

**Dual promotion strategy of interface modification and ion doping for  
efficient and stable carbon-based planar CsPbBr<sub>3</sub> perovskite solar  
cells**

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**Table S1.** The fitting results of the equivalent circuit based on PSCs w/o or with CsBr modification.

Devices	$R_s$ ( $\Omega$ )	$R_{co}$ ( $\Omega$ )	$R_{rec}$ ( $\Omega$ )
w/o CsBr	174.14	4.613	5110.68
with CsBr	226.09	0.0182	10332.74

**Table S2.** Photovoltaic parameters of CsPbBr<sub>3</sub> PSCs w/o and or CsBr modified.

Devices	scan	$J_{SC}$ (mA/cm <sup>2</sup> )	$V_{OC}$ (V)	FF	PCE (%)	HI
w/o CsBr	forward	6.51	1.04	0.66	4.47	0.257
	reverse	6.57	1.21	0.75	6.02	
with CsBr	forward	6.56	1.19	0.69	5.45	0.174
	reverse	6.64	1.21	0.82	6.60	

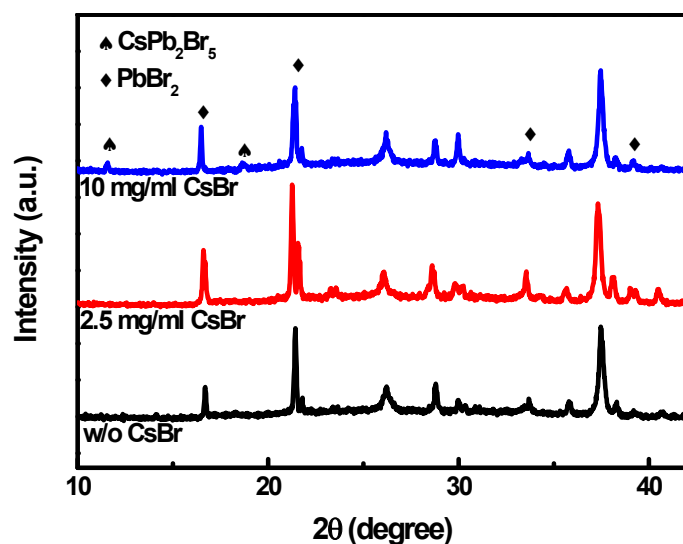


Fig. S1 XRD patterns of the PbBr<sub>2</sub> films modified with different concentration of CsBr (0, 2.5 mg/mL, 10 mg/mL).

