Supporting Information for

Amidation Induced Self-Reduction of *p*-GO with Lewis-Base Termination for All-Inorganic $CsPbIBr_2$ Perovskite Solar Cells

Jian Du,[a,b] Jialong Duan,[a,*] Qiyao Guo,[a] Yanyan Duan,[c] Xiya Yang,[a] Quanzhu Zhou[d] and Qunwei Tang[a,*]

[a] College of Information Science and Technology, Jinan University, Guangzhou 510632, PR China;

[b] School of Light Industry and Chemical Engineering, Dalian Polytechnic University, Dalian 116034, China;

[c] State Centre for International Cooperation on Designer Low-Carbon and Environmental Material (SCICDLCEM), School of Materials Science and Engineering, Zhengzhou University Zhengzhou 450001 (P. R. China);

[d] BTR New Material Group Co., Ltd., Shenzhen (China).

*Corresponding Author. Email address: duanjialong@jnu.edu.cn (J.L. Duan);

tangqunwei@jnu.edu.cn (Q.W. Tang).

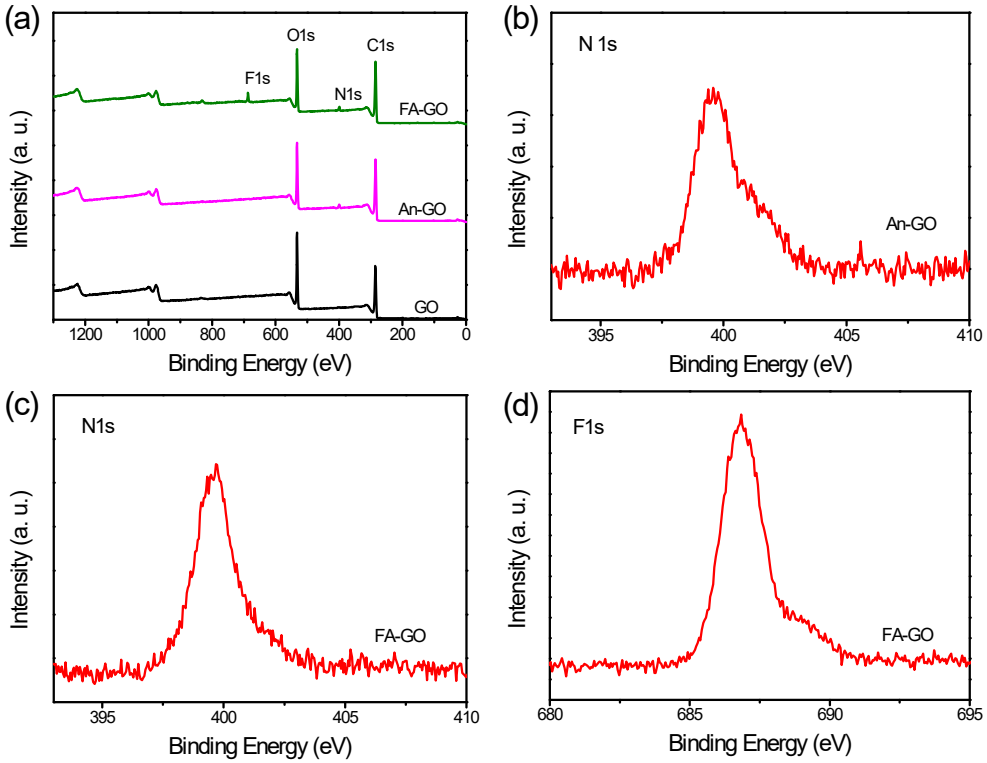

Fig. S1 (a) XPS survey scans and high-resolution XPS spectra of N 1s and F 1s in (b) An-GO and (c-d) FA-GO.

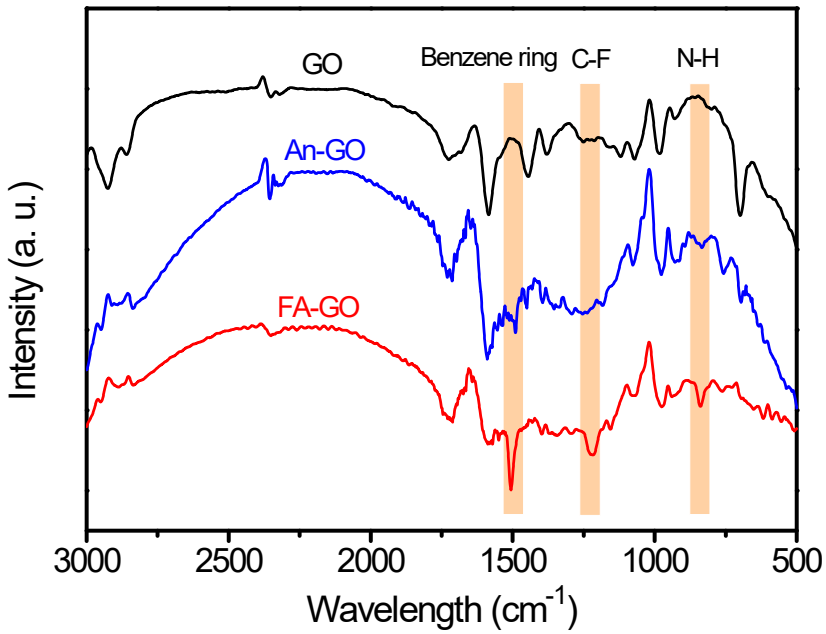

Fig. S2 FTIR spectra of GO, An-GO and FA-GO samples.

