WIXED METAL PEROVSKITE CONSISTING OF TIN WITH LOW VOLTAGE LOSS

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We have already reported that the interface between TiO2 / perovskite (MAPbI3: Pb-PVK) contains Ti-O-Pb linkages which passivates the hetero-interface traps acting as charge recombination centers (1-5). In addition, we have proved that insertion of thin passivation layer (Trifluoro,ammonium propane cation: (F1)) increased the efficiency of the Pb-PVK solar cells (6). These results were applied for enhancing the efficiency of SnPb mixed metal perovskite solar cells. We have already reported that mixed metal perovskite (MAPbSnxI3:SnPb-PVK) showed photoconversion properties in IR region (up to 1000 nm) (1). The SnPb PVK has a potential to possess ideal band gap (about 1.4eV), which is better than that of MAPbI3 (around 1.55eV) (1). The short circuit current (Jsc) was high, reaching to 30 mA/cm² (for comparison, 24mA/cm² for MAPbI3) because of the wide range of light harvesting properties from visible to IR region. However, the open-circuit voltage (Voc) was lower than 0.3 V, suggesting the presence of high density charge recombination centers. We discuss why the perovskite solar cells consisting of Sn have low efficiency, compared to MAPbI3 from the view point of hetero-interface architecture obtained from Pb-PVK study. We focused on the Voc loss for the evaluation of these hetero-interfaces. In the composition of TCO/c-TiO2/mp-TiO2/SnPb-PVK/SPIRO/Au (A), the Voc loss was about 0.9eV, which is larger than that of conventional MAPbI3 (0.4 eV). We found that Ti-O-Sn linkages are present at the hetero-interface between TiO2 and SnPb PVK and create new traps (charge recombination center). In order to remove the hetero-interface, inversion structure (TCO/PEDOT-PSS/SnPb-PVK/C60/Au)(B) was made. The Voc loss for (B) decreased to 0.5 eV which was lower than 0.9 eV for the common structure (A). In addition, the insertion of F1 was also effective for enhancing the efficiency. Finally, the Voc loss decreased to 0.45 eV and 16% efficiency was obtained. It was proved that hetero-interface for SnPb mixed metal PVK is much more serious than that for Pb-PVK solar cells.


![Fig. 1 Photovoltaic performance for SnPb-PVK (B) in the text](image-url)

Eff: 15.93, Jsc: 26.53mA/cm², Voc, 0.77V, FF: 0.78