

# Supporting information

## Bandgap tuning of CsPbBr<sub>3</sub> perovskite with synergistically improved quality via Sn<sup>2+</sup> doping for high-performance carbon-based inorganic perovskite solar cells

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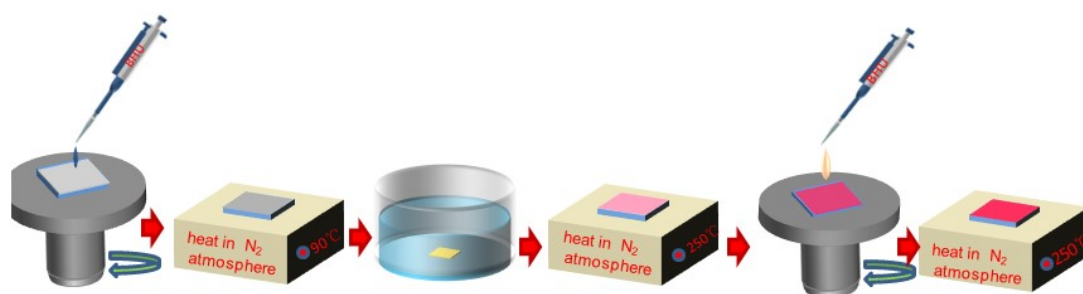


Fig. S1 Schematic illustration of the deposition process of CsPb<sub>1-x</sub>Sn<sub>x</sub>Br<sub>3</sub> perovskite films

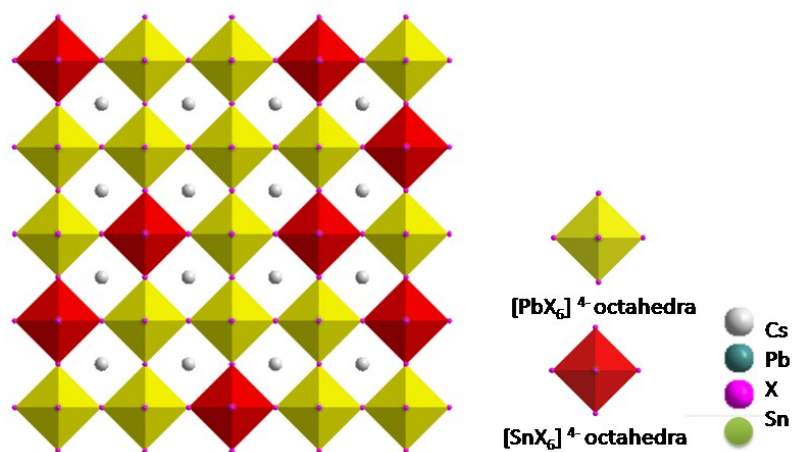


Fig. S2 Crystal structural model of  $\text{CsPb}_{1-x}\text{Sn}_x\text{Br}_3$  perovskite

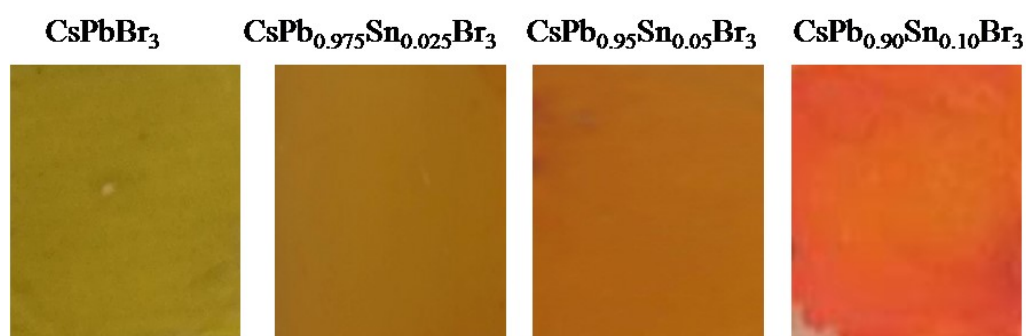


Fig. S3 Optical images of  $\text{CsPb}_{1-x}\text{Sn}_x\text{Br}_3$  perovskite films

