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Inverted Poly(3-hexylthiophene-2,5-diyl)(P3HT):[6,6]-Phenyl C61 butyric acid methyl ester (PCBM) bulk heterojunction solar cells with cadmium sulfide (CdS) as the hole blocking layer

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P3HT:PCBM bulk heterojunction solar cells with poly 3,4-ethylenedioxythiophene:poly styrenesulfonate (PEDOT: PSS) as Hole Blocking Layer (HBL) has become increasingly feasible with large-area of donor–acceptor interface for efficient light-induced charge separation. Few metal oxides have also been utilized for P3HT: PCBM based solar cells as HBL which blocks the back electron leakage and increasing the charge collection before recombining. Although PEDOT: PSS has been heavily studied in these types of solar cells, it has been identified as a source for degrading the active layer due to its hydrophobic nature. In this study, inverted P3HT: PCBM solar cells were fabricated by using either of CdS and TiO_2 thin films as HBL, and the effects of CdS layer thickness on the device performance were investigated. The device with thin CdS layer offered short circuit (J_{SC}) over 7.5 mA/cm^{2}with an open circuit voltage (V_{OC}) of 0.57 V which provides overall power conversion efficiency of over 2 % under AM 1.5 illumination (100 mW/cm^2) conditions, which is over 100 % higher than that of Titanium dioxide thin film as the hole blocking layer. The major contribution is 75 % improvement in the V_{OC}, due to the lower work function of CdS. Even though there was a small improvement in the V_{OC} with the thickness of CdS thin film, the conversion efficiency is decreased due to reduced J_{SC} as per the strong absorption of CdS in the UV region verified by the optical absorption spectra.

Key words: CdS, electron selective layer, P3HT:PCBM, thin film, polymer

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