Supporting Information

p-type Mesoscopic NiO as an Active Interfacial Layer for Carbon Counter Electrodes Based Perovskite Solar Cells

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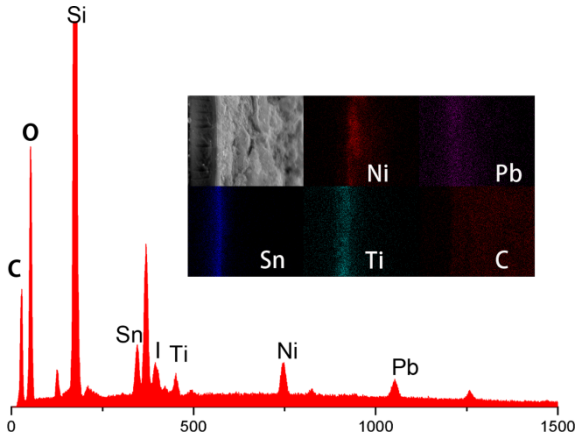

Fig. S1 Cross-sectional scanning electron micrograph (SEM) of TiO_2/NiO($CH_3NH_3PbI_3$)/carbon device and energy-dispersive x-ray (EDX) spectroscopy with elemental mapping of Ni, Ti, Pb, Sn and C.

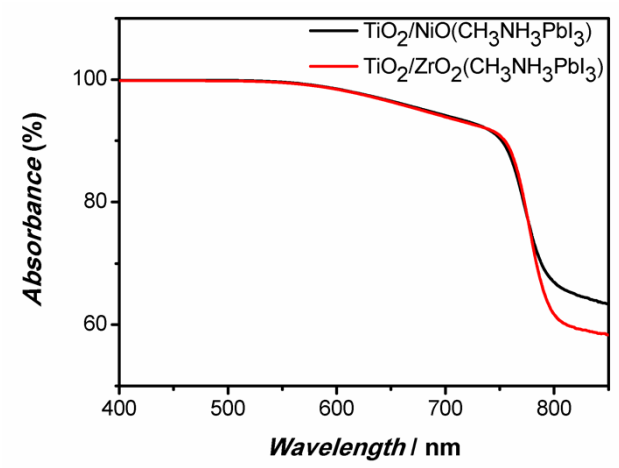

Fig. S2 The absorbance of TiO_2/NiO($CH_3NH_3PbI_3$) films and TiO_2/ZrO_2($CH_3NH_3PbI_3$) films, the $CH_3NH_3PbI_3$ was deposited using two-step sequential deposition method.

