Dual role of Cs_2SnI_6: A hole transporter and an absorber for perovskite based solar cells

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Introduction

Over the last one year, organic-inorganic lead (Pb) halide based perovskite solar cells (PSCs) have successfully achieved more than 20% photoconversion efficiencies (PCE) in a variety of solar cell architectures [1]. These overwhelming results are mainly due to its good ambipolar electron and hole transport properties, high excitation carrier life time and absorption coefficients. However, the presence of Pb demands to look out for a Pb free material with similar properties. Therefore, there has been a continuous research interest for Pb free new perovskite and perovskite related materials such as Cs_2SnI_6. Recent studies demonstrated that Cs_2SnI_6 works as a good hole transporter (HT) in dye sensitized solar cells (DSSCs) and also it can be used as lead free absorber in PSCs with PCE less than 1% so far [2]. Here, in this work we present the reasons for low performance of Cs_2SnI_6 based solar cells and possibilities to increase its performance.

Experiment

Impurity free thin films of Cs_2SnI_6 were characterized by X-ray diffraction (XRD), photoluminescence (PL) and transient absorption (TA) to look for its role as light harvester. Device structure as shown in Figure 1 was used for the current study. Also, DSSC was successfully fabricated to confirm its role as HT.

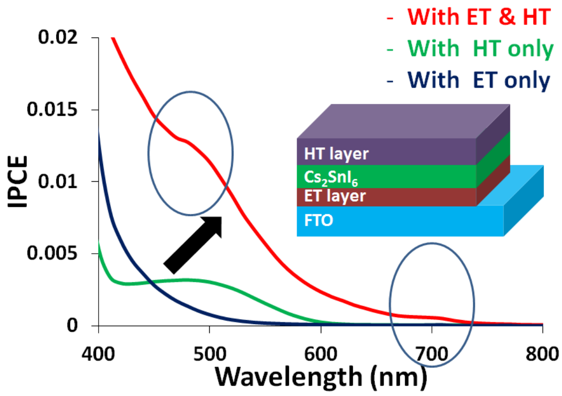

Figure 1. IPCE showing contribution of Cs_2SnI_6 in photocurrent generation

Results and discussion

Figure 1. clearly indicates that Cs_2SnI_6 can be used as a light absorbing layer. With implementation of only electron transport (ET) and hole transport (HT) layer, there was no contribution of Cs_2SnI_6 in photocurrent generation. We found that both HT and ET layers are therefore necessary for exciton splitting.

Reference

[1] www.nrel.gov/ncpv/images/efficiency_chart. jpg

[2] X. Qiu, and M. G. Kanatzidis *et al*, *Sol. Energy Mater. Sol. Cells*, 2017, **159**, 227–234.