Role of Morphology and Crystallinity of Nanorod and Planar Electron Transport Layers on the Performance and Long Term Durability of Perovskite Solar Cells

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ABSTRACT

High efficiency is routinely reported in $CH_3NH_3PbI_{3-x}Cl_x$ sensitized mesoscopic solar cells (PSCs) employing planar and scaffold architectures; however, a systematic comparison of their photovoltaic performance under similar experimental conditions and their long term stability have so far not been discussed. In this paper, we compare the performance and durability of PSCs employing these two device configurations and conclude that although a planar architecture routinely provides high initial photoconversion efficiency (PCE), particularly high open-circuit voltage (V_{OC}), a scaffold is crucial to achieve long term durable performance of such devices. In a comparative study of scaffold (rutile nanorods, NRs) *vs*. planar devices, the efficiency in latter dropped off by one order of magnitude in ∼300 h despite their similar initial PCE of ∼12%. We compared the performance and the durability of two types of scaffolds, i.e., pristine and $TiCl_4$ treated NRs, and observed that the pristine NRs showed >10% improvement in the PCE after ∼1300 h whereas the cells employing post-treated NR scaffold retained ∼60% of initial value. We address the origin of the different photovoltaic performance of planar and scaffold devices in the context of photoanode morphology and its possible effect on the cell durability.

KEYWORDS: Rutile nanorods based perovskite solar cells; Stability of perovskite solar cells; Lifetime of solution processed solar cells; Rutile nanowires; $TiCl_4$ treatment in perovskite solar cells

DOI: 10.1016/j.jpowsour.2015.02.084