



# Bandgap of thin film solar cells

We demonstrate through precise numerical simulations the possibility of flexible, thin-film solar cells, consisting of crystalline silicon, to achieve power conversion efficiency of 31%. Our ...

Cadmium sulfide (CdS) buffer layer is commonly used in Kesterite  $\text{Cu}_2\text{ZnSn}(\text{S},\text{Se})_4$  (CZTSSe) thin film solar cells. However, the toxicity of Cadmium (Cd) and perilous waste, which is generated during the deposition process (chemical bath deposition), and the narrow bandgap ( $\sim 2.4$  eV) of CdS restrict its large-scale future application.

In this paper, two types of single absorber layer solar cells, Mo/p-CIS/n-CdS/Al-ZnO and Mo/p-CISSe/n-CdS/Al-ZnO, are simulated using the solar cell simulation software (SCAPS-1D), and the effect of the thickness of the absorber layer on the photovoltaic performance of the solar cells is investigated. In addition, the total thickness of the CIS/CISSe ...

Thin-film solar cell (TFSC) is a 2nd generation technology, made by employing single or multiple thin layers of PV elements on a glass, plastic, or metal substrate. ... the current limitation of employment of  $\text{Sb}_2\text{Se}_3$  is on single-junction for its greater bandgap.  $\text{Sb}_2\text{Se}_3$ -based solar cells provide a higher absorption coefficient and better ...

The long-term stability of kesterite  $\text{Cu}_2\text{ZnSn}(\text{S},\text{Se})_4$  (CZTSSe) thin-film solar cells (TFSCs) is crucial for the sustainable mass production of photovoltaic systems.

Solar cells are commonly recognized as one of the most promising devices that can be utilized to produce energy from renewable sources. As a result of their low production costs, little material consumption, and projected increasing trajectory in terms of efficiency, thin-film solar cells have emerged as the technology of choice in the solar industry at present. ...

The performance of thin-film solar cells is strongly dependent on the generation rate parameter, which indicates the number of excitons (electron-hole pairs) created per point in the solar cell due to photon absorption. ... As shown in Fig. 3 (b), the CTS solar cell with bandgap  $E_g$  exhibits the highest recombination rate, which is expected ...

The second generation of solar cells includes several thin-film photovoltaic (PV) technologies, including cells based on  $\text{Cu}(\text{In}_{1-x}\text{Ga}_x)\text{Se}_2$  copper indium gallium diselenide alloys (CIGS). CIGS is one of the most promising thin film PV technologies, with an experimental efficiency of 23.35% achieved by Solar Frontier KK in 2019 (Nakamura et al., 2019, Kato, 2017).

Among them, Ternary semiconductor  $\text{Cu}_2\text{SnS}_3$  (CTS) thin films are a good p-type direct bandgap semiconductor material with an structure-dependent bandgap value (0.93-1.35 eV) as well as an absorption coefficient being greater than  $10^4 \text{ cm}^{-1}$ , and the conversion efficiency of CTS thin film solar cells can reach



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30 % in theory [4, 5].

Its properties are the result of its n-type highly disintegrates semiconductor behavior and its broad band gap in the range of 3.5-4.3 eV after ... . et al. Structural, electrical, and optical properties of ITO thin films and their influence on performance of CdS/CdTe thin-film solar cells. J Mater Sci: Mater Electron 32 ...

DOI: 10.1016/J.TSF.2018.11.017 Corpus ID: 139759109; Bandgap of thin film solar cell absorbers: A comparison of various determination methods @article{Carron2019BandgapOT, title={Bandgap of thin film solar cell absorbers: A comparison of various determination methods}, author={Romain Carron and Christian Andres and Enrico Avancini and Thomas ...

In this research, SCAPS-1D software was used to analyze CdTe-based thin-film solar cells. In the first step, a solar cell with FTO/TiO<sub>2</sub>/CdS/CdTe configuration was employed as a reference cell. The CdSe X Te 1-X layer was then inserted after the buffer layer instead of the traditional CdTe absorber layer to increase efficiency. The result is a modified cell with a ...

Attempts to remove environmentally harmful materials in mass production industries are always a major issue and draw attention if the substitution guarantees a chance to lower fabrication cost and to improve device performance, as in a wide bandgap Zn<sub>1-x</sub>Mg<sub>x</sub>O (ZMO) to replace the CdS buffer in Cu(In<sub>1-x</sub>Ga<sub>x</sub>)Se<sub>2</sub> (CIGSe) thin-film solar cell structure. ...

