

## Supporting Information

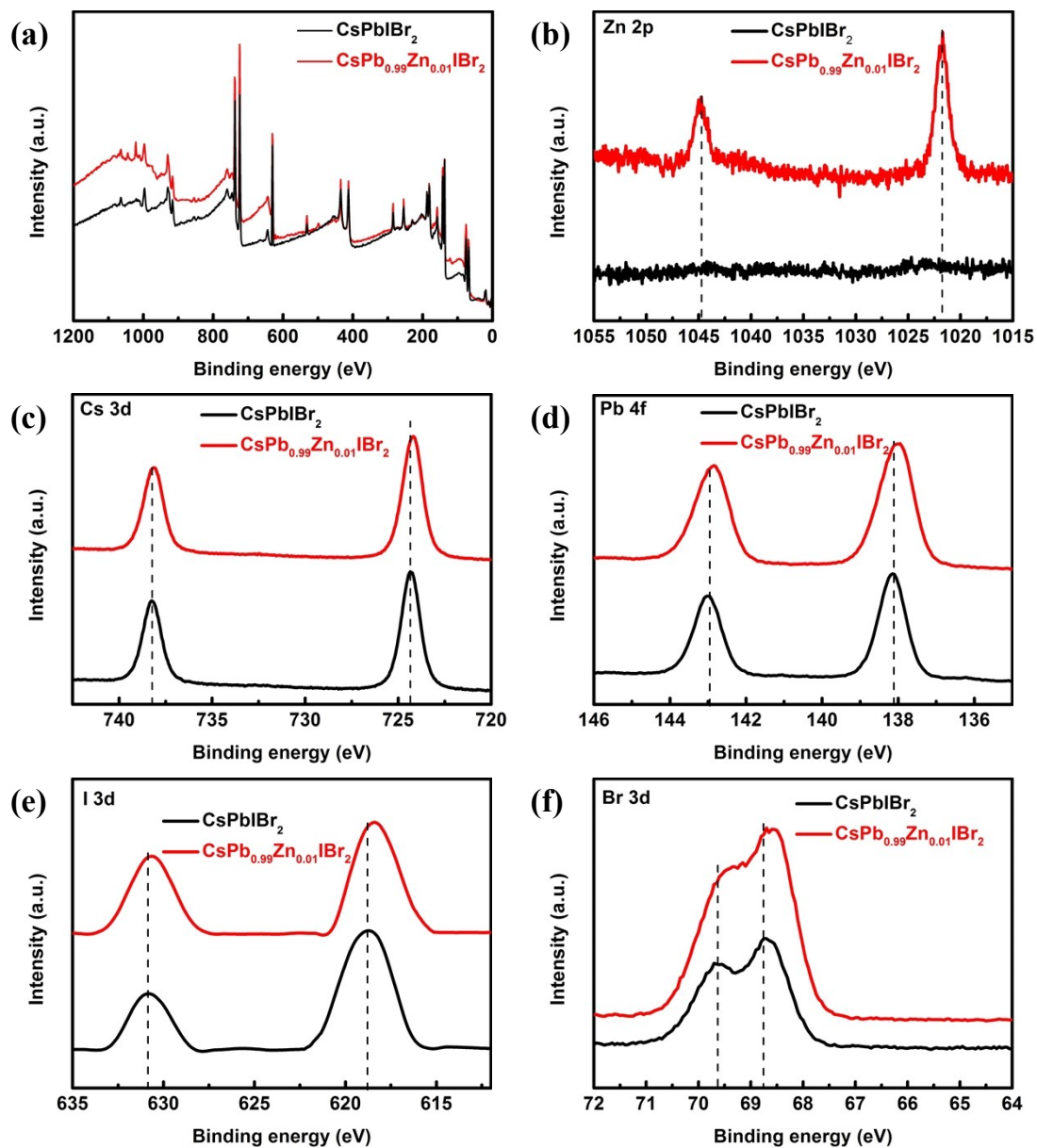
### **Zinc Ion Functional Doping for All-Inorganic Planar CsPbIBr<sub>2</sub> Perovskite Solar Cell with Efficiency over 10.5%**

