVSCs measured at open circuit condition (V = 1.04, 1.12 and 1.15 V, respectively).