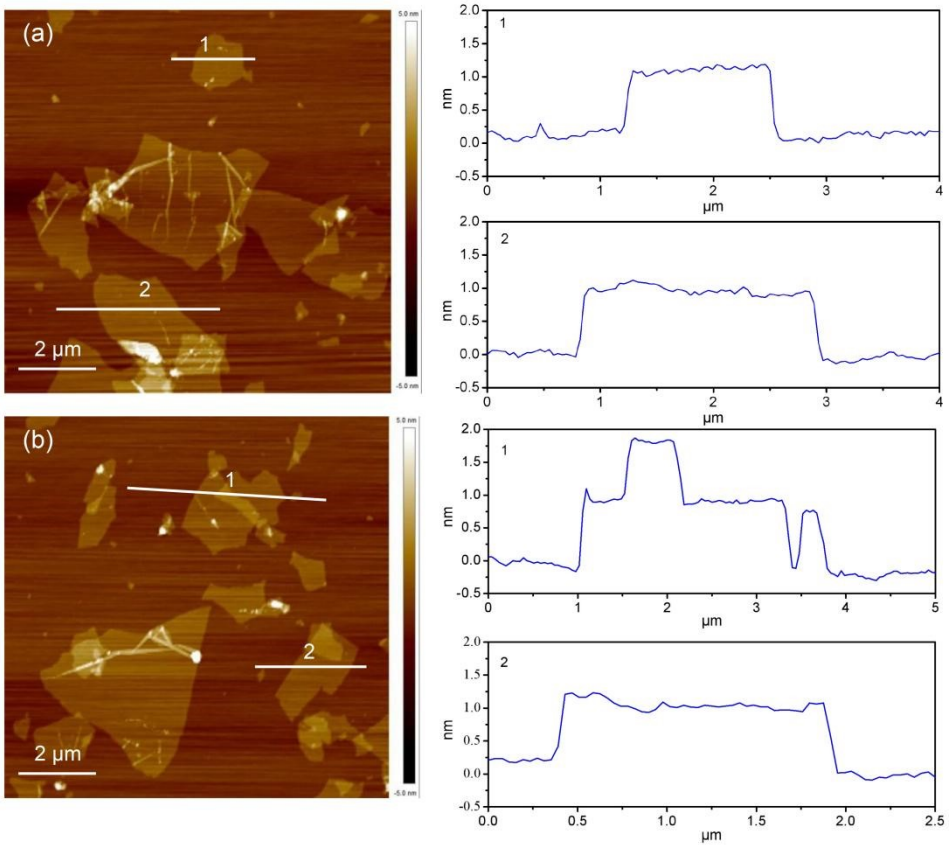

Fig. S3 AFM images and the corresponding thickness of (a) GO and (b) FA-GO interlayers.

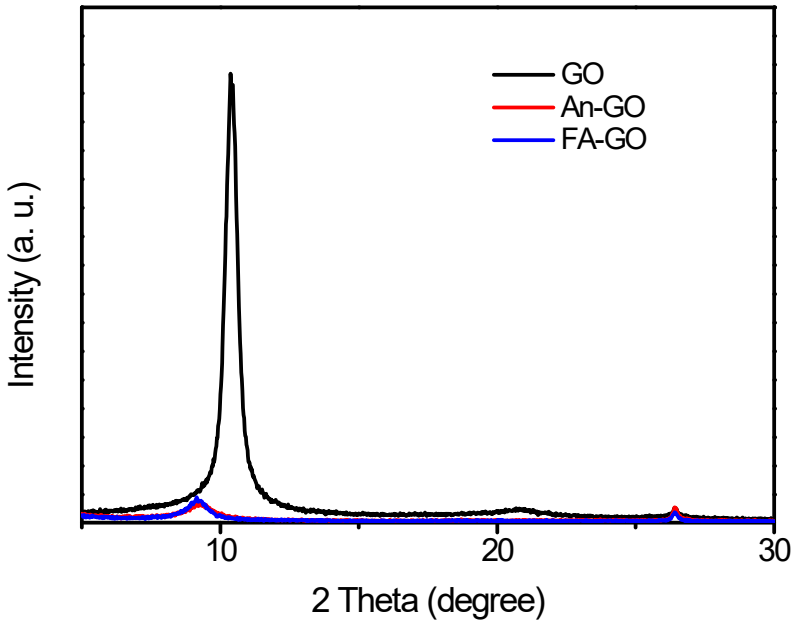

Fig. S4 XRD patterns of GO, An-GO and FA-GO.

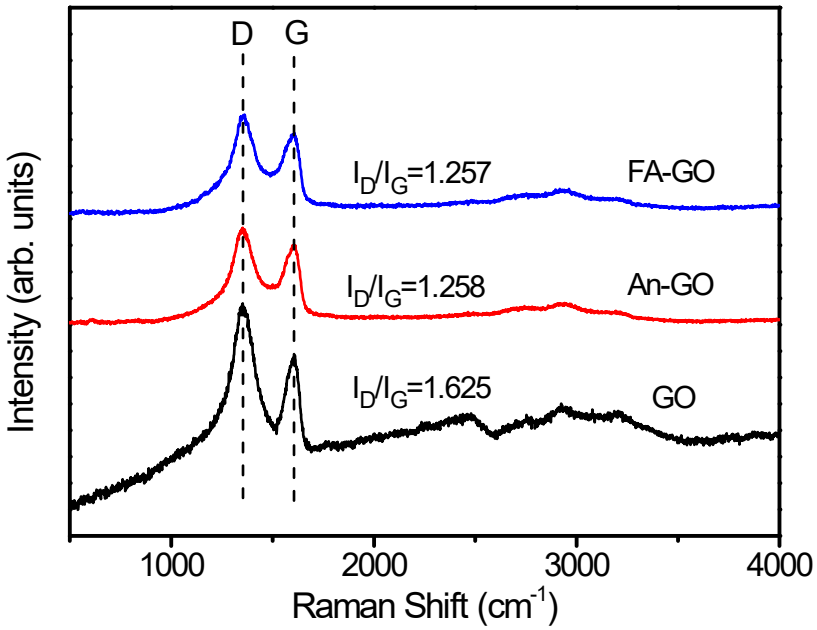

Fig. S5 Raman spectra of GO, An-GO and FA-GO.

