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A General Strategy to Prepare High-quality Inorganic Charge-transporting Layers for Efficient and Stable All-layer-inorganic Perovskite Solar Cells

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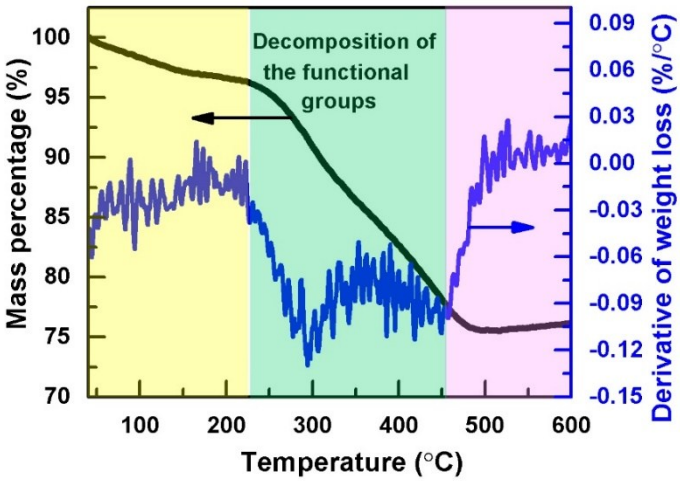

Fig. S1. Thermogravimetry in N_2 of the OA-capped NCs.

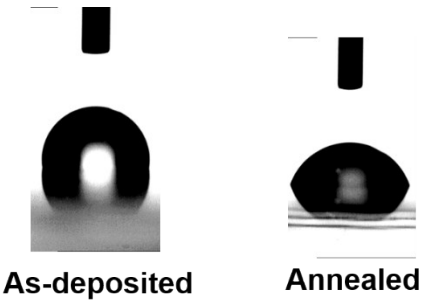

Fig. S2. The moist angles of OA-capped In_2O_3 NCs before and after annealing at 250 °C.

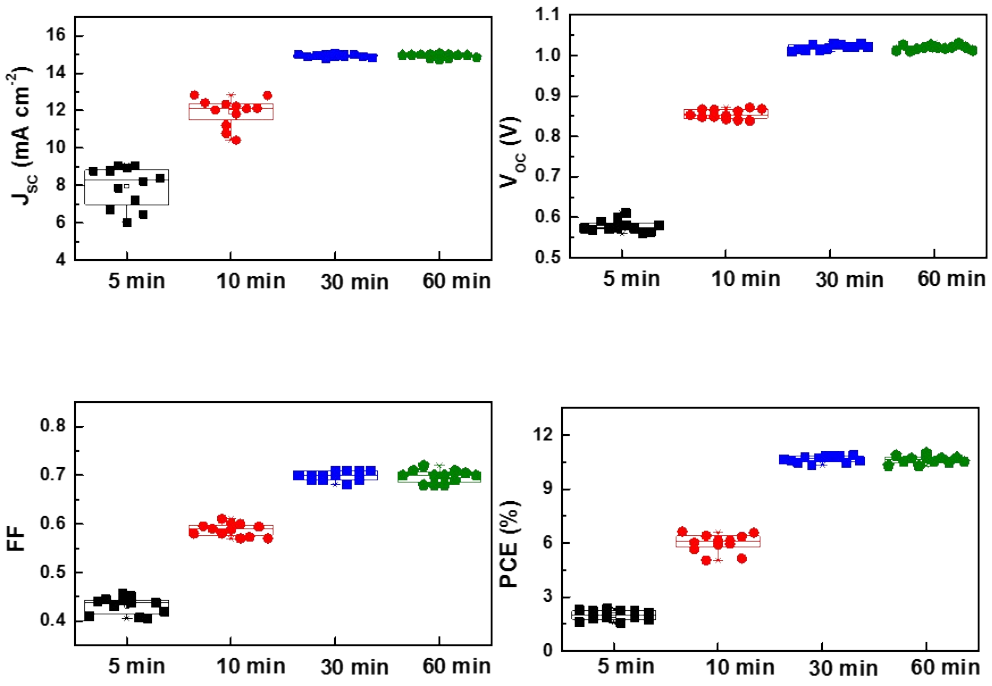

Fig. S3. Statistic photovoltaic parameters of devices with C-In_2O_3 ETLs annealed for different times.

