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# All-oxide n-AZO/p-SnOx hetero-junction for flexible solar cells: A numerical approach

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## ABSTRACT

Researcher needs to explore some metal oxide semiconductors based solar cells which would help to escape the indispensableness of Si-wafer as well as to cut down the overall cost of PV module production by a large margin. Owing to the low processing temperature and easily tunable electrical and optical properties of metal oxides, SnOx in particular , n-AZO/p-SnOx hetero-junction thin film solar cell have been proposed.

In this paper, an all-oxide n-AZO/p-SnOx hetero-junction thin film solar cell have hasbeen proposed to make a pathway for a thin film flexible solar cell. Based on some experimental parameter values of SnOx as light absorber layer, detail numerical analysis of the thin film solar cell has been carried out using TCAD device simulator. Oxygen dependent SnOx parameters like band gap, electron affinity, extinction coefficient and hetero-interface defect along with bulk defect have been considered in the analysis. Moreover, electron affinity, band gap and absorption coefficient significantly change with oxygen mole fraction (x) of SnOx and thus electrical and optical properties of SnOx are tunable to some extent.Effect of bulk and interface defect along with the other heterointerface phenomenon on the carrier transport and hence, overall performance of the device is considered in this study. In continuation to above, the effect of band offset between AZO and SnOx layer has been also detailed out in this work.

Further, spectral response of AZO/SnOx hetero-junction solar cell has been also extracted for different thicknesses of SnOx absorber layer Our simulation results shows that a maximum Voc of 0.9V and Jsc of ~16 mA/cm2 can be obtained by tuning the bandgap and electron affinity of SnOx layer.

[PP2]Edited

## MATERIALS

SnOx (Tin-oxide) and AZO (aluminium doped Zinc Oxide)

1 Simulation studies on n-AZO/p-SnOx heterojunction thin film solar cells based on finite element analysis (FEA) using TCAD simulation software (Silvaco ATLAS TCAD tool, version 5.24.1.R) has been reported in this article.

2 The effect of bulk and interface defect along with the other heterointerface phenomenon on the carrier transport and hence, overall performance of the device is considered in this study.

3 Performance analysis with the variation of x dependent parameters of SnOx like electron affinity, band gap and absorption coefficient along with the thickness of SnOx has been carried out and some best possible design in terms of these parameters have been proposed.

4 In our simulation study, we have shown the effect of bulk defect, electron affinity and band gap along with extinction coefficient of p-SnOx film on power conversion efficiency of AZO/SnOx hetero-junction solar cell.

5 The proposed structure for the metal oxide based thin film solar cell examined in this study. The jJunction between AZO and SnOx materials forms the n-p heterojunction in which, n-AZO acts as an emitter or window layer because of its wider band gap than p-SnOx.

6 Tin oxide ($SnO_x$) films were deposited on a quartz glass substrate using an e-beam evaporation technique at room temperature under controlled flow of oxygen in the e-beam chamber.

7 Based, experimental characterization of SnOx absorber layer like absorption coefficient, band gap and carrier concentration, etc., the simulation study has been carried out to proper AZO/SnOx thin film solar cell