Perovskite-type solar cell based on ZnO Nanorods Array: Current-Voltage (I-V) Characteristics

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1. Introduction

Development of lead halide perovskite, or methylammonium lead iodide ($MAPbI_3$) perovskite, has advanced rapidly in terms of photovoltaic output in shorter time compared to more mature and developed solar cells, such as dye sensitized solar cell or Si based solar cells. From 2009 when PSCs was first adopted by Miyasaka et al. [1] until development in 2012, its efficiency (η) has extended to higher than 10 %. Further development in 2013 and 2014 has further increased η of more than 15 % and 20 %, respectively. ZnO based PSCs is developed based on high electron mobility of ZnO material.

In this report, ZnO based PSCs is reported and have improved coverage of perovskite over ZnO nanorods array (NRA) surface. Such improvement also leads to improvement of η although the value of η is still very low (less than 1 %).

2. Experimental

A seed layer solution was prepared from a mixture of zinc acetate dihydrate with 2-methoxyethanol. The solution was stirred and heated at 60°C for 30 min after an addition of 10 drops of ethanolamine as a stabilizer. The deposition of the solution was done by spin coating on the cleaned FTO glass substrates and followed by a heat treatment at 100°C for 10 min before final annealing at 350°C for 1 h. Chemical bath deposition was used to grow the NRA at 85°C for 3 h.

Molar ratio of PbI_2 to MAI was at equimolar value of 1.2 M of perovskite solution with DMF and DMSO mixed solvent (vol. ratio at 7 : 1, respectively). The solution was spin coated at 1000 rpm speed. The sample coated with perovskite was then annealed at low (less than 20%) humidity in a glove box. The annealing was done at 100°C for 30 min. For PSCs fabrication, a platinum plate was used as a metal contact. For comparison purposes, carbon nanotube (CNT) paste was applied on top of a perovskite sample while the other was without CNT paste.

3. Results and Discussions

Figure 1 shows the FE-SEM observations of perovskite morphology on top of ZnO NRA. Figure 2 shows the I-V curve of the PSCs with and without CNT paste.

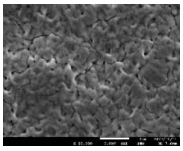
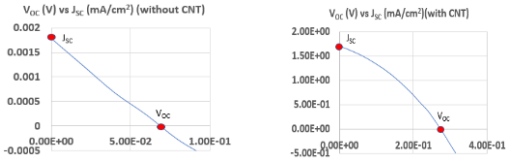


Fig. 1. FESEM Images of perovskite morphology



(a) (b)

Fig. 2. I-V curve of PSCs (a) without and (b) with CNT paste

References

1. Kojima, A., et al., *Organometal Halide Perovskites as Visible-Light Sensitizers for Photovoltaic Cells.* Journal of the American Chemical Society, 2009. **131**(17): p. 6050-6051.