Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
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Electronic Supporting Information:

Highly Efficient and Stable Inverted Perovskite Solar calls with Two-dimensional ZnSe Deposited by Thermal Evaporator for Electron Collection

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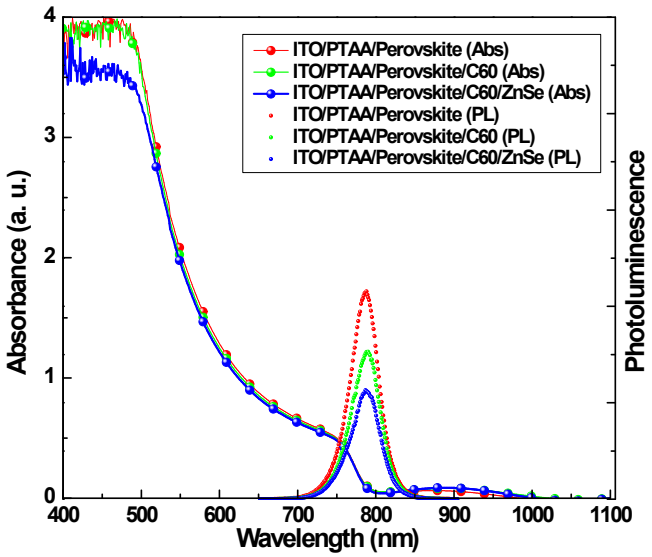


Figure S1. UV-vis-NIR absorption and photoluminescent spectra of ITO/PTAA/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$, ITO/PTAA/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$/C60, and ITO/PTAA/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$/C60/ZnSe(3nm).

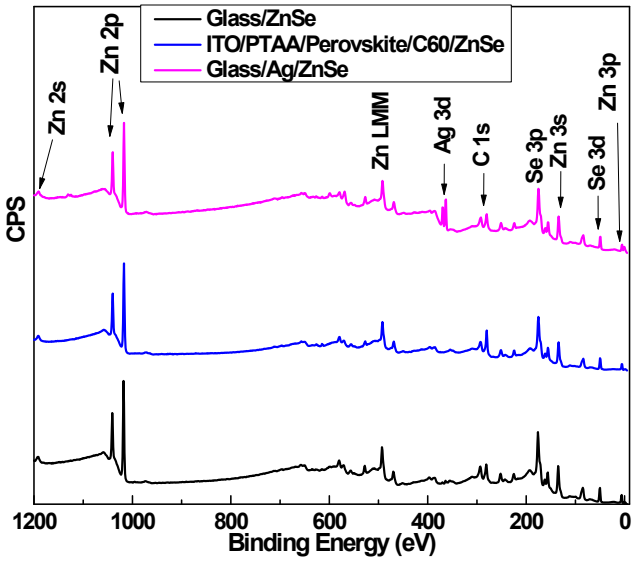


Figure S2. XPS spectra of ZnSe on glass, C60, and Ag.

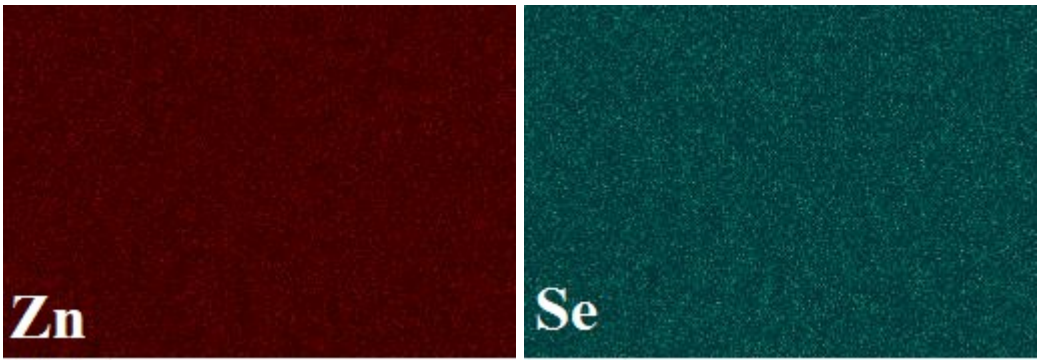
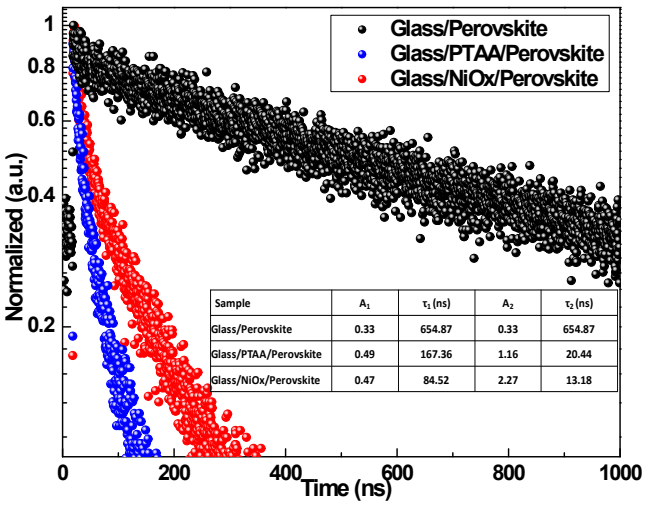


Figure S3. SEM mapping of ZnSe film on top of perovskite/C60.



Sample	A_1	τ_1 (ns)	A_2	τ_2 (ns)
Glass/Perovskite	0.33	654.87	0.33	654.87
Glass/PTAA/Perovskite	0.49	167.36	1.16	20.44
Glass/NiOx/Perovskite	0.47	84.52	2.27	13.18

Figure S4. Time resolved PL of glass/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$, PTAA/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$ and NiO_x/ $FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$.

Table S1. Parameters of fitting the TR-PL decay curves of samples, glass/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$, PTAA/ $FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$ and NiO_x/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$.

Sample	**A_1**	**τ_1 (ns)**	**A_2**	**τ_2 (ns)**	**L_D (nm), h^+**	**μ (cm^2 V^{-1} s^{-1}), h^+**
Glass/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$	0.33	654.87	0.33	654.87		
Glass/PTAA/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$	0.47	84.52	2.27	13.18	920.08	0.05
Glass/NiO_x/$FA_{0.9}MA_{0.1}PbI_{2.7}Br_{0.3}$	0.49	167.36	1.16	20.44	638.48	0.02