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Abstract

Effect of V-Incorporated NiO Hole Transport Layer on the Performance of Inverted Perovskite Solar Cells †

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Abstract: Organic–inorganic hybrid perovskite solar cells have resulted in tremendous interest in developing future generation solar cells, due to their high efficiency exceeding 25%. For inverted type perovskite solar cells, the hole transporting layer plays a crucial role in improving the efficiency and stability of the perovskite solar cells by modifying band alignment, electric conductivity, and interfacial recombination losses. Here, vanadium doped NiO is selected as a hole transporting layer to study the impact of V dopant on the optoelectronic properties of NiO and photovoltaic performance. The prepared materials are characterized using XRD, SEM, TEM, and XPS. A TEM micrograph confirms that p-type materials have a small spherical dot structure. The V-doped NiO, used as a hole-extraction layer, can be prepared by a simple solvothermal decomposition method. The presence of V in the NiO layer has an influence on the conductivity of the NiO layer. Besides, synthesized p-type material can be used to fabricate a relatively low processing temperature, and has the advantage of a wide choice of transparent conductive oxide substrate. As a result, an inverted type planar perovskite solar cell incorporating of vanadium in NiO hole-transport layer improves the power conversion efficiency. The photovoltaic property of the prepared solar cell is measured under AM 1.5 G simulated light. The photocurrent density is 21.09 mA/cm^2, open-circuit voltage is 1.04 V, and the fill factor is 0.63. As a result, the overall power conversion efficiency reaches 13.82%.

Keywords: vanadium doping; conductivity; perovskite solar cell

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