Supplementary Materials

Device Characterization

Mesoscopic perovskite solar cells, as shown in Figure 1a, were fabricated via the fast crystallization method as reported in our previous work.[1] The film structure and composition were studied using UV-vis absorbance spectroscopy and X-ray diffraction (XRD). The perovskite film absorbs light ranging from 350 to 800 nm, as shown in Figure S1. X-ray diffraction measurement was used to further examine the formation of the perovskite phase and crystallization. As shown in Figure S2**,** the perovskite $MAPbI_3$ film shows strong diffraction peaks for (110), (220), and (310) at 2θ of 14.1°, 28.4°, and 31.8°, indicating the typical tetragonal phase of perovskite. Furthermore, there are no detectable amounts of starting MAI or PbI_2 phase peaks, confirming that the sample is compositionally pure. To evaluate the quality of the $MAPbI_3$ thin film, we characterized the morphological properties using scanning electron microscopy (SEM). The top-view SEM image of the thin film is shown in Figure 1. The SEM image clearly shows the complete surface coverage and large grains in the range of 150–350 nm (Figure S3). Cross-section SEM also indicates the completed grain structures of the thin film prepared via the fast crystallization method (Figure S3).

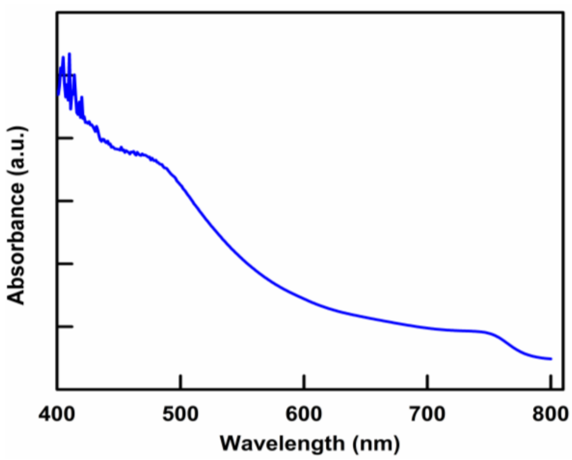

Figure (S1). UV-vis absorption spectra of $MAPbI_3$ perovskite absorber layer.

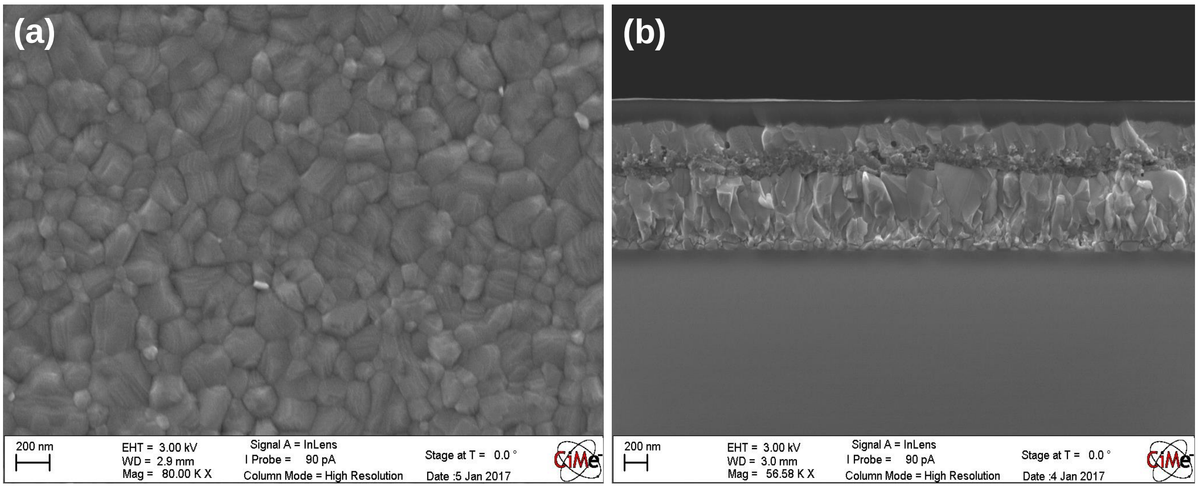

Figure (S2). (a) Surface and (b) Cross-sectional SEM morphology of $MAPbI_3$ perovskite absorber layer.