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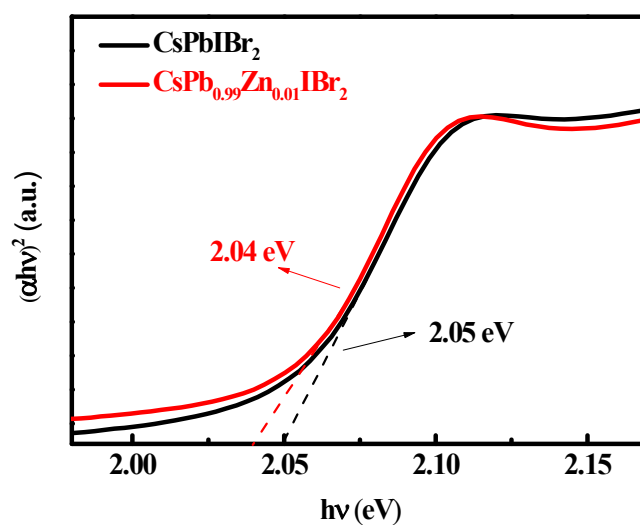
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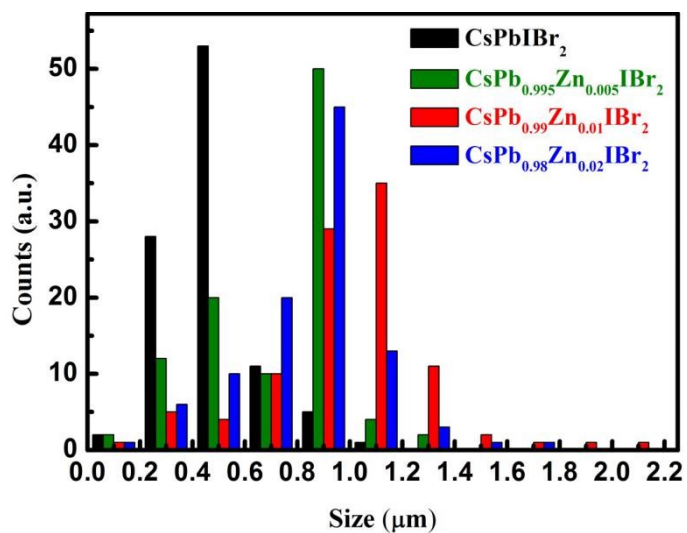
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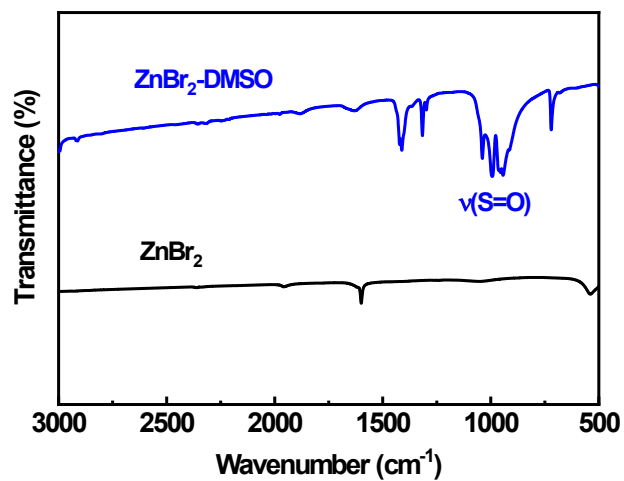
**Fig. S1.** a) XPS survey spectra of pristine  $\text{CsPbI}_3$  and  $\text{CsPb}_{0.99}\text{Zn}_{0.01}\text{I}_3$  films. b) Zn 2p, c) Cs 3d, d) Pb 4f, e) I 3d, and f) Br 3d XPS core spectra of pristine  $\text{CsPbI}_3$  and  $\text{CsPb}_{0.99}\text{Zn}_{0.01}\text{I}_3$  films, respectively.



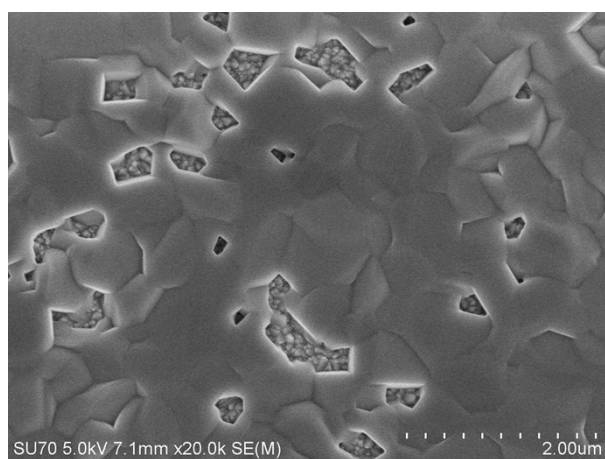
**Fig. S2.** Tauc plots of perovskite films obtained from UV-vis absorption spectra with equation  $(\alpha h\nu)^2 = A(h\nu - E_g)$ .