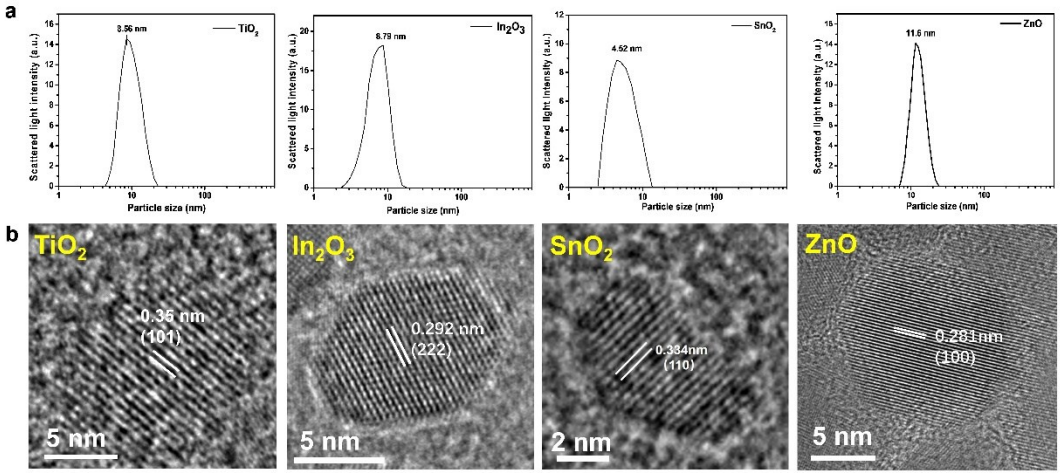

Fig. S4. (a) Dynamic light scattering and (b) and high-resolution TEM images of the OA coated MOX NCs.

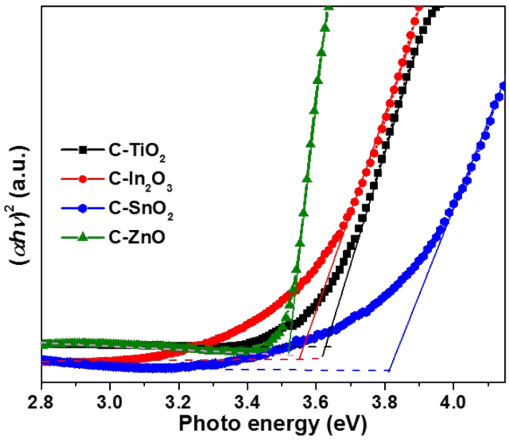

Fig. S5. UV–vis absorption of different C-MOX films.

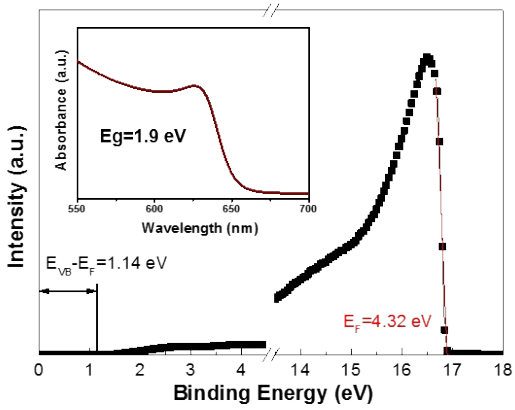

Fig. S6. UPS and the UV–vis absorption of $CsPbI_2Br$ films, from which the band structure can be extracted.

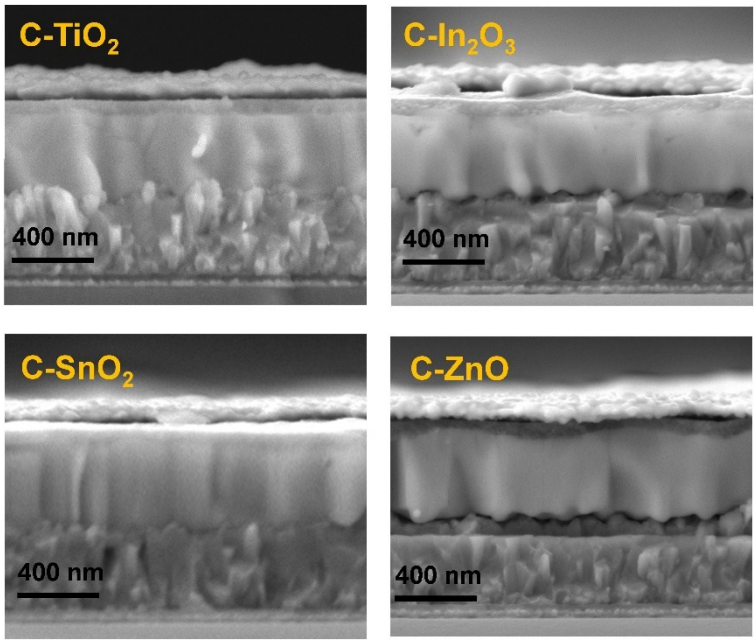

Fig. S7. The cross-sectional SEM images of all-layer-inorganic PSCs with the structure FTO/NiMgLiO/$CsPbI_2Br$/C-MOX/Ag.