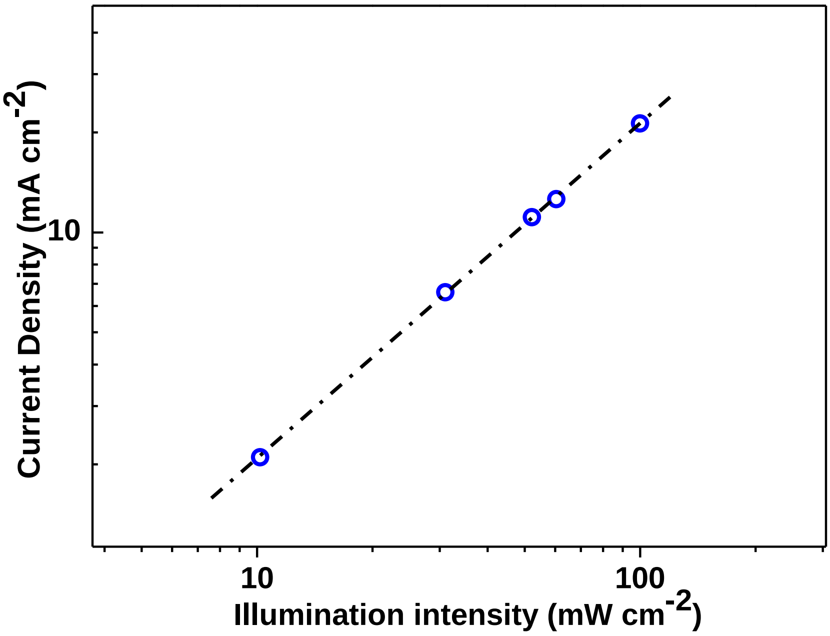

Figure (S3). Current density of the device measured under various illumination levels where the net photocurrent is constant, (b) from mid forward bias to knee voltage.

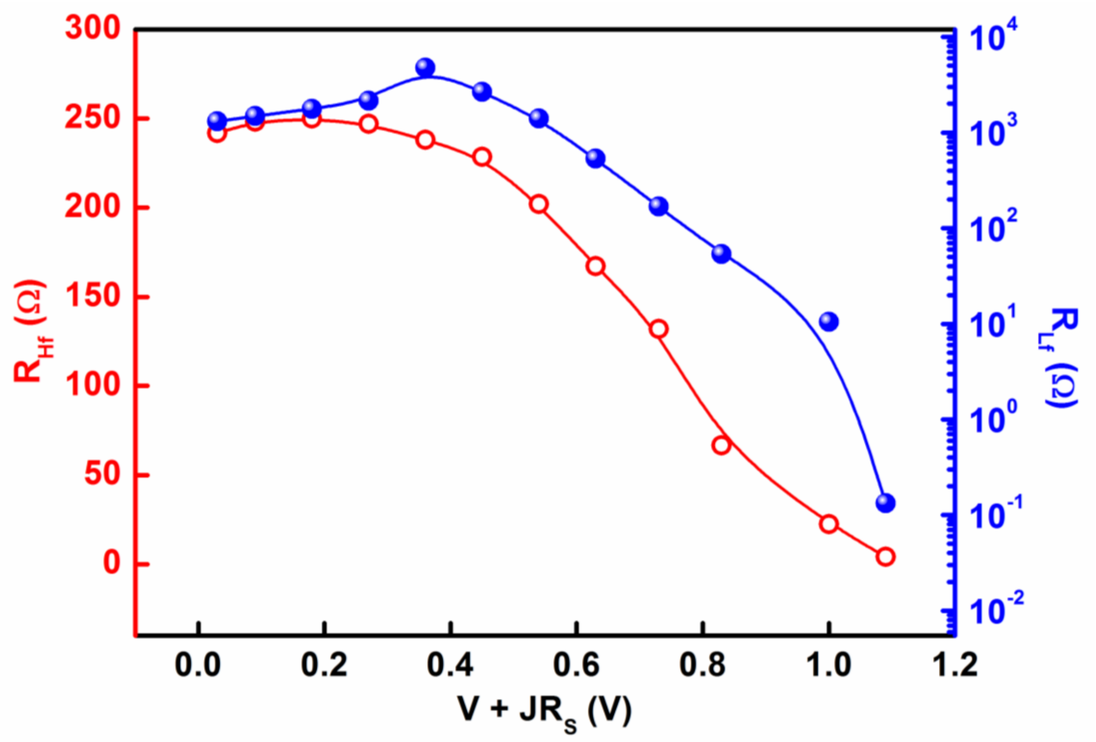

Figure (S4). The variation of high and low frequency resistance as a function of V+JR_S.

