

Fabrication High Covered and Uniform Perovskite Absorbing Layer With Alkali Metal Halide for Planar Hetero-junction Perovskite Solar Cells

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Organic-inorganic hybrid perovskite have attracted significant attention as a new revolutionary light absorber for photovoltaic device due to its remarkable characteristics such as long charge diffusion lengths (100-1000nm), low recombination rate, and high extinction coefficient. Recently, power conversion efficiency of perovskite solar cell is above 20% that is approached to crystalline silicon solar cells. Planar heterojunction perovskite solar cells have simple device structure and can be fabricated low temperature process due to absence of mesoporous scaffold that should be annealed over 500 oC. However, in the planar structure, controlling perovskite film qualities such as crystallinity and coverage is important for high performances. Those controlling methods in one-step deposition have been reported such as adding additive, solvent-engineering, using anti-solvent, for pin-hole free perovskite layer to reduce shunting paths connecting between electron transport layer and hole transport layer.

Here, we studied the effect of alkali metal halide to control the fabrication process of perovskite film. During the morphology determination step, alkali metal halides can affect film morphologies by intercalating with PbI₂ layer and reducing CH₃NH₃PbI₃-DMF intermediate phase resulting in needle shape morphology. As types of alkali metal ions, the diverse grain sizes of film were observed due to different crystallization rate depending on the size of alkali metal ions. The pin-hole free perovskite film was obtained with this method, and the resulting perovskite solar cells showed higher performance as > 10% of power conversion efficiency in large size perovskite solar cell as 5 X 5 cm. X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and inductively coupled plasma optical emission spectrometry (ICP-OES) are analyzed to prove the mechanism of perovskite film formation with alkali metal halides.

Keywords: perovskite