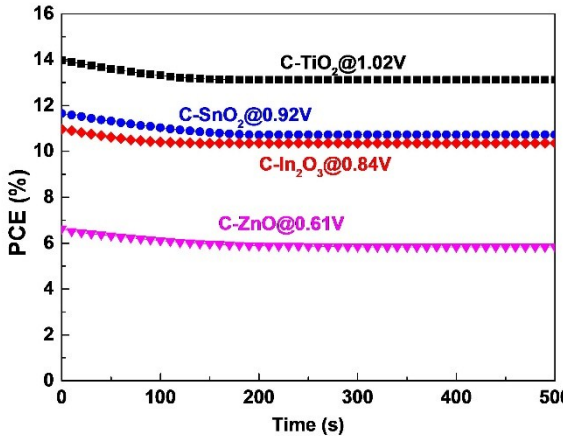

Fig. S8. The stabilized power output data (SPO) of devices based on different ETLs.

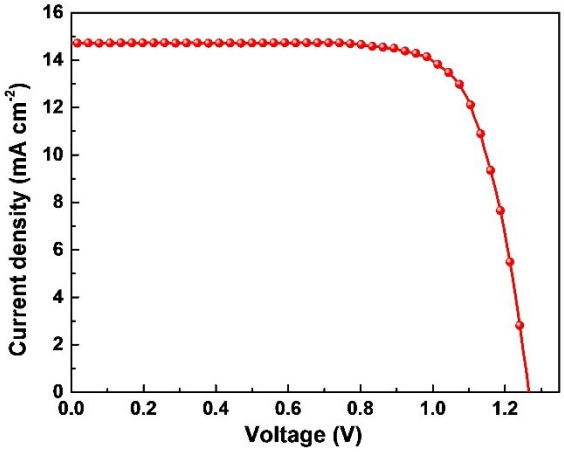

Fig. S9. *J-V* curve of the champion device with the C-TiO_2 as the ETL.

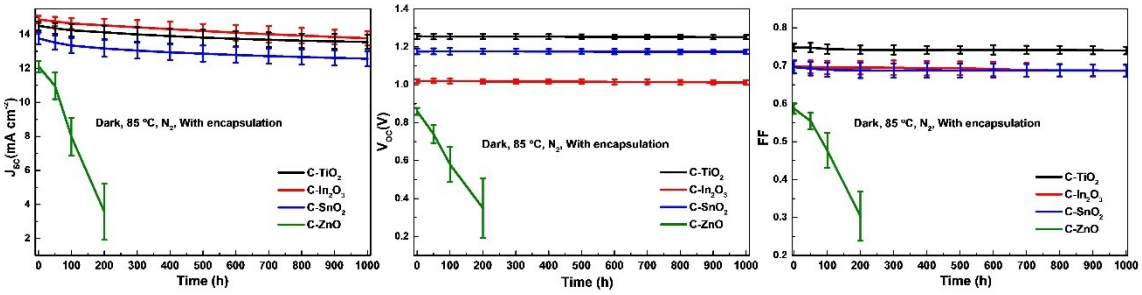

Fig. S10. Changes of photovoltaic parameters of encapsulated devices with different ETLs aged at 85 °C in the dark in a glovebox containing an inert N_2 atmosphere.

Table S1. Summary of the champion PCE and stability of $CsPbI_2Br$ and other cesium lead halide-based devices.