Kesterite-type materials, Cu<sub>2</sub>ZnSn(S,Se)<sub>4</sub> (CZTSSe), have gained interest to be used as absorber for thin-film solar cells in the last years because they consist of elements of low toxicity and high abundancy in the earth's crust, having a high absorption coefficient and stability, and a tunable bandgap energy E<sub>g</sub> between 1.0 eV (Cu<sub>2</sub>ZnSnSe ...

Thin-film solar cells are a type of solar cell made by depositing one or more thin layers (thin films or TFs) of photovoltaic material onto a substrate, such as glass, ... In a typical solar cell, a single absorber with a bandgap near the peak of the solar spectrum is used, and any photons with energy greater than or equal to the bandgap can ...

Efficiencies of 34.6% for CIGS thin-film solar cells and 29.9% for CZTSSe thin-film solar cells are predicted with a concentration of 100 suns, the respective one-sun ... [Show full abstract ...

Amongst the proposed concepts only tandem solar cells and graded bandgap solar cells have experimentally shown reasonable efficiency with required stability and the ...

Device modeling and simulation studies of a CdTeSe thin film solar cell have been carried out. A variety of band-gap profiles, including ungraded, front graded, back graded, and double graded profiles of the CdTeSe absorber layer are examined and their performance characteristics have been analyzed. The calculation reveals that single junction cells with ...



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Dye-sensitized solar cells (DSSCs) belong to the group of thin-film solar cells which have been under extensive research for more than two decades due to their low cost, simple preparation methodology, low toxicity and ease of ...

Solar cells are commonly recognized as one of the most promising devices that can be utilized to produce energy from renewable sources. As a result of their low production costs, little material consumption, and ...

Thin films of halide perovskites are promising for solar cell technology but they do not perform well at the band edge due to the low optical absorption. Herein, Chen et al. fabricate a high ...

This work presents a systematic study that evaluates the feasibility and reliability of local band gap measurements of Cu(In,Ga)Se<sub>2</sub> thin films by vale. Skip to Main Content. Advertisement. Journals. ... Local Band Gap Measurements by VEELS of Thin Film Solar Cells - 24 Hours access EUR EUR35.00 GBP &#163;30.00 ...

Cadmium Telluride (CdTe) with its energy bandgap ( $E_g$ ) of 1.45 eV is an optimum semiconducting material for solar cells. Moreover, its bandgap is "direct" with larger absorption coefficient ( $>5 \times 10^5$  /cm), which means that about 99% of incoming photons with energy greater than the bandgap ( $E_g$ ) can be absorbed within only a few microns of CdTe film thickness [1], [2].

Thin-film photovoltaic materials like WS<sub>2</sub> offer abundant, low-cost, transparent energy sources. WS<sub>2</sub> boasts high carrier mobility, a superior optical absorption coefficient over  $10^5$  cm<sup>-1</sup>, a favorable band gap of 1.3 eV, and non-toxic properties, making it a promising photon absorber. Previous studies explored various WS<sub>2</sub>-based solar cell designs for ...

In future work, localized band gap variations will be measured on a more localized length scale to investigate, e.g., the influence of chemical inhomogeneities and dopant accumulations at grain boundaries. Key words: VEELS, monochromated STEM, band gap, Cu(InGa)Se<sub>2</sub>, chalcopyrite, solar cell INTRODUCTION Thin film solar cells based on Cu(In,Ga)Se

A thin-film AlGaInP/AlGaAs/InGaAs/InGaAs inverted metamorphic multijunction solar cell with a bandgap of 1.96/1.53/1.16/0.83 eV is fabricated.

The obtained band gap value ranges from 1.075 eV to 1.21 eV, which indicate that the as-deposited nanocrystalline Sb<sub>2</sub>Se<sub>3</sub> films are suitable for application in thin-film ...

The composition of elements at different depths of the thin film was also investigated. It was confirmed that CZTSSe thin film with high sulfur element content on the surface and low at the bottom were obtained after PSS ...



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In this paper, we investigate a way to improve the performance of thin films CIGS-based solar cells by optimizing their spectral responses. Band gap profile grading, ...

CMT thin film has a lower band gap than CZT thin film due to better crystallinity and larger grain sizes as per XRD patterns and Table S1, Supporting Information. These energy band gaps are also close to the desired range (1.4-1.7 eV) for manufacturing a solar cell, indicating the potential applications of these materials.

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