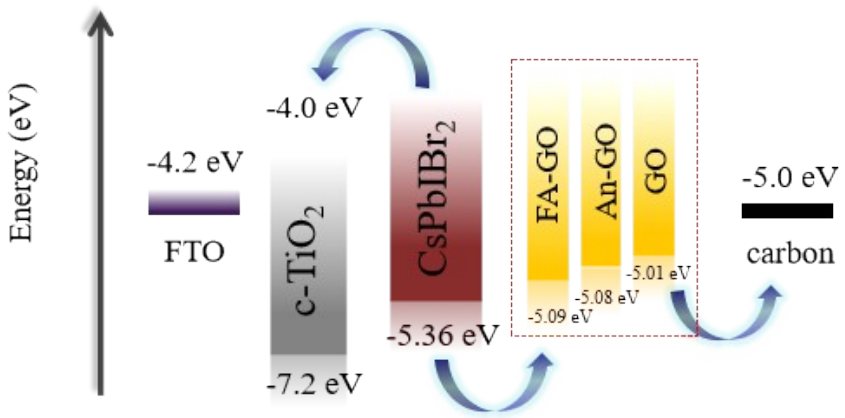

Fig. S6 Energy-level diagram of $CsPbIBr_2$ PSC. The energy level of $CsPbIBr_2$ perovskite film is obtained from previous work.[S1]

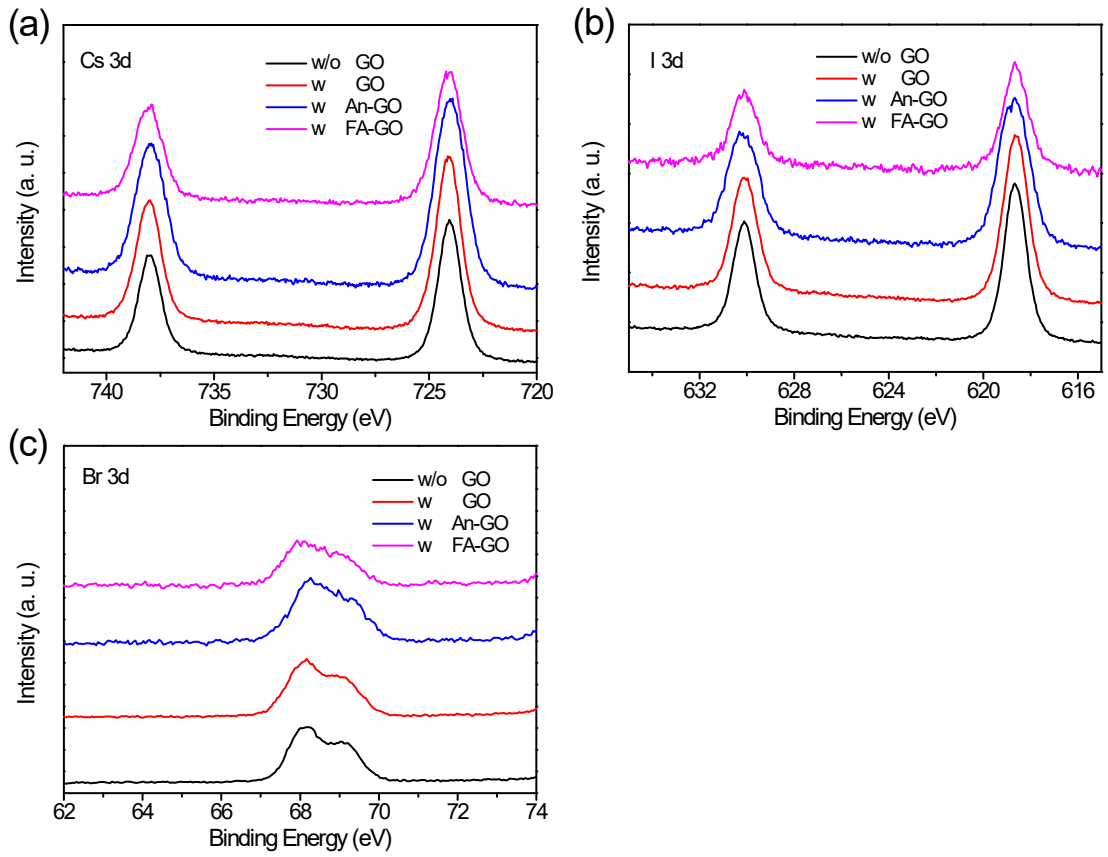

Fig. S7 XPS spectra of Cs 3d, I 3d and Br 3d in $CsPbIBr_2$, $CsPbIBr_2$ + GO, $CsPbIBr_2$ + An-GO and $CsPbIBr_2$ + FA-GO.

