Inverted $CsPbI_2Br$ Perovskite Solar Cells with Enhanced Efficiency and Stability in Ambient Atmosphere via Formamidinium Incorporation

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ABSTRACT: $CsPbI_2Br$ is expected to be a candidate for the top layer of the all perovskite tandem solar cells. However, the perovskite is prone to change the phase from α (black) to δ (yellow) type. In this research, $Cs_{1-x}FA_xPbI_2Br$ perovskites were fabricated in ambient atmosphere and their properties immediately after fabrication and the phase stability were investigated. The quality of the perovskite films was enhanced and the trap density was reduced after the incorporation of the FA cations. The phase stability of the $Cs_{1-x}FA_xPbI_2Br$ perovskite was effectively enhanced. Consequently, the highest power conversion efficiency of 12.28% with open-circuit voltage (Voc) of 1.09 V, current intensity (Jsc) of 15.65 mA cm^{-2}, and fill factor of 72% in the planar solar cell based on $Cs_{0.7}FA_{0.3}PbI_2Br$ perovskite was achieved. The band gap was optimized to be about 1.82 eV suitable for all perovskite tandem top layer. Most importantly, all the photovoltaic parameters of $Cs_{0.7}FA_{0.3}PbI_2Br$ perovskite solar cells showed ignorable decay after 2 months' measurement in ambient atmosphere with the presence of air and humidity without encapsulation.