Titanium Dioxide and Cadmium Sulfide Thin Films as the Electron Transporting Layer for P3HT:PCBM Bulk-Heterojunction Solar Cells

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Abstract

Poly (3-hexylthiophene) (P3HT) and phenyl-C61-butyric acid methyl ester (PCBM) bulk heterojunction solar cells are of immense interest due to their potential towards fabrication of flexible and low-cost solar cells using simple solution process techniques. The role of hole-blocking layer (HBL) is vital in the inverted device structure. In this work, we investigated the effect of Titanium dioxide (TiO_2) and Cadmium sulfide (CdS) thin films as the hole blocking layer on the performance of the P3HT:PCBM solar cells. TiO_2 and CdS thin films with same thickness were fabricated by using simple chemical bath deposition and spray pyrolysis respectively [1–4]. Solar cells were fabricated on the fabricated HBL by spin coating a chlorobenzene (CB) solution of P3HT: PCBM (1:1 by weight) containing 25 mg/ml P3HT and 25 mg/ml PCBM. Solar cells fabricated with TiO_2 as HBL showed better short circuit current density (Jsc) when compare to CdS devices. However, the overall power conversion efficiency (PCE) is higher for the devices with CdS as HBL predominantly due to higher Voc and fill factor. The increased Voc of the CdS devices was due to higher valence band position of CdS when compare to TiO_2 from the vacuum level. The detail results and the mechanism behind the improved PCE of the CdS based devices will be discussed in the presentation.