Perovskite absorber	**Device structure**	***PCE* (%)**	**Stability**					**Reference**
			Decline	Dark/Light	Temperature	Atmosphere	Encapsulation	
$CsPbI_2Br$	FTO/TiO_2/$CsPbI_2Br$/P3HT/Au	12.02	10% for 960 h	Dark	/	dried glovebox	Without	Adv. Mater. 2018, 1705393
$CsPbI_2Br$	FTO/c-TiO_2/m-TiO_2/$CsPbI_2Br$/spiro-OMeTAD/Ag	12.5	No drop for 500 h	Dark	25 ℃	Ambient (RH < 25%)	Without	J. Phys. Chem. Lett. 2018, 9, 3646−3653
$CsPbI_2Br$	FTO/c-TiO_2/$CsPbI_2Br$/spiro-OMeTAD/Ag	10.56	9% for 35 days	Dark	25-30 ℃	Dry box RH=15-20%	Without	Sol. RRL 2018, 2, 1700180
3D–2D–0D $CsPbI_2Br$	FTO/TiO_2/$CsPbI_2Br$/PTAA/Au	12.39	No drop for 60 days	Dark	25 ℃	RH=25-35%	Without	Adv. Energy Mater. 2018, 1703246
Mn^{2+} doped $CsPbI_2Br$+ QDs	FTO/TiO_2/$CsPbI_2Br$/$CsPbI_2Br$ QDs/PTAA/Au	13.47	3% for 35 days	Dark	25 ℃	RH=25-35%	Without	ACS Energy Lett. 2018, 3, 970−978
$CsPbI_2Br$	FTO/TiO_2/$CsPbI_2Br$/spiro-OMeTAD/Au	14.78	No drop for 500 h	Dark	25 ℃	Ambient (RH ~ 20%)	Without	Adv. Funct. Mater. 2018, 28, 1803269
$CsPbI_2Br$+ Mn^{2+} doped $CsPbI_3$ QDs	FTO/TiO_2/$CsPbI_2Br$/$CsPbI_3$ QDs/PTAA/Au	14.45	<10% for 20 days	Dark	/	N_2	Without	Joule 2, 1–11, August 15, 2018
$CsPb_{0.98}Sr_{0.02}I_2Br$	FTO/c-TiO_2/m-TiO_2/$CsPb_{1-x}Sr_xI_2Br$/P3HT/Au	11.3	No drop for 30 days	Dark	25 ℃	RH<50 %	With	ACS Energy Lett. 2017, 2, 2319−2325
$CsPbI_2Br$	ITO/Ca/C60/$CsPbI_2Br$/TAPC/TAPC:MoO_3/Ag	11.8	4% for 66 days	Dark	25 ℃	/	With	Adv. Mater. 2017, 29, 1605290
$CsPbI_2Br$	ITO/SnO_2/ZnO/$CsPbI_2Br$/Spiro-	14.6	20% for 300 h	Dark	85 ℃	N_2	Without	Adv. Mater. 2018,

	OMeTAD/MoO_3/Ag							1802509
$CsPbI_2Br$	FTO/NiOx/$CsPbI_2Br$/ ZnO@C60/Au (inverted)	~13	20% for 360 h	Dark	85 ˚C	N_2	Without	J. Am. Chem. Soc. 2018, 140, 3825
$CsPbI_2Br$	FTO/TiO_2/$CsPbI_2Br$/spiro-OMeTAD/Au	9.3	<1% for 1500 h	Light (UV filter)	25 ˚C	N_2	/	J. Phys. Chem. Lett. 2017, 8, 4122−4128
$CsPbI_2Br$	ITO/Ca/C60/$CsPbI_2Br$/TAPC/TAPC:MoO_3/Ag **(inverted)**	11.8	20% for 120 h	Light (UV filter)	25 ˚C	ambient	With	Adv. Mater. 2017, 29, 1605290
$CsPbI_2Br$	ITO/c-TiO_2/$CsPbI_2Br$/spiro-OMeTAD/Au	16.07	<10% for 120 h	Light	25 ˚C	N_2	Without	Joule 2019, 3, 1–14
$CsPbI_2Br$	ITO/SnO_2 /PN4N/PVSC/PDCBT/MoO3 /Ag	16.2	<10% for 400 h	Light	25 ˚C	N_2	Without	Adv. Mater. 2019, 1901152
$CsPbI_2Br$	**FTO/NiMgLiO/$CsPbI_2Br$/C-TiO_2/Bi/Ag (inverted)**	**13.84**	**8% for 1000 h**	**Dark**	**85 ˚C**	**N_2**	**With**	**This work**
$CsPbI_2Br$	**FTO/NiMgLiO/$CsPbI_2Br$/C-TiO_2/ Bi/Ag (inverted)**	**13.88**	**5% for 1000 h**	**Light (UV filter)**	**45 ˚C**	**N_2**	**With**	**This work**
$CsPbI_3$	FTO/PTAA/$CsPbI_3$ (OTG)/PCBM/BCP/ Ag **(inverted)**	13.32	~15% for 30 days	Dark	25 ˚C	RH <10%	Without	Adv. Mater. 2019, 1900605
$CsPb_{0.9}Sn_{0.1}IBr_2$	FTO/c-TiO_2/m-TiO_2/$CsPb_{0.9}Sn_{0.1}IBr_2$ /carbon	11.3	No drop for 14 days	Dark	100 ˚C	/	With	J. Am. Chem. Soc. 2017, 139, 14009−14012
$CsPbBr_3$	FTO/c-TiO_2/m-TiO_2/GQDs/$CsPbBr_3$/ carbon	9.7	No drop for 40 days	Dark	80 ˚C	RH=0%	/	Angew. Chem. Int. Ed. 2018, 57, 3787 – 3791