Impact of Homogenous Perovskite Layer in Organometal Halide Perovskite Solar Cells

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INTRODUCTION

Perovskite solar cells have recently attracted a great deal of attention, with power conversion efficiencies greater than 15% superseding a number of established thin- film solar technologies. Most work has focused on a pinhole free perovskite layer. Here, we studied the impact of homogenous perovskite layers deposited on top of the mesoporous TiO_2 layer, in hole conductor free organometal perovskite solar cells. Hole conductor free perovskite solar cells are used in this work, in order to minimize other possible effects.

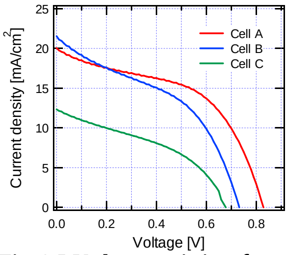

Fig. 1 J-V characteristics of perovskite solar cells

RESULTS AND DISCUSSION

Fig. 1 shows the current density-voltage characteristics of cells A, B and C measured under standard AM 1.5G condition with input solar power P_{in} of 1000 W/m^2. The surface morphology of the device was viewed with field emission Scanning Electron Microscope (SEM) shown in Fig. 2. We noticed that different cell areas have different surface morphologies. These different surface morphologies have significant impact on the performances of each cell. For the best morphology, a Power Conversion Efficiency (PCE) of 8.30% was achieved and 3.35% for less homogenous perovskite layer. The photocurrent of cells A, B and C were characterized with the IPCE measurement. We observed that Cell A and Cell B presents a relatively higher IPCE in the whole measured wavelength than that of Cell C as shown in Fig. 3. Cell A has the highest PCE of 8.30%, Cell B a higher PCE of 6.59% and Cell C a high PCE of 3.35% as shown in Table 1 below. The highest PCE obtained in Cell A is mainly ascribed to the high open circuit voltage (*Voc)* and Fill Factor (FF) values, and this indicates that the light harvesting efficiencies and charge carrier extraction are significantly influenced by the homogeneity of the perovskite layer. The higher short circuit current density (*Jsc)* obtained in Cell B might be due to light scattering effect by the agglomeration of $CH_3NH_3PbI_3$ Crystals as shown in Fig. 2 b.

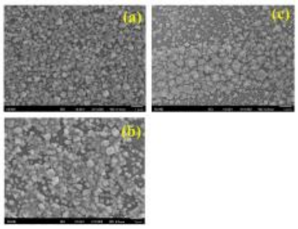

Fig. 2 Top view SEM images of Cells A (a), B (b) and C (c).

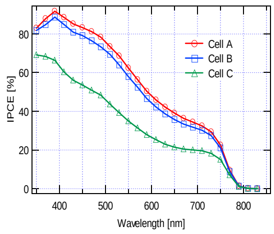

Fig. 3 IPCE spectra for cells A, B and C

Table 1 Perovskite solar cell parameters

Cell	Jsc [mA/cm^2]	Voc [V]	FF	η[%]
A	20.0	0.83	0.50	8.30
B	21.5	0.73	0.42	6.59
C	12.3	0.68	0.40	3.35

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[2] Jiangjian Shi, Yanhong Luo et al. ACS *Appl. Mater.* (2014), 6, 9711

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