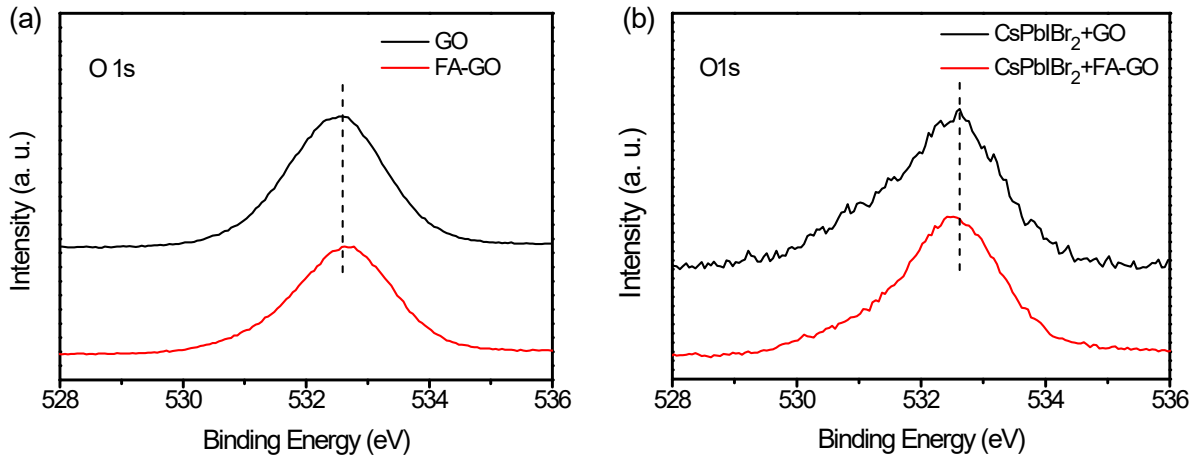

Fig. S8 High-resolution XPS spectra of O 1s in (a) GO and FA-GO and (b) $CsPbIBr_2$ + GO and $CsPbIBr_2$ + FA-GO.

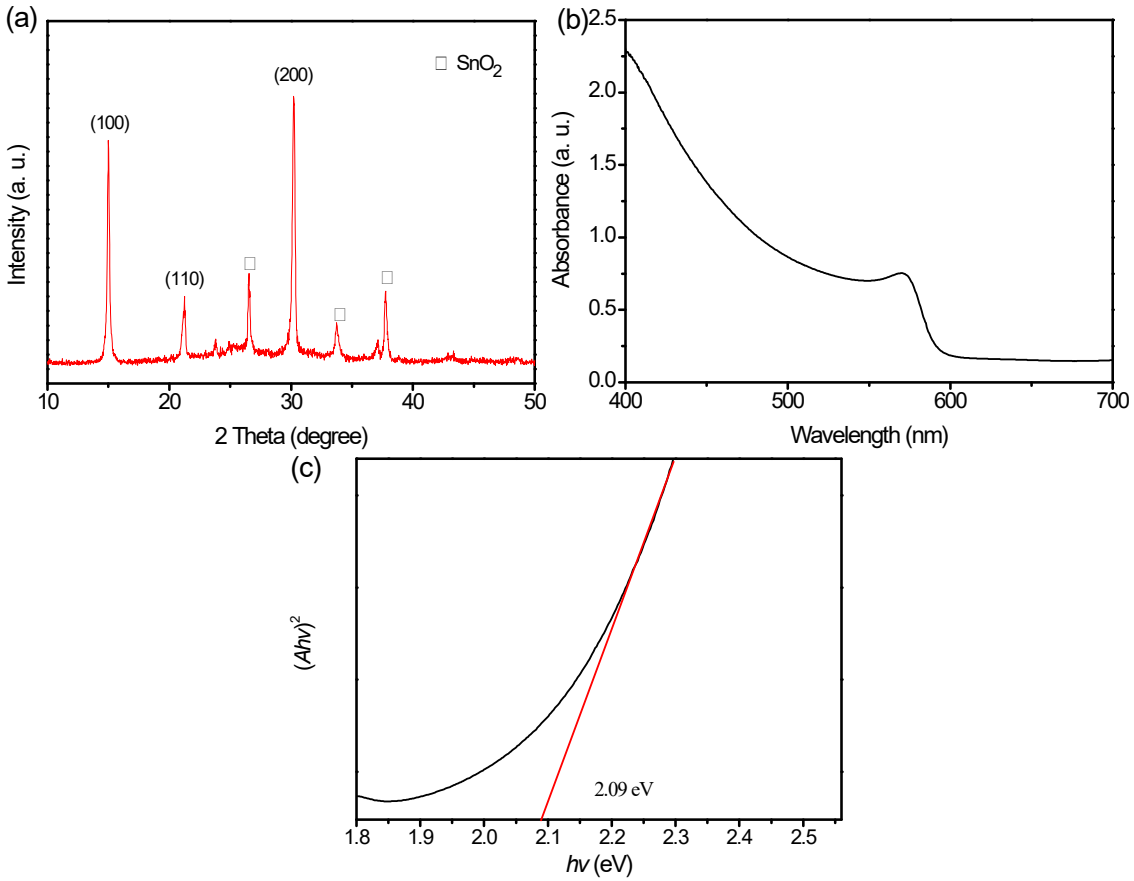

Fig. S9 (a) XRD pattern of synthesized $CsPbIBr_2$ film on FTO/*c*-TiO_2 substrate. (b) Optical absorbance of $CsPbIBr_2$ film. (c) The bandgap of $CsPbIBr_2$ was calculated to be 2.09 eV.

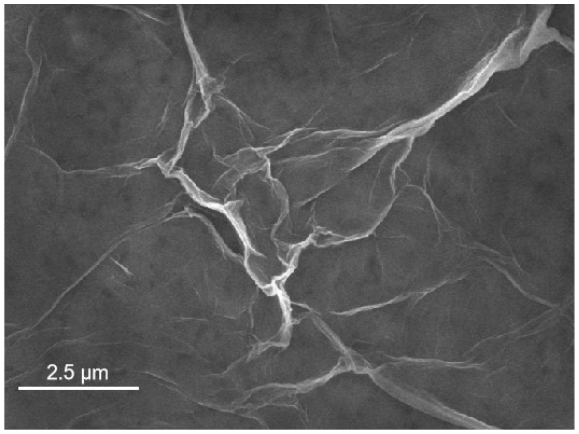

Fig. S10 SEM image of An-GO covered perovskite film.

