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Modelling and Study of a Tandem Solar Photovoltaic Cells

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ABSTRACT:

The simulation of GaInP/GaAs double junction solar is done based on a modeling of a Tandem solar cell including window, back surface field, and tunnel junction. In this study, we focused on the extract of parameters (V_{oc} , J_{sc} , FF, η) which are investigated using the computational numerical modeling TCAD tool Silvaco ATLAS. This GaInP/GaAs solar cell is composed of a (AlInP) window and (GaInP) BSF for the GaInP top cell, a (GaInP) window and (GaInP) BSF for the GaAs bottom cell. First, we have studied the GaInP/GaAs cell with a GaInP / GaInP tunnel junction and the other with the same structure but with a GaAs/GaAs tunnel junction. Their performances were investigated for the tunnel junction with a thickness of $0.01\mu m$. Second, we have simulated GaInP/GaAs solar cell without BSF, but with GaInP and AlInGaP material, considering their varied thickness from $0.05\mu m$ to $2.3\mu m$ for the bottom BSF cell. Then, A wide band gap material $In_{0.5}(Al_{0.7}Ga_{0.3})_{0.5}P$ is proved to be a better choice for the BSF layer by increasing efficiency than using other widely used GaInP material under the same cell configuration because of its high photo generation rate. It has been noticed that the best conversion efficiency is obtained for the optimized dual-junction solar cell, under standard conditions AM1.5G illumination was the short circuit current density, the open circuit voltage, fill factor, and the conversion efficiency of $J_{sc}=15.38mA/cm^2$, $V_{oc}=2.40V$ FF=89.71%, and $\eta=33.19\%$ were obtained from the tandem cell.

Key Words: Tandem (DJ), Tunnel junction, Back surface field (BSF), TCAD Silvaco

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important notes

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