Alternative Back Contact Materials for CdS/CdTe Thin Film Solar Cells

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Abstract

CdS/CdTe thin film solar cells have become matured photovoltaic technology, next to silicon solar cells technology due to ideal band gap, low manufacturing cost, and scalability of CdTe deposition. Although CdS/CdTe solar cells with copper based back contact have shown the best efficiencies by reducing roll-over effect and enhancing the electrical properties of CdTe, it is well known that their performance reduces with time, mainly due to diffusion of Cu through the CdTe absorber. This study focuses on finding a suitable alternative back contact namely, spiro/Au, MoO_3 / Ag, CuI / Au and Poly(ethylenedioxythiophene): polystyrene sulphonate(PEDOT:PSS) /Au in which Au and Ag contacts were deposited through thermal evaporation under high vacuum together with MoO_3 as a hole transporter while spiro, CuI and PEDOT:PSS hole transporters were deposited using spin coating technique. Performance of the device with PEDOT:PSS/Au exhibited the highest short-circuit current density over 24 $mAcm^{-2}$ together with an open circuit voltage of 0.39V and a fill factor of 0.32 which resulted an efficiency of 3.04% at solar simulator intensity of 100 mW/cm^2 among the studied material combinations. However, fill factor of this device was poor in comparison with device with Cu/Au contact, probably due to poor compatibility between inorganic and organic interface. These solar cell structures were subjected to stability checking for a period up to 8 months from their fabrication. Device with Cu/Au lost about 5 % of its initial efficiency while efficiency of device with PEDOT:PSS/Au remained the same over the period of 8 months.

Keywords: Back contact, thermal evaporation, hole transporter, thin film solar cell