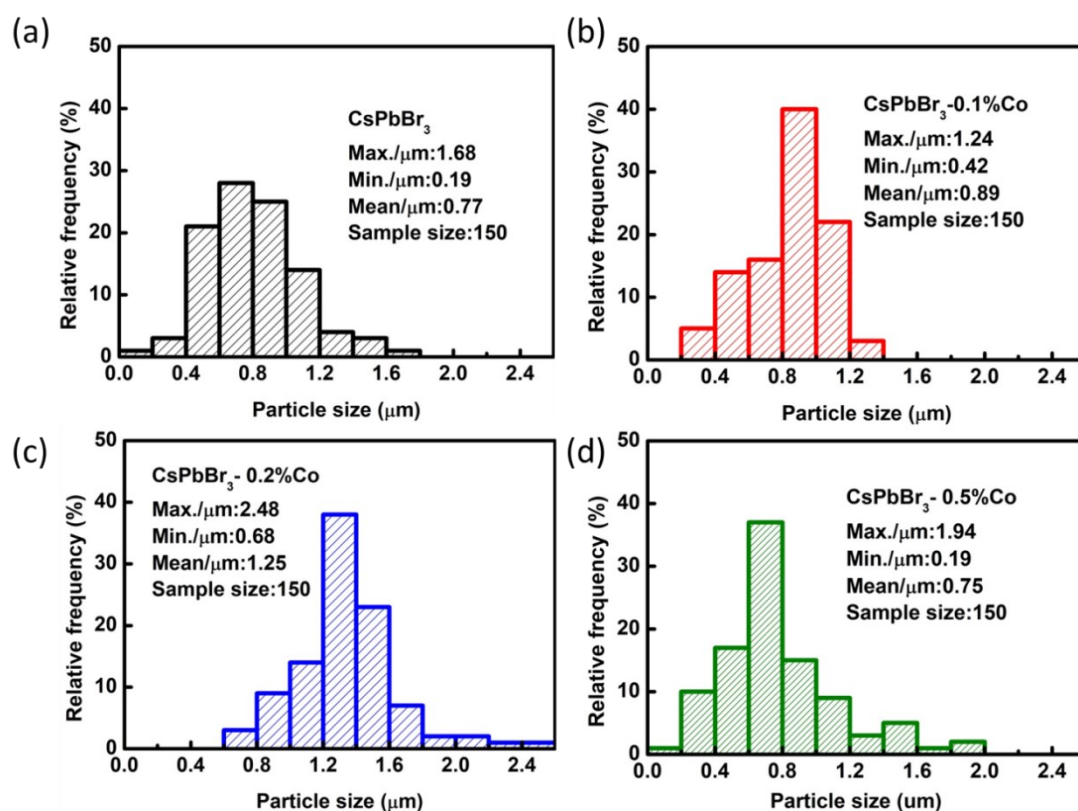
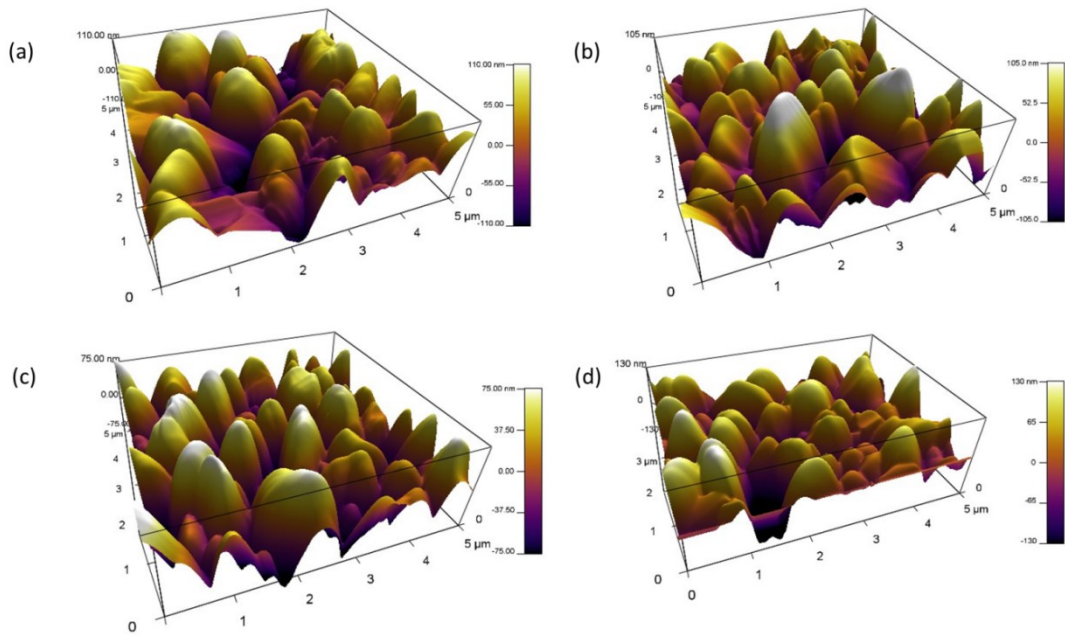
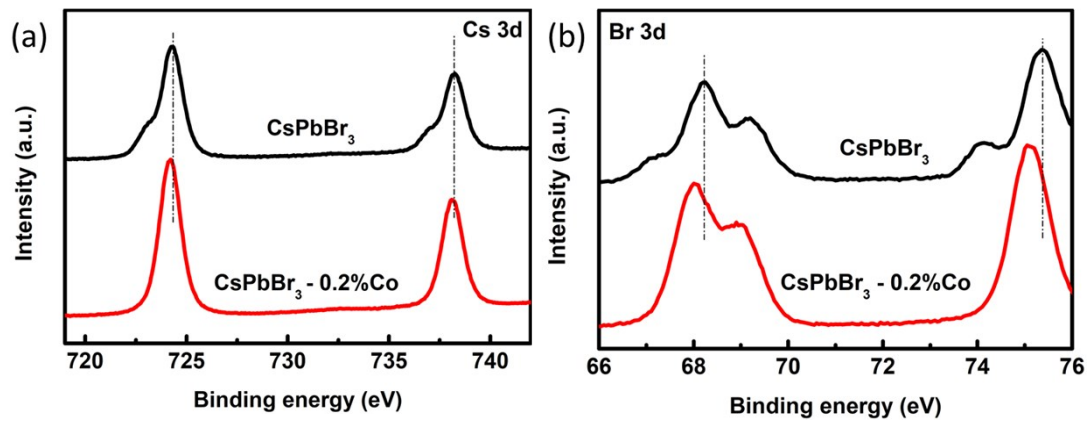


Fig. S2. Frequency distribution histogram of particle size statistics (a) CsPbBr<sub>3</sub>, (b) CsPbBr<sub>3</sub>-0.1%Co, (c) CsPbBr<sub>3</sub>-0.2%Co, (d) CsPbBr<sub>3</sub>-0.5%Co.



**Fig. S3.** The 3D-KPFM image of (a)  $\text{CsPbBr}_3$ , (b)  $\text{CsPbBr}_3\text{-}0.1\%\text{Co}$ , (c)  $\text{CsPbBr}_3\text{-}0.2\%\text{Co}$ , (d)  $\text{CsPbBr}_3\text{-}0.5\%\text{Co}$ .



**Fig. S4.** High-resolution XPS spectra of  $\text{CsPbBr}_3$  and  $\text{CsPbBr}_3\text{-}0.2\%\text{Co}$  films at the Cs 3d and Br 3d.

