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Optimal Design of InGaP/GaAs Heterojonction Solar Cell

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Abstract : We studied mainly the influence of temperature, thickness, molar fraction and the doping of the various layers (emitter, base, BSF and window) on the performances of a photovoltaic solar cell. In a first stage, we optimized the performances of the InGaP/GaAs dual-junction solar cell while varying its operation temperature from 275°K to 375 °K with an increment of 25°C using a virtual wafer fabrication TCAD Silvaco. The optimization at 300°K led to the following result Icc =14.22 mA/cm2, Voc =2.42V, FF =91.32 %, η = 22.76 % which is close with those found in the literature. In a second stage ,we have varied the molar fraction of different layers as well their thickness and the doping of both emitters and bases and we have registered the result of each variation until obtaining an optimal efficiency of the proposed solar cell at 300°K which was of Icc=14.35mA/cm2,Voc=2.47V,FF=91.34,and η =23.33% for In(1-x)Ga(x)P molar fraction(x=0.5).The elimination of a layer BSF on the back face of our cell, enabled us to make a remarkable improvement of the short-circuit current (Icc=14.70 mA/cm2) and a decrease in open circuit voltage Voc and output η which reached 1.46V and 11.97% respectively. Therefore, we could determine the critical parameters of the cell and optimize its various technological parameters to obtain the best performance for a dual junction solar cell. This work opens the way with new prospects in the field of the photovoltaic one. Such structures will thus simplify the manufacturing processes of the cells; will thus reduce the costs while producing high outputs of photovoltaic conversion.

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