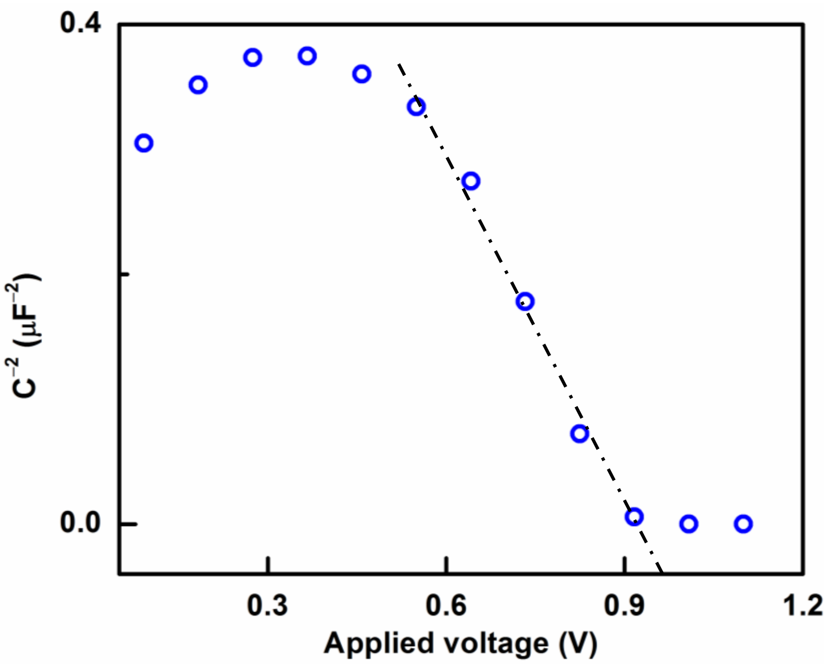

Figure (S5). A Mott-Schottky (MS) plot of a PSC at the frequency of 10 KHz in the bias range from 0 V to V_{OC}.

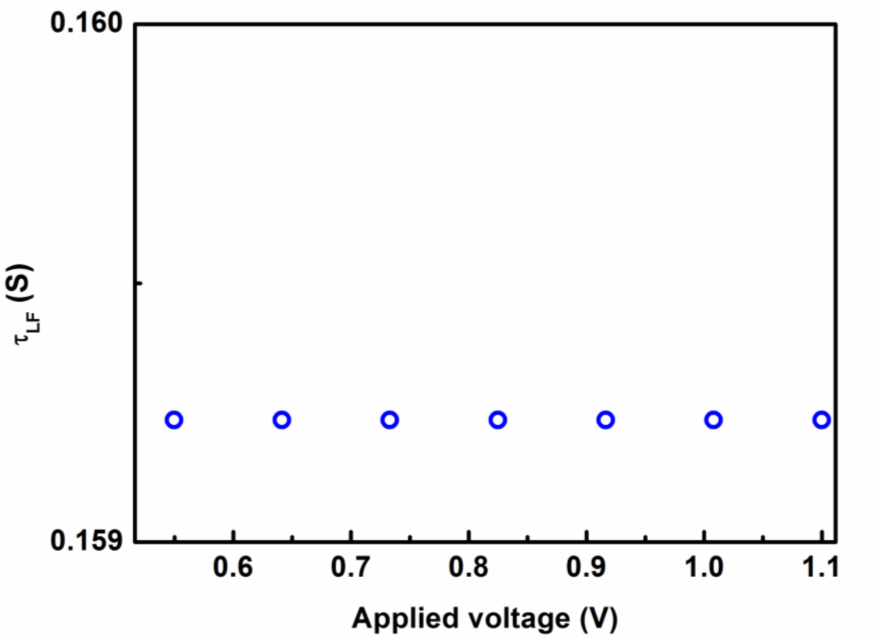

Figure (S6). Variation of the low frequency time constant as a function of applied bias for a PSC.

REFERENCES

1. D. Prochowicz, M. Franckevicius, A. M. Cieślak, S. M. Zakeeruddin, M. Graetzel and J. Lewiński, J. Mater. Chem. A, 2015, 3, 20772–20777