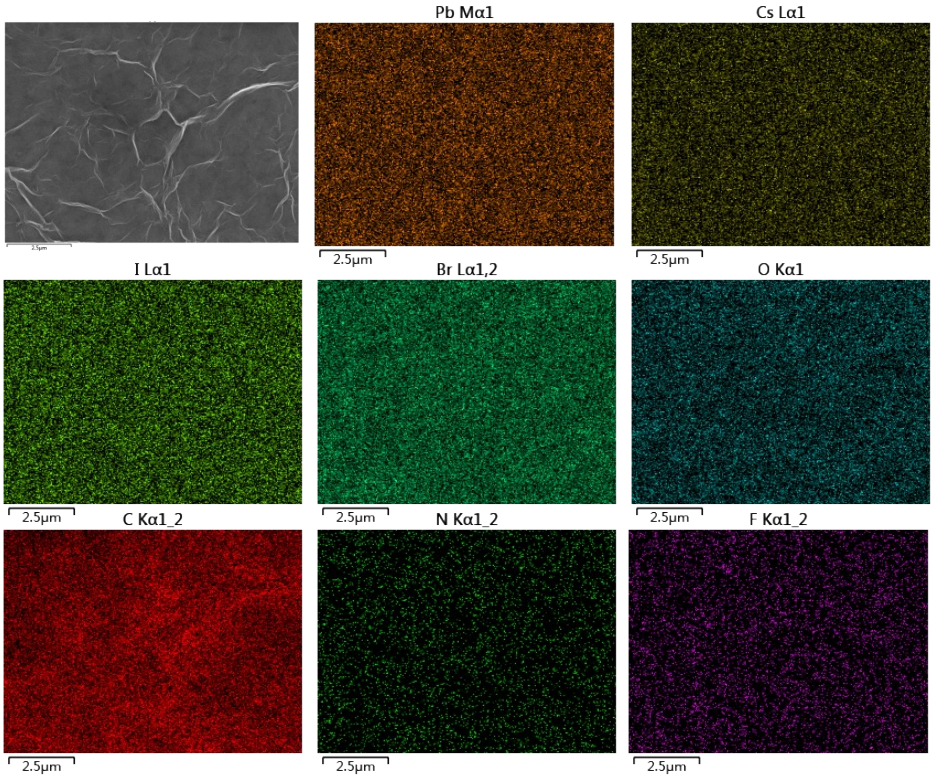

Fig. S11 The elemental mapping images in $CsPbIBr_2$ + FA-GO film.

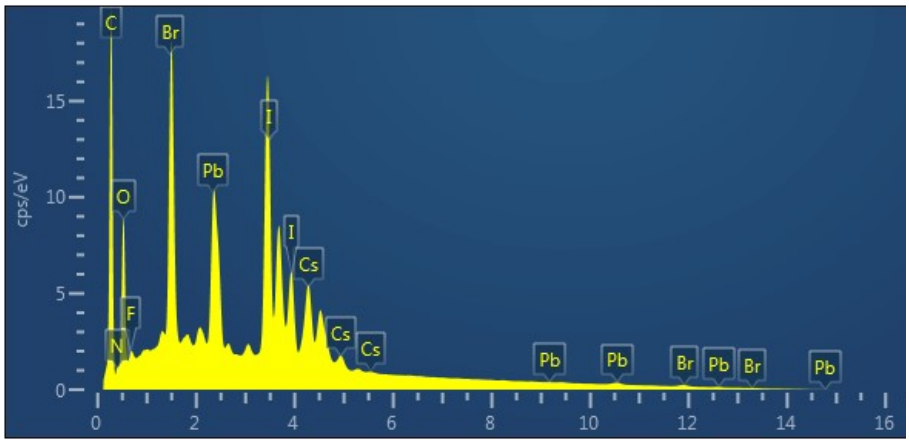

Fig. S12 EDS spectrum of FA-GO supported on $CsPbIBr_2$ film.

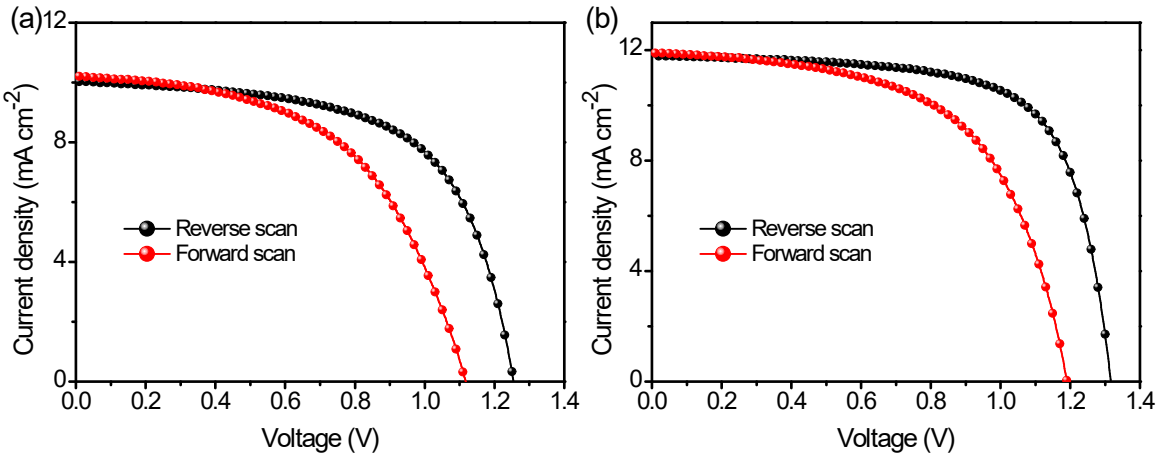

Fig. S13 *J-V* curves of the (a) control and (b) FA-GO tailored PSCs under forward and reverse scan directions.