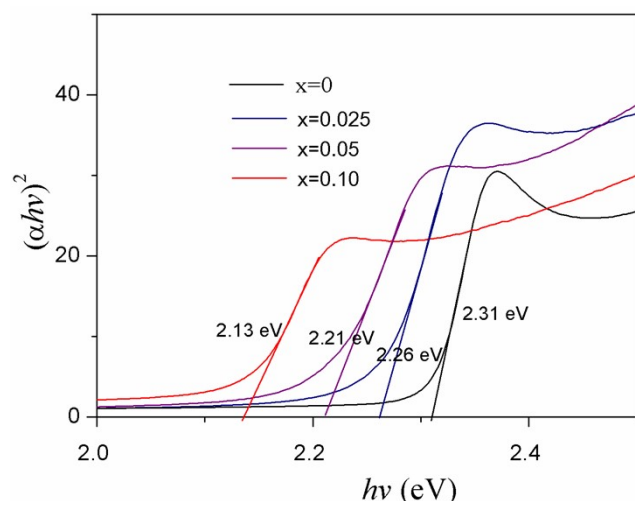


Fig. S4 Tauc plots of  $\text{CsPb}_{1-x}\text{Sn}_x\text{Br}_3$  perovskite films

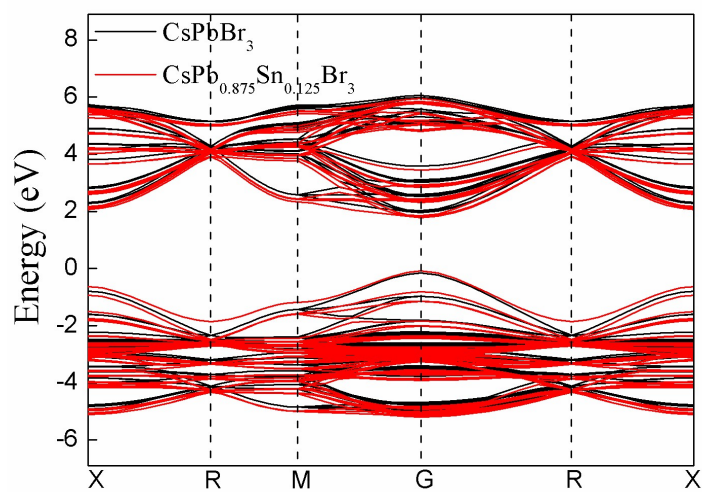


Fig. S5 The calculated band structure of  $\text{CsPbBr}_3$  and  $\text{CsPb}_{0.875}\text{Sn}_{0.125}\text{Br}_3$  perovskites

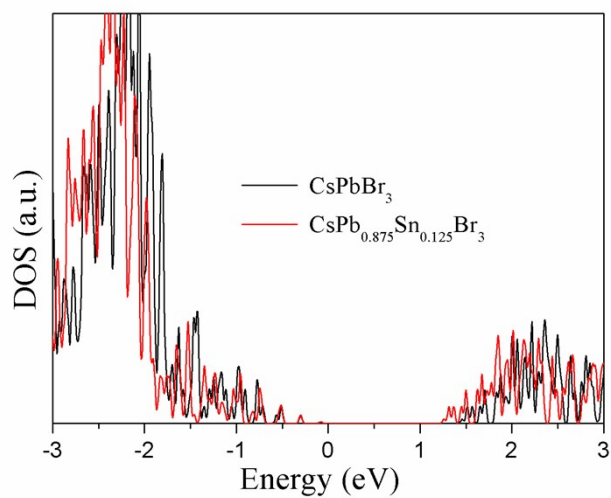


Fig. S6 The calculated total DOS of  $\text{CsPbBr}_3$  and  $\text{CsPb}_{0.875}\text{Sn}_{0.125}\text{Br}_3$  perovskites

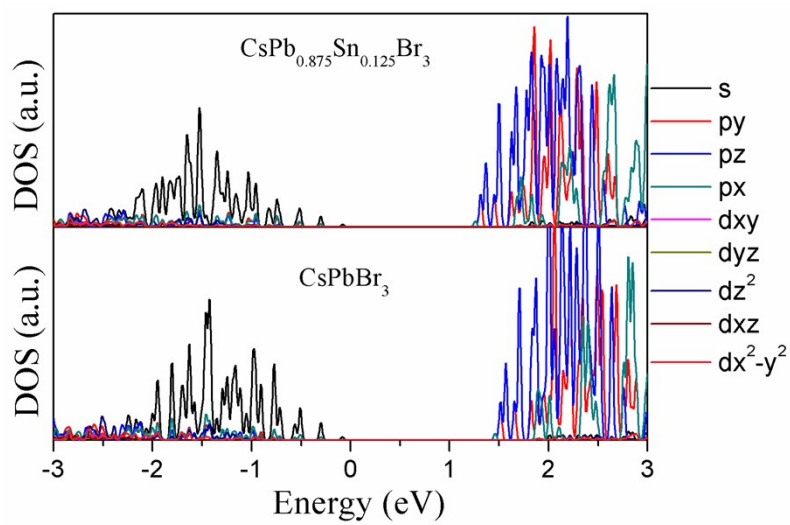


Fig. S7 The calculated DOS of Pb for  $\text{CsPbBr}_3$  and  $\text{CsPb}_{0.875}\text{Sn}_{0.125}\text{Br}$  perovskites

