Origin of Open Circuit Voltage in wide band gap absorbers of all inorganic Cesium Perovskite Solar Cells

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Wide band gap absorbers were synthesized based on cesium lead bromide and iodide mixture in perovskite solar cells, $CsPbBr_{3-x}I_x$, where x varies between 0, 0.1, 0.2, and 0.3 molar ratio. High photoconvertion efficiencies were performed of 3.98 % for the perovskite composition of small amount of iodide as $CsPbBr_{2.9}I_{0.1}$. We observed that the open circuit voltage V_{oc} depends mainly of two factors, which are (i) the band gap of the perovskite and (ii) the work function of the hole transport material HTM. An increment in V_{oc} was observed for the device with larger perovskite band gap, while keeping the electron and hole extraction contacts the same. Additionally, the bilayer P3HT/MoO_3 with deeper HOMO level instead of *spiro*-OMeTAD as HTM, thus increased the V_{oc} from 1.16 V to 1.3 V for $CsPbBr_3$ solar cell, although the photocurrent is lowered due to charge extraction issues. The stability was also investigated which confirmed that the addition of small amount of iodide into the $CsPbBr_3$ perovskite is necessarily to stabilize the cell performance over time.