Cadmium sulfide interface layer for improving the performance of titanium dioxide/poly (3-hexylthiophene) solar cells by extending the spectral response

Thanihaichelvan, M., Sockiah, K., Balashangar, K., Ravirajan, P.

Abstract

This work focused on studying the effect of cadmium sulfide (CdS) interfacial layer on the performance of titanium dioxide (TiO2)/poly (3-hexylthiophene) (P3HT) solar cells and finding out its effect on charge recombination dynamics of hybrid TiO2/P3HT solar cells. FESEM images confirm the uniform distribution of chemical bath deposited CdS layer on TiO2 nanoparticles. Insertion of CdS layer at the nanocrystalline TiO2/P3HT interface broadens quantum efficiency spectrum of the solar cells with peak values over 80 and 40 % at the wavelengths of maximum absorption of CdS and P3HT respectively and hence enhances short-circuit current density (JSC) from 3.5 to 5.9 mAcm−2 under simulated illumination (70 mWcm−2) with an AM 1.5 filter. CdS layer further improves open circuit voltage (VOC) from 0.35 to 0.57 V, which is consistent with higher built-in voltage in CdS/P3HT than in TiO2/P3HT due to relatively lower laying conduction band edge of CdS. Photovoltaic transient measurements show that the carrier life-time in TiO2/CdS/P3HT solar cell is an order of magnitude longer than that in TiO2/P3HT solar cell. Optimized TiO2/P3HT solar cells with CdS interlayer yield power conversion efficiencies over 1.5 %, which is three times greater than that for similar solar cells without CdS layer.