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Quantum and conversion efficiencies optimization of superstrate CIGS thin-films solar cells using In2Se3 buffer layer

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Abstract: In this present contribution, AMPS-1D device simulator is employed to study the performances of superstrate SLG/TCO/p-Cu(In,Ga)Se2(CIGS)/n-ODC/n-In2Se3/Metal thin film solar cells. The impact of theTCO and Metal work functions on the cell performance has been investigated. The combination of optical transparency and electrical property for TCO front contact layer is found to yield high efficiency. The obtained results show that the TCO work function should be large enough to achieve high conversion efficiency for superstrate CIGS solar cell. Nevertheless, it is desirable for Metal back contact layer to have low work function to prevent the effect of band bending in the n-In2Se3/Metal interface. Several TCOs materials and metals have been tested respectively as a front and back contact layers for superstrate CIGS solar cells. An efficiency of 20.18%, with Voc ? 0.71 V, Jsc ? 35.36 mA/cm2 and FF ? 80.42%, has been achieved with ZnSn2O3-based as TCO front contact layer. In the case of SnO2:F front contact and indium back contact layers, an efficiency of 16.31%, with Voc ? 0.64 V, Jsc ? 31.4 mA/cm2 and FF ? 79.4%, has been obtained. The present results of simulation suggest an improvement of superstrate CIGS solar cells efficiency for feasible fabrication.

Keywords : Cu(InGa)Se2 material, Superstrate solar cells, Transparent conducting oxides, Barrier height, AMPS-1D