(Abstract٨)

"Optimization of key parameters towards high performance perovskite solar cells"

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Abstract

Here, we report important findings regarding underestimated parameters for the synthesis and fabrication of high-performance perovskite solar cells. These parameters include the effect of Fluorine-doped Tin Oxide (FTO) etching, FTO cleaning, the number of compact TiO_2 (c-TiO_2) layer, the number of mesoporous TiO_2 (m-TiO_2) layers and the aging time before Ag deposition. Our results demonstrated that etching of FTO substrate with Zn/ HCl is an essential step and has a major effect on the solar cell's open circuit voltage (Voc), fill factor (FF) and power conversion efficiency (PCE). Furthermore, we demonstrate new and improved protocols for the complete cleaning of FTO substrates. Despite the use of sonication and plasma etching in previous cleaning techniques, SEM images clearly show black clouds in the samples, which may be due to residual Zn particles in the FTO grooves. Thus, a soft toothbrush was used with detergent before sonication to detach the remaining Zn particles. In addition, the optimum number of spin coated layers of compact and mesoporous TiO_2 precursors was investigated. We found that one mesoporous and two compact TiO_2 layers were required to obtain a homogenous pinhole-free compact layer. Consequently, we demonstrate that using these optimized device fabrication procedures, a high efficiency of 17.96% for 6 mol% Co3+-doped TiO_2 solar cells can be obtained in comparison to 16.98% for pristine TiO_2-based cells. Such cells are particularly important for wearable applications that require a small area and a high energy.