Perovskite-type solar cell base on ZnO Nanorods Array: the effect of molar ratio of PbI_2 to MAI on formation of Perovskite Layer

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1. Introduction

Lead halide perovskite, also known as methylammonium lead iodide perovskite or $MAPbI_3$, is one of perovskite material for photovoltaic, optical, or electrical applications. Spin coating method is capable to form perovskite thin film without the use of complex method. We are fabricating the perovskite-type solar cell (PSC) based on ZnO nanorods array (NRA).

In this report, a relationship has been investigated between the ratio of PbI_2 to methylammonium iodide (MAI) and the microstructure of formed perovskite layer. Various molar ratio of PbI_2 to MAI was selected from equimolar to 1 to 3. Comparison between 1-step and 2-steps spin coating is also discussed.

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. The cycle of spin coating and heating was repeated 3 times before a 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 is set to be equimolar, 2 : 3, and 1 : 3 through 1-step and 2-steps spin coating. For the 1-step spin coating, the $CH_3NH_3PbI_3$ ($MAPbI_3$) solution was formed by combining PbI_2 solution with MAI powder in 1 mL N,N-DMF solvent. The 2-steps process consists of two separate solutions of PbI_2 in N,N-DMF solvent (heated at 120 °C) and MAI in 2-propanol solvent (heated at 90 °C). The spin coatings for 1-step and 2-steps were done with a speed of 2000 rpm.

3. Results and Discussions

The FE-SEM observations at equimolar concentration of PbI_2 and MAI show an array of cubic perovskite arranged in microfiber shape. For 2 : 3 molar ratio, the cubic shape perovskite becomes more distinct.

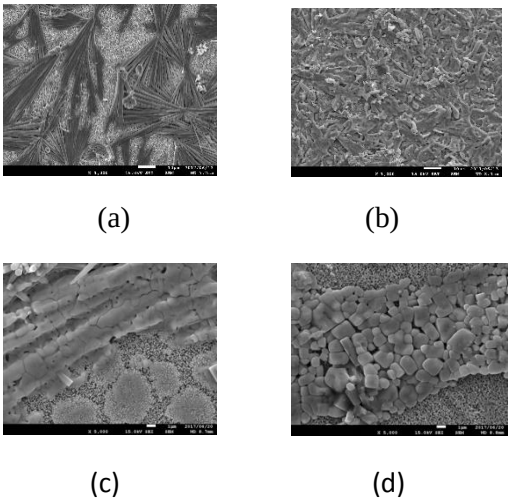

Fig. 1. FESEM Images of perovskite formed at: equimolar for (a) 1-step, and (b) 2-steps spin coating and 2 : 3 molar ratio for (c) 1-step, and (d) 2-steps spin coating