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Data Article

Modeling and performance analysis dataset of a CIGS solar cell with ZnS buffer layer

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ABSTRACT

This article represents the baseline data of the several semiconductor materials used in the model of a CIGS thin film solar cell with an inclusion of ZnS buffer layer. As well, input parameters, contact layer data and operating conditions for CIGS solar cell simulation with ZnS buffer layer have been described. The schematic diagram of photovoltaic solar cell has been depicted. Moreover, the most important performance measurement graph, J-V characteristic curve, resulting from CIGS solar cell simulation has been analyzed to estimate the optimum values of fill factor and cell efficiency. These optimum results have been obtained from the open circuit voltage, short circuit current density, and the maximum points of voltage and current density generated from the cell.

Specifications Table

Subject area	*Applied physics*
More specific subject area	*Solar energy*

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Type of data	*Table and figure*
How data was acquired	*The values of the materials have been accumulated from the references [1–12]. Afterwards, the numerical simulation was conducted by ADEPT 2.1 simulation tool [13] using the layer data and thus the output parameters of the CIGS solar cell have been filtered.*
Data format	*Filtered and analyzed*
Experimental features	*The solar cell has been designed as SLG/Mo/CIGS/ZnS/i-ZnO/ZnO/Al-grid stack. Thereafter, the impacts of different variable parameters of the constituent materials have been taken into consideration. Finally, the cell performance has been computed from the simulation study.*
Data accessibility	*Data is in the article*

Value of the data

- This dataset can be used to compare the theoretical result of other CIGS solar cell models.
- Using these dataset researchers can easily develop a theoretical model of a solar cell.
- The simulation approach used in other simulators can be justified by using the simulated performance data.
- These data will be helpful to expand the idea of numerical modeling before fabrication of CIGS solar cells.

1. Data

The values of the materials which have been used different layers for simulation to design a CIGS solar cell are presented in Table 1. The reflectance and the recombination velocity for holes and electrons for both front and back contact layer of the cell have been listed in Table 2. The simulation was carried out under some simulation conditions that have been represented by Table 3. All of these data has been assumed from the published research articles [1–12]. Fig. 1 lays out the schematic design for ZnO:Al/i-ZnO/ZnS/CIGS structure. Consequently, Fig. 2 shows the J-V characteristic curve for optimized CIGS photovoltaic cell whereas Table 4 reports the performance parameters of the cell.

Table 1
Input parameters for CIGS solar cell simulation with ZnS buffer.

Parameters	n-ZnO: Al	i-ZnO	n-ZnS	p-CIGS
Thickness, $t_m(\mu m)$	0.20	0.02	0.04	3.00
Dielectric constant, K_s	7.80	7.80	8.28	13.60
Refractive index, N_{dx}	2.00	2.00	3.16	3.67
Band gap, $E_g(eV)$	3.30	3.30	3.68	1.21
Electron affinity, $\chi_e(eV)$	4.60	4.60	4.13	4.21
Electron mobility, $\mu_n(cm^2V^{-1}s^{-1})$	160	130	250	100
Hole mobility, $\mu_p(cm^2V^{-1}s^{-1})$	40	30	70	25
Conduction band effective density of states, $N_c(cm^{-3})$	2.2×10^{18}	1.5×10^{18}	1.7×10^{18}	2×10^{18}
Valence band effective density of states, $N_v(cm^{-3})$	1.8×10^{19}	1.6×10^{19}	2.4×10^{19}	1.6×10^{19}
Donor concentration, $N_d(cm^{-3})$	1×10^{18}	–	5×10^{16}	–
Acceptor concentration, $N_a(cm^{-3})$	–	–	–	3×10^{16}
Electron lifetime, $\tau_n(s)$	5×10^{-8}	3×10^{-8}	2×10^{-8}	1×10^{-8}
Hole lifetime, $\tau_p(s)$	5×10^{-9}	3×10^{-9}	6×10^{-8}	5×10^{-8}