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Numerical Thickness Optimization Study of CIGS Based Solar Cells with SCAPS-1D

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Introduction

The photovoltaic market knew a strong grow in the last fewyears. Although various sectors and technologies splits themarket, the cells containing Silicon dominates it with morethan 85%, this is due primarily to the maturity of the nanoelectronic industry which uses massively the Silicon and good performance of the cells [1]. However, the manysteps of production make this material technology expensive and reedy, which justifies the interest to developthe cells in less expensive thin layers. Chalcopyrite Cu(In,Ga)Se (CIGS) is a very promising material for thin film photovoltaics and offers a number of interesting advantages compared to the bulk silicon devices. In addition, CIGS cells offer many advantages: Cells CIGS arefabricated sonochemically [1], offer a significantabsorption capacity which requires 100 times less material(~1µm) than the Silicon cells (~100µm), and they can be deposited on various types of substrates (flexible or rigid) of large [2].

In this work, we present numerical simulations results of aheterojunction cells based on CIGS (i-ZnO / CdS / OVC / CIGS) using the SCAPS-1D simulations code.

Theoretical Study

The studied HIT cell is represented in the figure below.

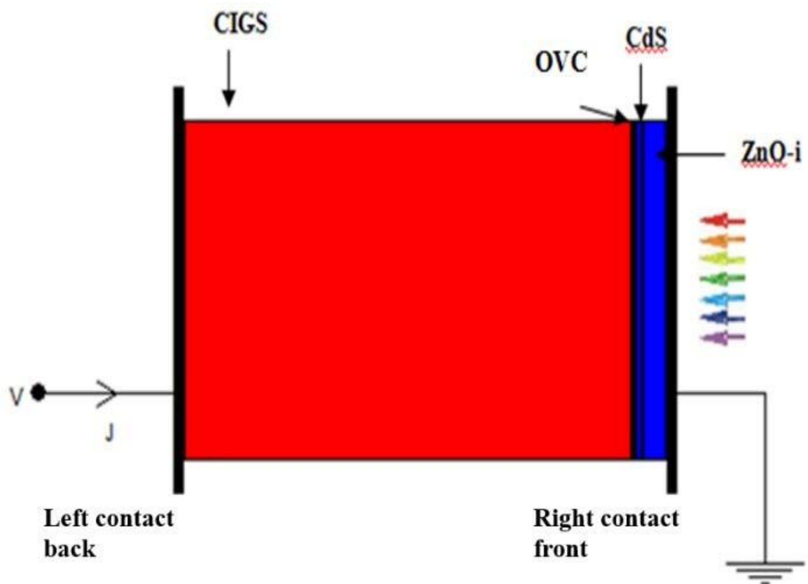

Fig. 1: Heterojunction cells based on CIGS (i-ZnO / CdS /OVC / CIGS).

DOI: 10.21467/abstracts.122 ISBN: 978-81-954993-3-5

CIGS, is the absorber of the P-type cell. The junction is formed with CdS / ZnO, n-type semiconductors. ZnO is called a window layer because it has to pass radiation to the absorber. The CdS buffer, traditionally used, is optimal when combined with a CIGS with a gap of 1.15eV but lessoptimal when the latter's gap is higher.

Results and Discussion

This theoretical study is carried out in order to study the effect of the variation in thickness and doping of the p- CIGS layer, which represents the window layer in the heterojunction (i-ZnO / CdS / OVC / CIGS on the performance of solar cells. In figure 2, we have reported the results of calculation of the efficiency as a function of the thickness of the absorbent layer with a thickness varying between 100 to 3500 nm.

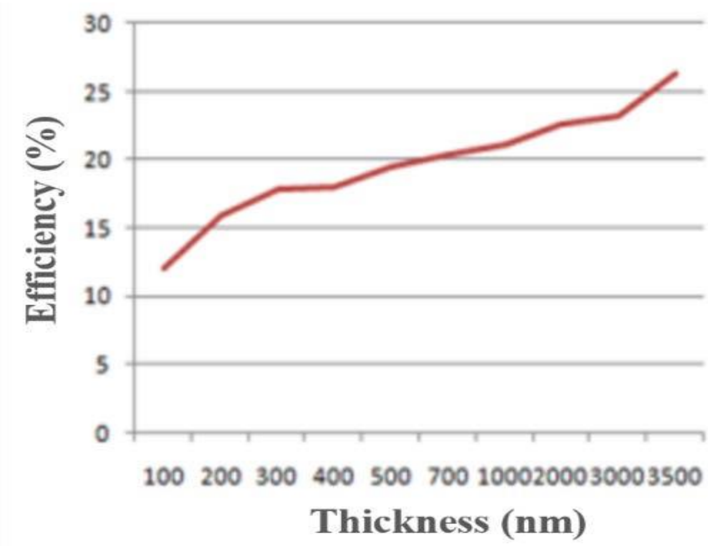

Fig. 2: Influence of CIGS thickness on the efficiency.

Conclusion

In this work we have used a numerical simulation to studythe characteristics of these devices. We have alsooptimized the physical and electrical parameters of a specific CIGS-based solar cell structure to achievemaximum electrical conversion efficiency. Modeling and simulation were done by SCAPS software,to study the performance of CuInGaSe-based solar cells. We can say that the parameters of the CIGS absorber layerplay a very important role in improving the efficiency ofheterojunction solar cells and the characteristics of the cellsare closely dependent on those of the individual layers.

References

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ISBN: 978-81-954993-3-5
Series: AIJR Abstracts
DOI: 10.21467/abstracts.122