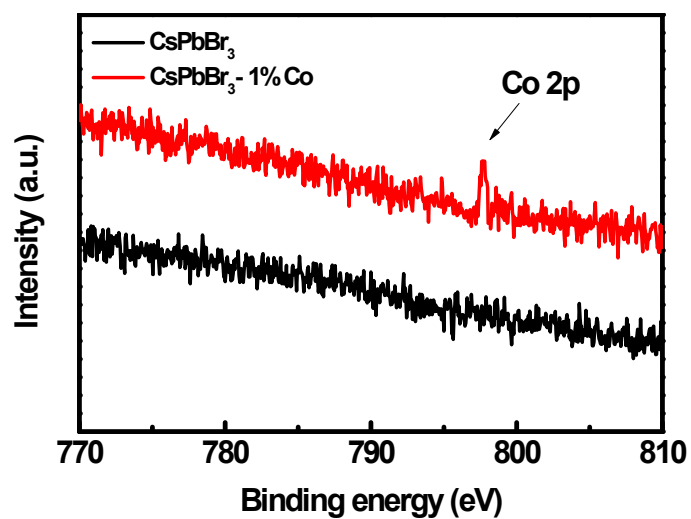


Fig. S5 High-resolution XPS spectra of CsPbBr<sub>3</sub> and CsPbBr<sub>3</sub>-1%Co films.

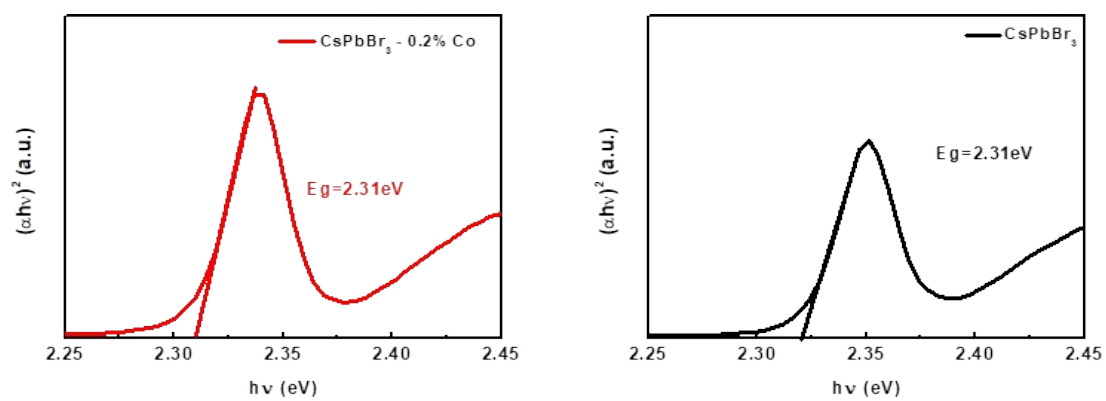
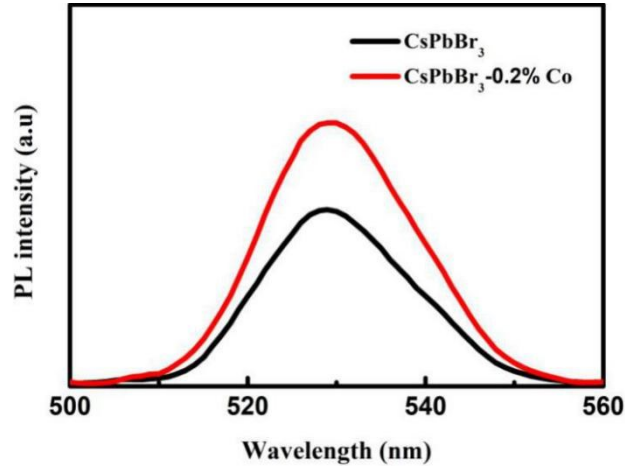
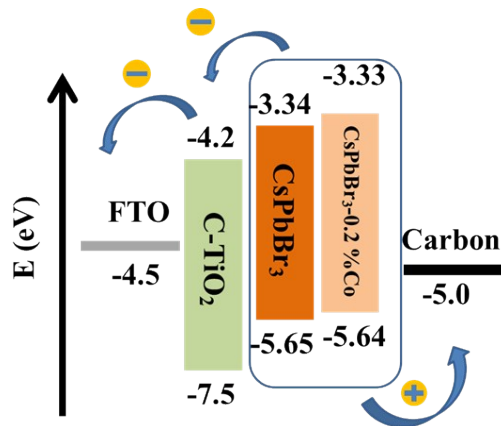


Fig. S6. Tauc plot for CsPbBr<sub>3</sub> and CsPbBr<sub>3</sub>-0.2%Co perovskite films.



**Fig. S7.** Steady-state PL spectra of perovskite films fabricated on top of glass.



**Fig. S8.** The energy level diagrams of the functional layer of  $\text{CsPb}_{1-x}\text{Co}_x\text{Br}_3$  PSCs.