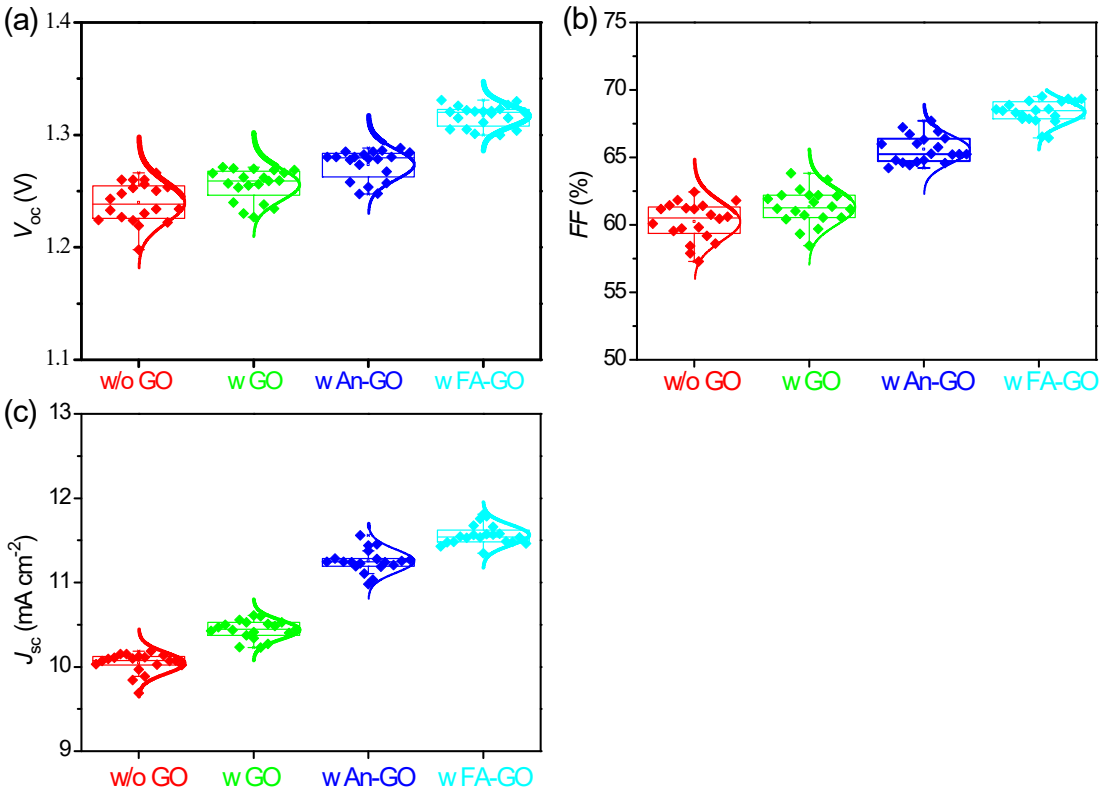

Fig. S14 Statistical V_{oc}, *FF* and J_{sc} distribution of solar cells with and without treatment.

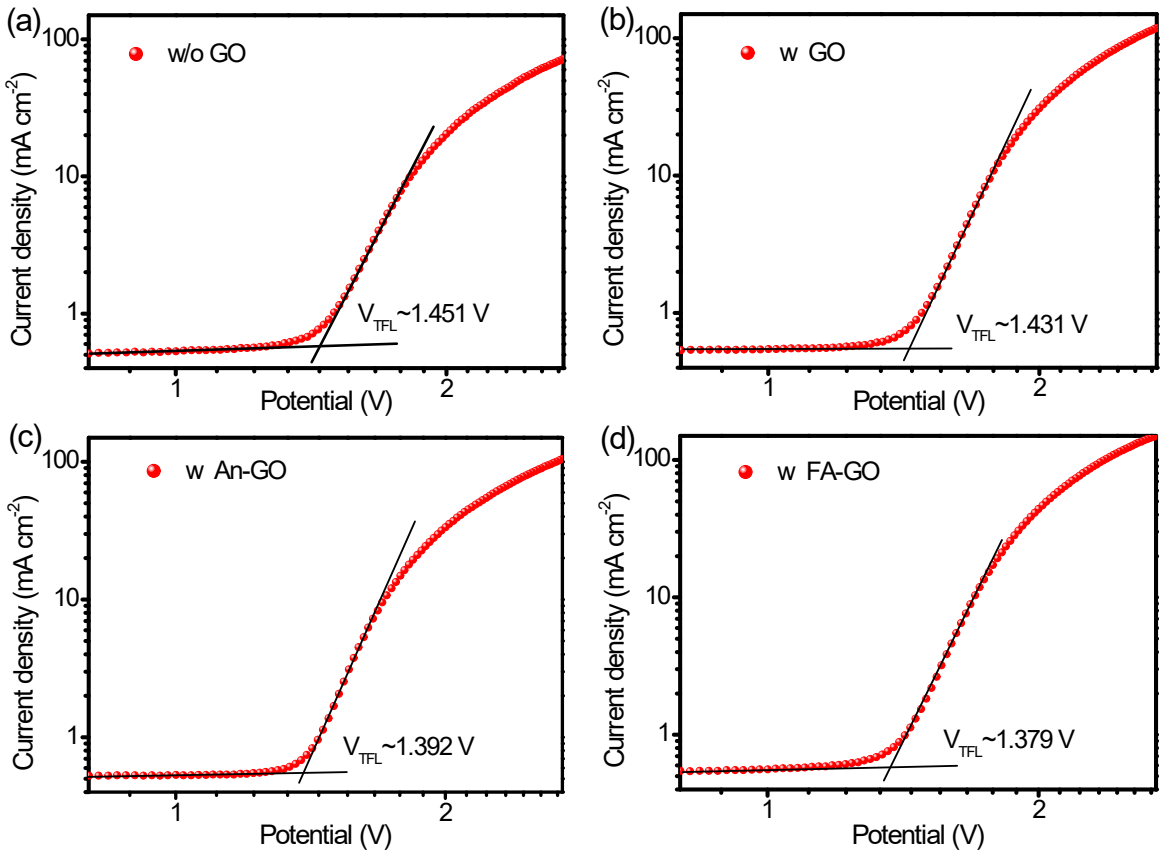

Fig. S15 Dark current curves for the electron-only devices of perovskite films with and without GO.