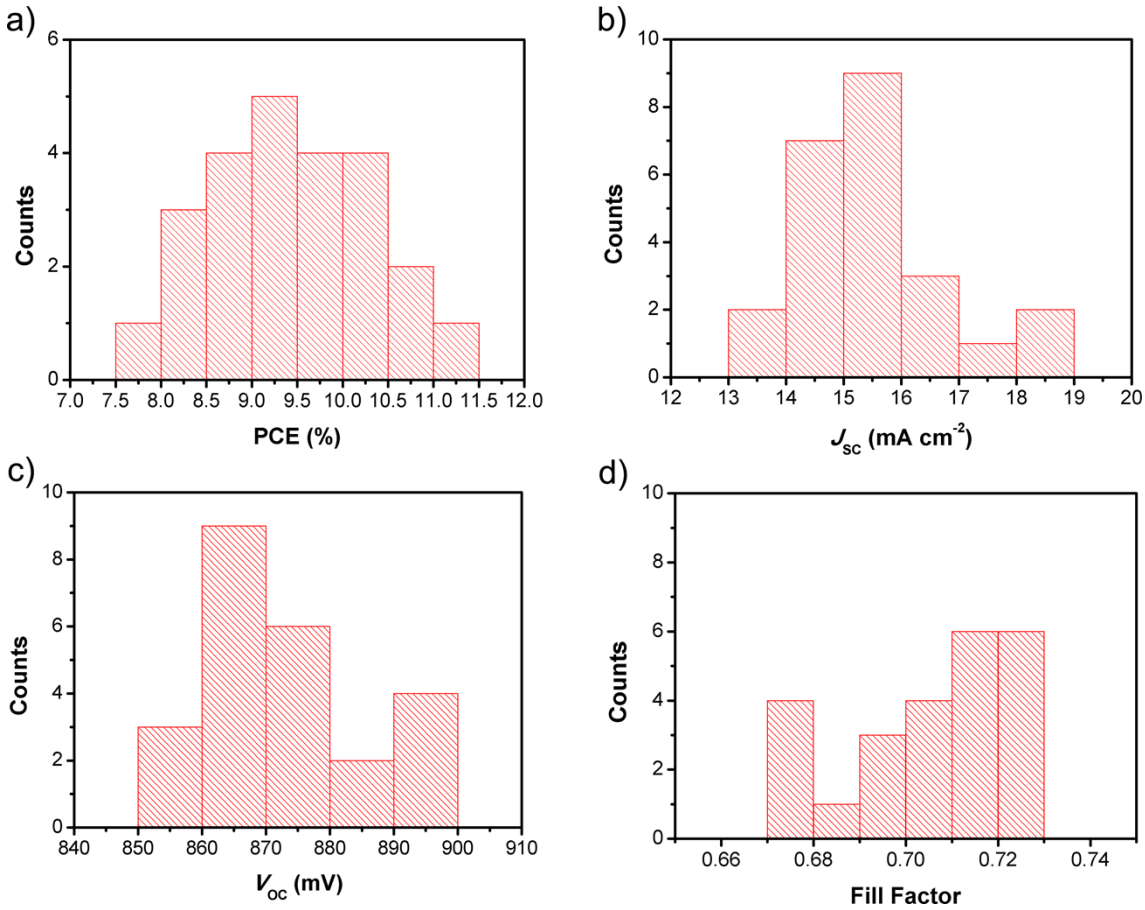

Fig. S3 Summary of photovoltaic parameters of 24 pieces of TiO_2/NiO($CH_3NH_3PbI_3$)/carbon devices: a) power conversion efficiency (PCE), b) short-circuit current density (J_{SC}), c) open-circuit voltage (V_{OC}), and d) fill factor.

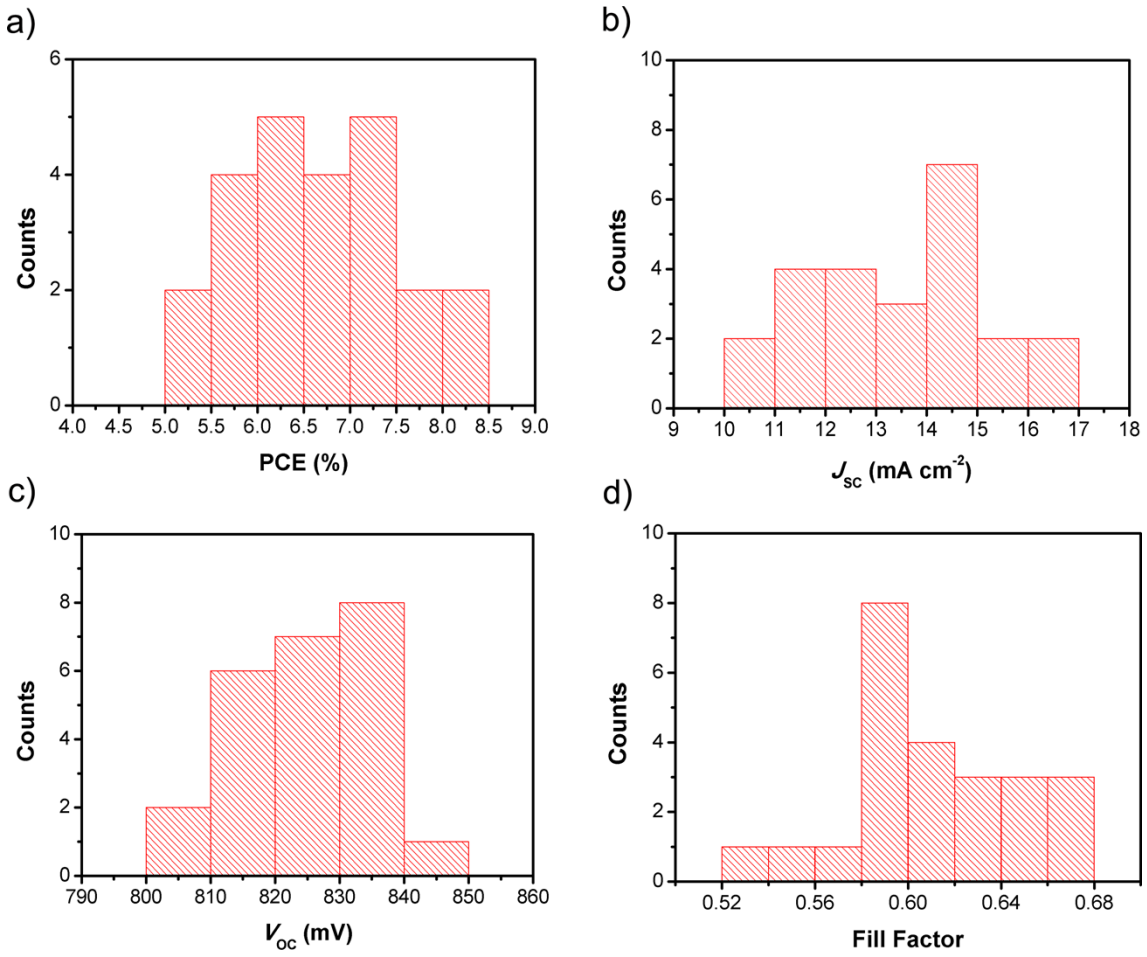

Fig. S4 Summary of photovoltaic parameters of 24 pieces of $TiO_2/ZrO_2(CH_3NH_3PbI_3)$/carbon devices: a) power conversion efficiency (PCE), b) short circuit current density (J_{SC}), c) open circuit voltage (V_{OC}), and d) fill factor.