**Fig. S3.** Grain statistical distribution based on the SEM surface morphology images.



**Fig. S4** Fourier transform infrared spectrometer (FTIR) spectra of ZnBr<sub>2</sub> and ZnBr<sub>2</sub>-DMSO powders.



**Fig. S5.** The scanning electron microscope (SEM) image of the CsPb<sub>0.9</sub>Zn<sub>0.1</sub>IBr<sub>2</sub> perovskite film.

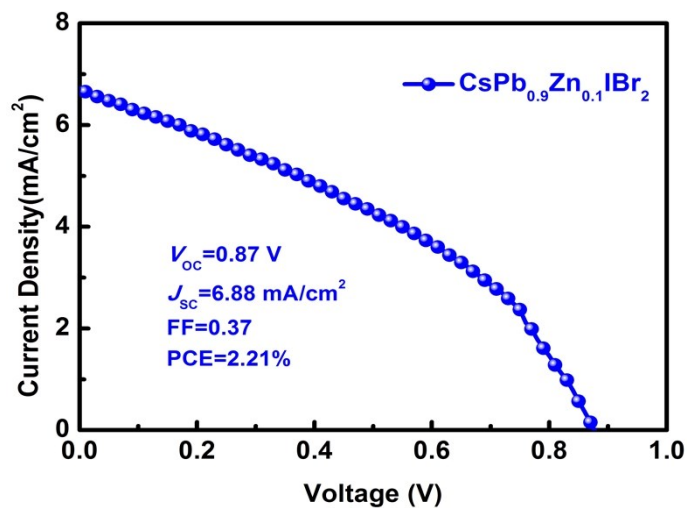


Fig. S6. The  $J$ - $V$  curve under RS of the  $\text{CsPb}_{0.9}\text{Zn}_{0.1}\text{IBr}_2$  and the corresponding data parameters.

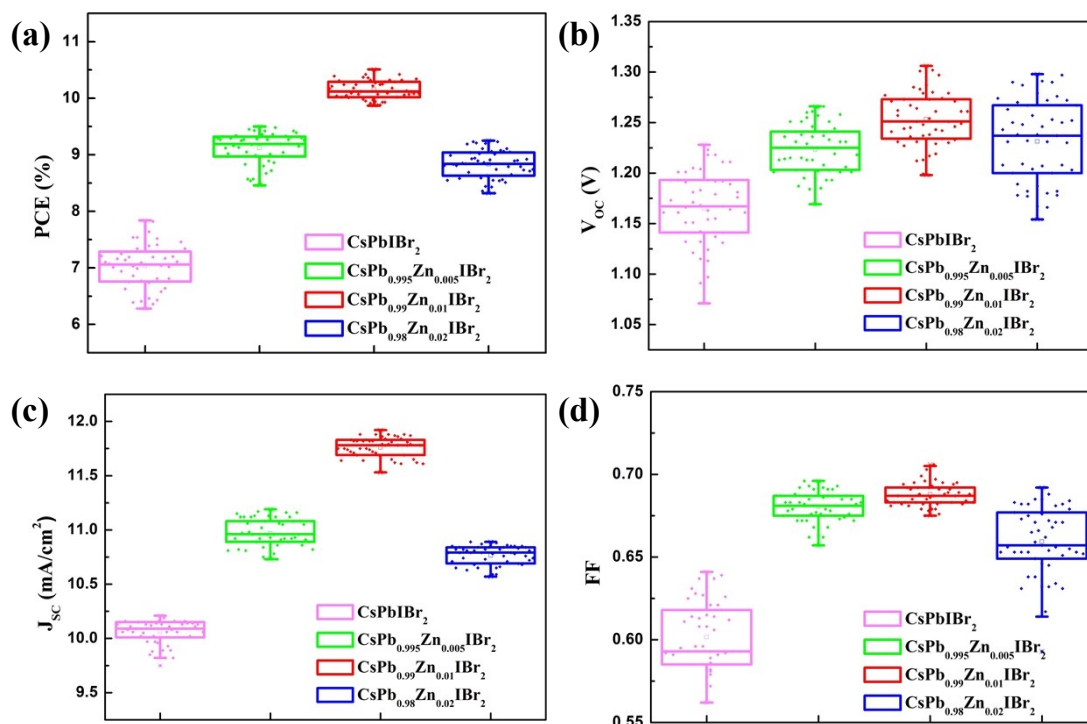


Fig. S7. a) PCE, b)  $V_{oc}$ , c)  $J_{sc}$ , and d) FF value distributions of  $\text{CsPbIBr}_2$ -based PSCs without and with different  $\text{Zn}^{2+}$  doping.