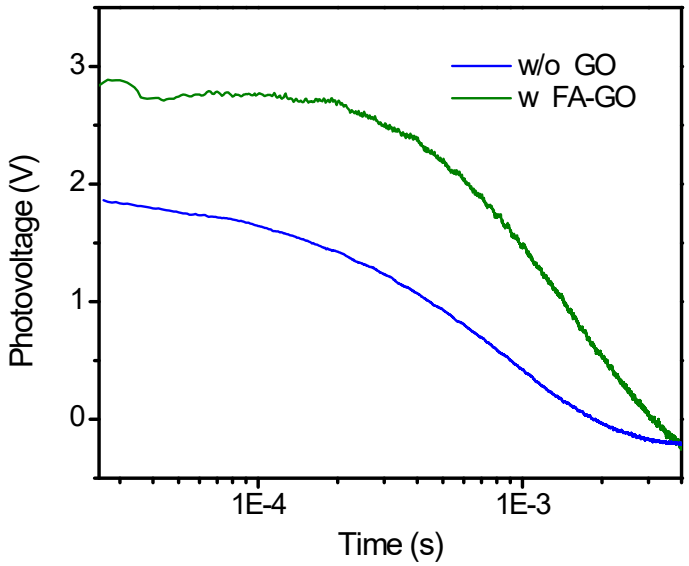

Fig. S16 Transient photovoltage of fabricated $CsPbIBr_2$ films with and without FA-GO.

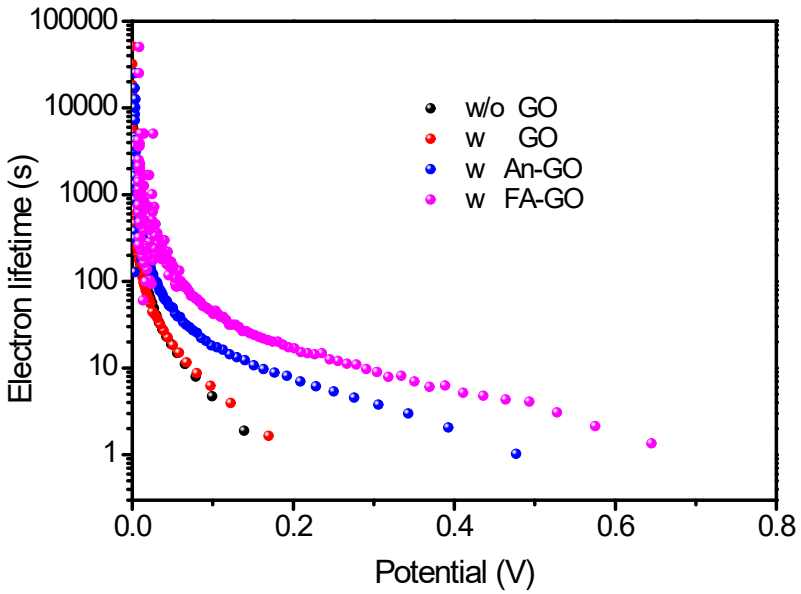

Fig. S17 Electron lifetime calculated from V_{oc} decay curves of various devices.

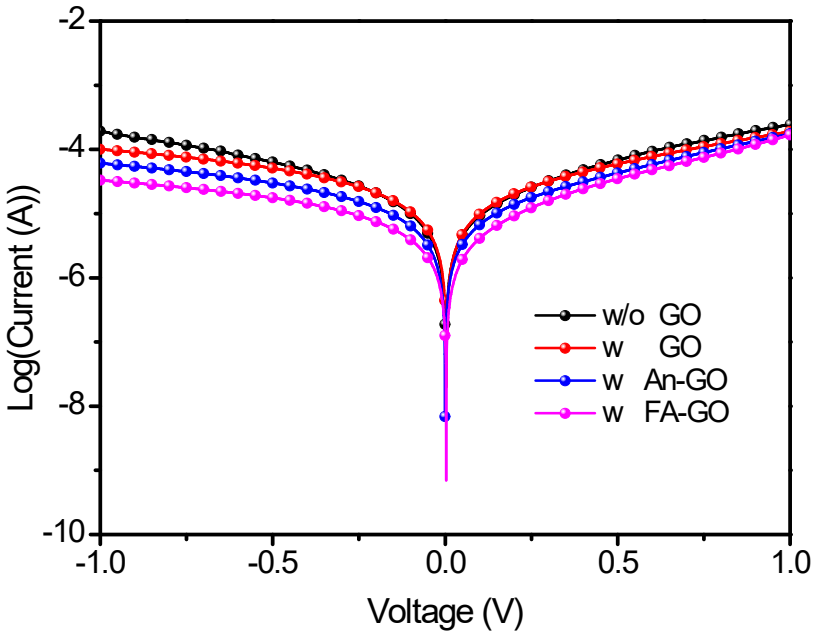

Fig. S18 Dark *J-V* curves of devices with and without GO.

