Optimizing CZTSSe Solar Cells: The Impact of Layer Parameters and Window Layers on Performance

Hadj Yahia Seba
Laboratoire de Matériaux, Technologie de systèmes énergétiques et environnement, Université de Ghardaïa. Noumirat, route de Ouargla Ghardaïa, Algeria

Lamia Chabane
Laboratoire de Physique des Matériaux, Faculté de physique USTHB, EL ALIA, Bab Ezzouar, Algiers, Algeria

Sonia Tata
Laboratoire de Physique des Matériaux, Faculté de physique USTHB, EL ALIA, Bab Ezzouar, Algiers, Algeria

Abstract:

In order to achieve significant advancements in solar cell development in the future, it is crucial to utilize abundant and non-toxic materials. One promising candidate is Copper zinc tin sulfur-selenium (CZTSSe), which has shown superior performance compared to other compounds previously studied. This material, readily available on Earth, demonstrates promising characteristics for use in solar cells, with a new conversion efficiency of 15,1% [1]. Our research focuses on investigating the impact of varying layers parameters of the cell on the performance of CZTSSe-based solar cells using AFORS-Het software. Furthermore, we have examined the effects of different window layers on the electrical parameters of the solar cell, as well as the thickness of the absorber layer, window layer, buffer layer, and doping concentrations of the absorber and buffer layers. The different window layers used in the simulation are, Indium Tin oxide (ITO), Zinc oxide doped Aluminium (Al: ZnO) and copper oxide (CuO). Our findings suggest that utilizing Al: ZnO as the window layer is optimal for CZTSSe solar cells. By optimizing solar cell parameters such as doping concentration, thickness, and temperature, we can enhance the efficiency of CZTSSe solar cells, we have achieved a maximum efficiency equal to 16,1 % corresponding to Voc, Jsc and FF equal to 734 mV, 32 mA/cm2 and 68,5 %, respectively. Our numerical simulation offers a novel approach to improving conversion efficiency and may guide experimental work in the future. This research is expected to be valuable for experimentalists working in the field of solar cell development

Keywords:

CZTSSe solar cells, Afors-Het, Simulation, window layers.