Carrier Transport Enhancement in Flexible Tin-Lead Perovskite Solar Cells

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Being lighter, flexible and bendable than the conventional perovskite solar cell (PSC) devices, flexible PSCs open numerous attractive applications. Lead based wide band gap flexible PSCs studies have been rigorously researched [1]. However, low band gap **flexible** PSCs research employing tin-lead based perovskite have been lesser known. Currently, investigation into tandem solar cells cautioning the importance of both low and wide band gap for flexible PSC devices [2]. Studies have demonstrated various techniques such as passivation, doping and additives can improve the overall performance of PSCs [3, 4]. The main reason behind this improvement is because of the reduction in defects thusly lead to efficient carrier transport within PSC devices. In this research, improvement in the fabricated perovskite thin films for flexile tin-lead has been successful with the inclusion of additives such as lead thiocyanate and guanidinium thiocyanate. The band edge of the perovskite layer and the charge collection layer have been found to be well aligned and thus facilitate the charge transfer and eventually enhance the efficiency of the flexible PSCs. Tin-lead based perovskite solar cells which has been formulated elsewhere have been employed in the current flexible PSC application [5]. In this study, the inverted flexible PSC devices have been constructed on PET/ITO flexible substrates. PEDOT:PSS has been used as hole transport layer, followed by mixed monovalent (FA^+ and MA^+) and divalent (Sn^{2+} and Pb^{2+}) cations based perovskite layer, C60 electron transport layer and BCP hole blocking layer. Silver electrode contacts have been coated on top of the structures via thermal evaporation technique. Flexible PSC devices with 14.36% efficiency, current density of 28.06 mA/cm2, open circuit voltage of 0.74 V and fill factor of 0.70 has been obtained in the measured device. Additives have been found as a suitable agent in promoting high quality, large grains in flexible perovskite thin films. In this exploration, the mechanisms behind enhancement in term of carrier transport and charge dynamics are investigated via transient absorption spectroscopy measurement and further correlation with the crystalline quality is investigated via XRD and UV-Vis measurement.

References

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