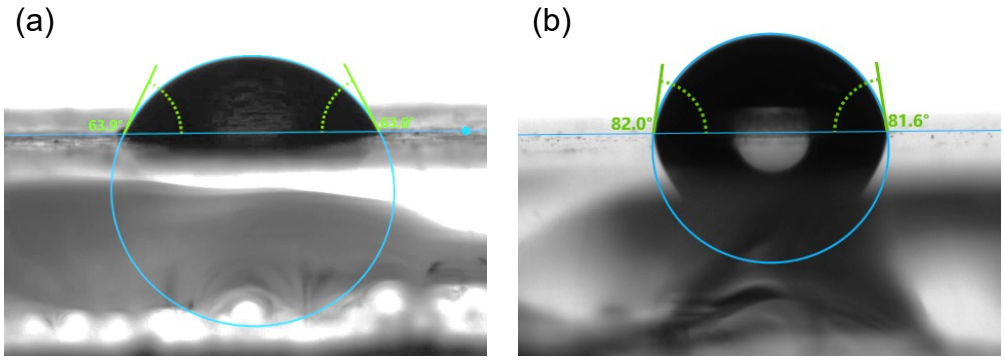

Fig. S19 Contact angles of $CsPbIBr_2$ and $CsPbIBr_2$/FA-GO films.

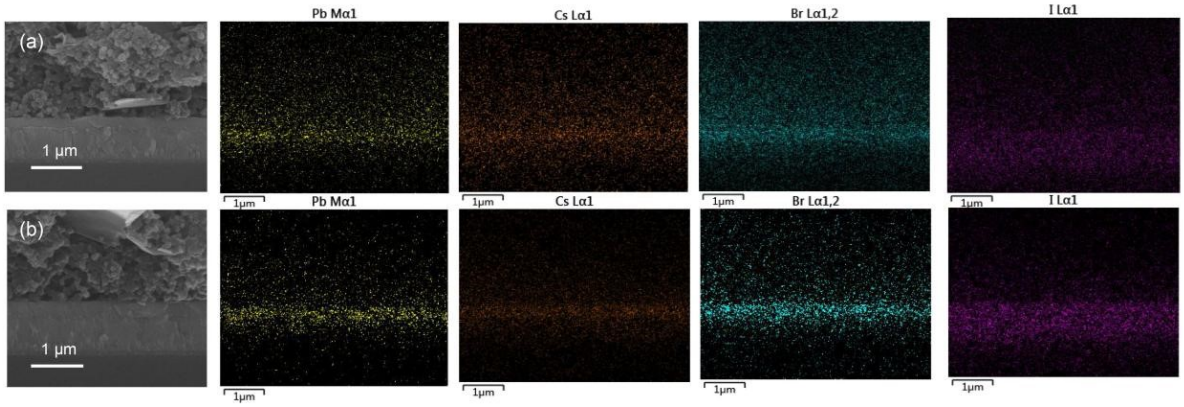

Fig. S20 Cross-sectional SEM images and corresponding elemental mapping images of the whole devices (a) without and (b) with FA-GO after aging treatment at 150 ^{o}C for 24 h.

Table S1. Summary of photovoltaic parameters for state-of-the-art $CsPbIBr_2$ PSCs.

Devices	V_{oc} (V)	J_{sc} (mA cm^{-2})	*FF* (%)	PCE (%)	Ref.
FTO/*c*-TiO_2/$CsPbIBr_2$/FA-GO/Carbon	**1.318**	**11.87**	**70.84**	**11.08**	**This work**
FTO/TiO_2/$CsPbIBr_2$/Spiro-OMeTAD/Au	1.12	11.65	72.39	9.44	[S2]
FTO/TiO_2/$CsPbIBr_2$/carbon	1.08	10.88	64	7.52	[S3]
FTO/*c*-TiO_2/$CsPb_{0.99}Zn_{0.01}IBr_2$/Spiro-OMeTAD/Ag	1.28	11.92	69	10.16	[S4]
FTO/SnO_2/$CsPbIBr_2$/carbon	1.19	9.76	57	6.79	[S5]
FTO/*c*-TiO_2/$CsPbI_{1+x}Br_{2-x}$/carbon	1.186	12.3	75	10.94	[S6]
FTO/SnO_2/$CsPbIBr_2$-PEI/$CsPbIBr_2$-MA/$CsPbIBr_2$/NiO_x/Ag	1.25	13.30	68	11.30	[S7]
FTO/*c*-TiO_2/$CsPbIBr_2$/Carbon	1.338	11.73	65	10.20	[S8]
FTO/TiO_2/$SmBr_3$/Sm-doped $CsPbIBr_2$/Spiro-OMETAD/Au	1.17	-	-	10.88	[S9]
FTO/*c*-TiO_2/CsBr/$CsPbIBr_2$/Carbon	1.26	11.80	72	10.71	[S10]
ITO/Cl-TiO_2/$CsPbIBr_2$/BHJ-2/MoO_3/Al	1.22	12.50	72.66	11.08	[S11]
FTO/ TiO_2/$CsPbIBr_2$/PCBM/Ag	1.25	11.63	74	10.78	[S12]
FTO/TiO_2/$CsPbIBr_2$/PCBM/Ag	1.21	11.58	69	10.48	[S13]
FTO/*c*-TiO_2/$CsPbIBr_2$/Spiro-OMeTAD/Au	1.10	12.03	65.40	8.65	[S14]
ITO/SnO_2/bulk $CsPbIBr_2$/QDs $CsPbIBr_2$/Spiro-OMeTAD/Au	1.22	9.41	71.36	8.16	[S15]
ITO/SnO_2/$CsPbIBr_2$/Spiro-OMeTAD/Au	1.27	9.21	71.80	8.43	[S16]
FTO/*c*-TiO_2/$CsPbIBr_2$/Carbon	1.14	9.11	63	6.55	[S17]

Table S2. FWHM data of GO, An-GO and FA-GO.

Samples	FWHM
GO	0.48
An-GO	0.71
FA-GO	0.71

Table S3. TRPL decay parameters of various perovskite films.

Device	τ_1	a_1	τ_2	a_2	τ_{ave} (ns)
w/o GO	0.3244	24.75%	6.7256	75.25%	1.143
w GO	0.3081	38.92%	7.91688	61.08%	0.746
w An-GO	0.2719	48.88%	6.3677	51.12%	0.532
w FA-GO	0.1535	55.08%	3.7687	44.92%	0.269

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