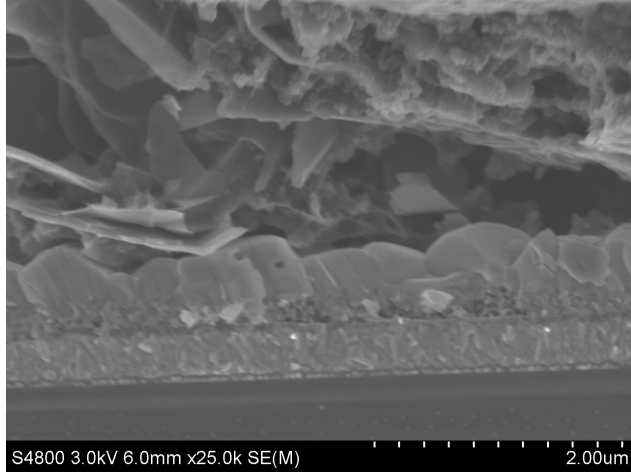


Fig. S8 The cross-sectional SEM image of carbon-based PSC with  $\text{CsPb}_{0.95}\text{Sn}_{0.05}\text{Br}_3$  perovskite film

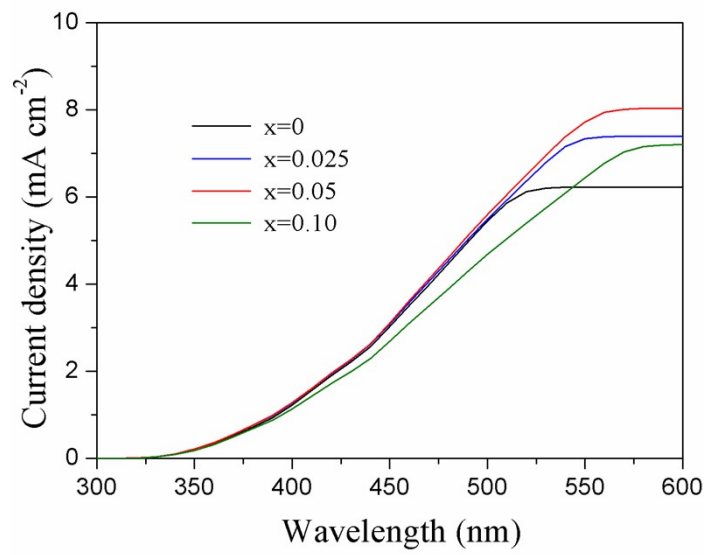


Fig. S9 Integrated current density of PSCs based on  $\text{CsPb}_{1-x}\text{Sn}_x\text{Br}_3$  perovskite films

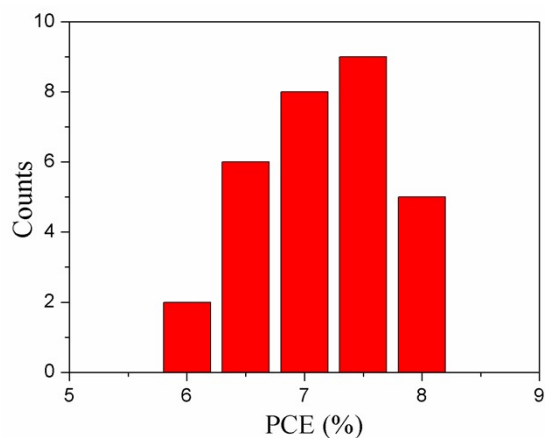


Fig. S10 Statistical efficiency distribution of 30 devices based on  $\text{CsPb}_{0.95}\text{Sn}_{0.05}\text{Br}_3$  perovskite film.

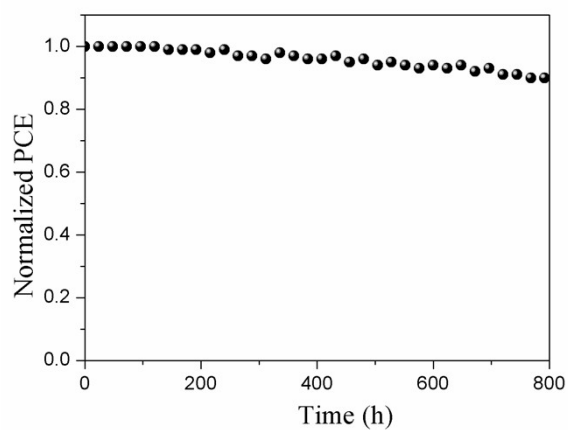


Fig. S11 Normalized PCE of  $\text{CsPbBr}_3$ -based PSC without any encapsulation in ambient condition with a temperature of 30 °C and a relative humidity of 45%.