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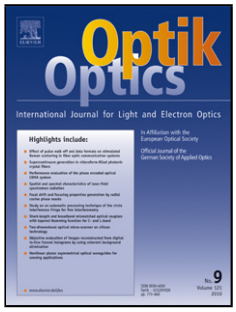

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Development of CZTGS/CZTS tandem thin film solar cell using SCAPS-1D

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Abstract

In this work, numerical modeling and simulation of a monolithic CZTGS/CZTS tandem structure has been carried out using SCAPS-1D. This is aimed at enhancing the performance of copper zinc tin sulfide (CZTS) solar cell using a double junction CZTGS/CZTS tandem structure. The top cell consists of a non-toxic element (germanium) used in tuning the band gap of copper zinc tin germanium sulfide (CZTGS) while the bottom cell is CZTS based. The best J-V characteristics of the top cell was obtained at a composition ratio of $Cu_2ZnSn_{0.8}Ge_{0.2}S_4$ with an efficiency of 9.39%. The bottom cell condition is simulated based on the state-of-art records with an efficiency of 8.4% which is in good agreement with experimental results. At an absorber thickness of 0.65 μm and 3.00 μm of the top and bottom sub-cell of the tandem structure under current matching condition of 18.53 mA/cm^2 gave an efficiency of 17.51%. This is a significant improvement in efficiency over that of the CZTS thin film solar cell with a single junction.

Keywords: Efficiency, CZTGS/CZTS, Optimization, Tandem, Thin film

1. Introduction

In response to the development of a tandem solar cell that could satisfy the standard requirement of photovoltaic cells (PVs) such as low cost of materials and fabrication, non-toxic and readily available constituent elements and high conversion efficiency without material degradation [1, 2], a suitable absorber layer material for thin film solar cells has to

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