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Effects of p-type-metal-doping (Ba, Cs, and Y) of the compact-TiO_2 electron transporting layer on the photovoltaic properties of n-i-p perovskite solar cells

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ABSTRACT

Tailoring of charge transport properties of the electron transport layer (ETL) in solution-processible solar cells is continuously addressed not only for the performance enhancements in perovskite solar cells but also in various other applications in nanotechnology. In this work, three p-type dopants: barium, cesium (Cs), and yttrium (Y) with varying crystal radii and charges are doped in the titanium dioxide (TiO_2) material so as to modify the electrical and optical properties of the ETL. The pure and doped TiO_2 films were prepared by spin-coating a sol–gel precursor and their effects on the crystal structure, morphology, optical, electrical and photovoltaic properties of the perovskite solar cells were studied and reported. Among them, Y-doped TiO_2 with similar crystal radii as that of the host titanium atom showed an enhanced photo-conversion efficiency mainly contributed by enhanced open circuit voltage and fill factor. The power conversion efficiency (PCE) for the perovskite absorber layer on Cs- and Y-doped TiO_2 show the maximum PCE of 2.81 and 4.50% respectively. These are encouraging results for optimizing the yttrium doping level and fabrication conditions to further push the performance indicators of PSCs.

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