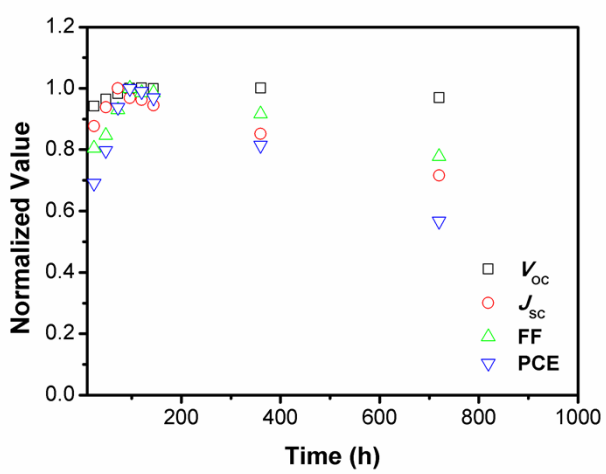

Fig. S5 The normalized photovoltaic parameters: open circuit voltage (Voc), short circuit current density (Jsc), fill factor (FF), and power conversion efficiency of TiO_2/NiO ($CH_3NH_3PbI_3$)/carbon device were recorded.

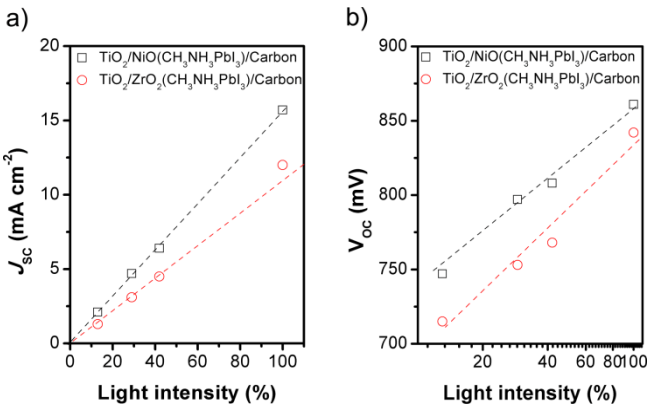

Fig. S6 a) Photo-current and b) photo-voltage response under different light intensity for $TiO_2/NiO(CH_3NH_3PbI_3)$/carbon device (black square) and TiO_2/ZrO_2 $(CH_3NH_3PbI_3)$/carbon device (red circle)**.**

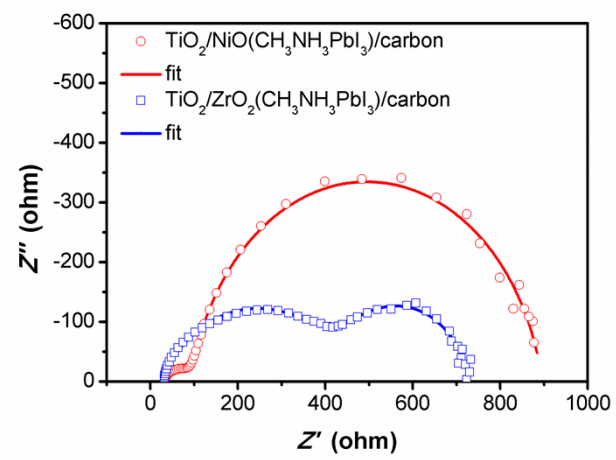

Fig. S7 Nyquist plots of $TiO_2/NiO(CH_3NH_3PbI_3)$/carbon device (red) and TiO_2/ZrO_2 $(CH_3NH_3PbI_3)$/carbon device (blue) in the dark with bias at 0.75 V over the frequency range of 100 mHz to 2 MHz.

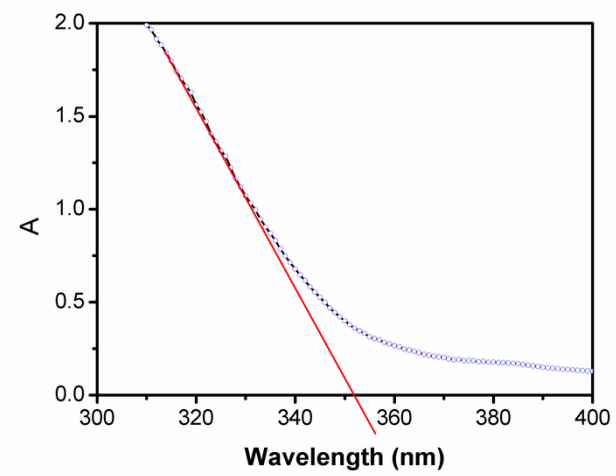

Figure S8 UV-vis spectra of NiO film and the Eg was calculated according to the equation: $Eg \approx 1240/\lambda$, showing that the NiO film have a band gap of ~3.5eV.