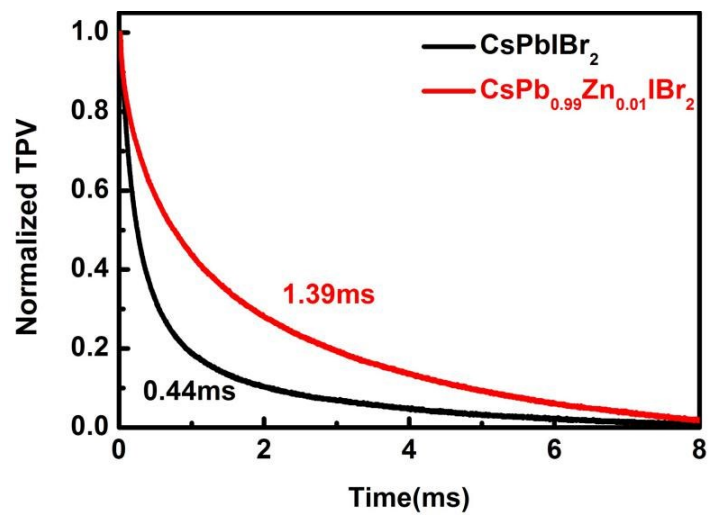


Fig. S8. TPV decay curves of the CsPbIBr<sub>2</sub> and CsPb<sub>0.99</sub>Zn<sub>0.01</sub>IBr<sub>2</sub> devices.

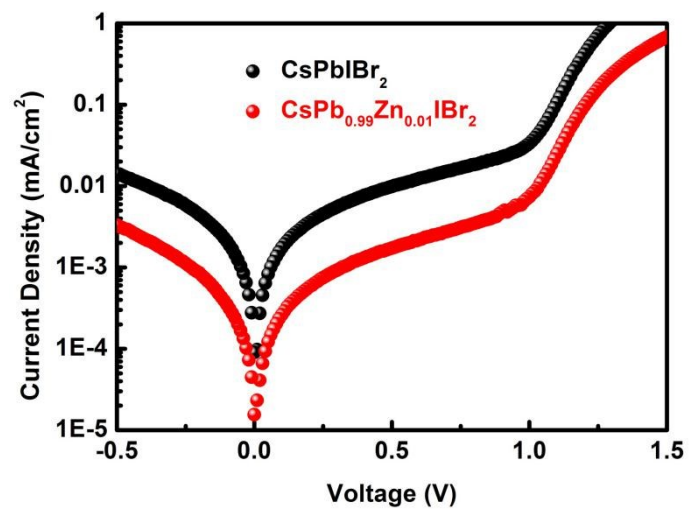


Fig. S9. The dark  $J$ - $V$  curves of the CsPbIBr<sub>2</sub> and CsPb<sub>0.99</sub>Zn<sub>0.01</sub>IBr<sub>2</sub> devices.

**Table S1.** Photovoltaic parameters of CsPbIBr<sub>2</sub> and CsPb<sub>0.99</sub>Zn<sub>0.01</sub>IBr<sub>2</sub> PSCs.

Device	Scan direction	$V_{oc}$ (V)	$J_{sc}$ (mA/cm <sup>2</sup> )	FF	PCE (%)	HI(%)
CsPbIBr <sub>2</sub>	FS	1.15	8.98	0.61	6.29	19.77
	RS	1.22	10.21	0.63	7.84	
CsPb <sub>0.99</sub> Zn <sub>0.01</sub> IBr <sub>2</sub>	FS	1.25	11.49	0.65	9.34	11.13
	RS	1.28	11.92	0.69	10.51	

**Table S2.** The fitted parameters of carrier lifetimes based on CsPbIBr<sub>2</sub> and CsPb<sub>0.99</sub>Zn<sub>0.01</sub>IBr<sub>2</sub> PSCs.

device	$A_1$	$\tau_1$ (ns)	$A_2$	$\tau_2$ (ns)	$\tau_{ave}$ (ns)
CsPbIBr <sub>2</sub>	84.17	1.98	15.83	11.33	2.27
CsPb <sub>0.99</sub> Zn <sub>0.01</sub> IBr <sub>2</sub>	60.36	4.82	39.64	12.59	6.37