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Numerical simulation of a solar cell based on a double CdTe/FeSi2 absorber layer and an AZO window layer with an efficiency of 26.34 %

Solar Cell simulation serves to reduce the number of work hours and optimize the resources dedicated to carrying out experiments. Simulation of solar cells based on AZO as window layer, cadmium telluride (CdTe) like first absorber layer and FeSi2 like second absorber layer with the structure (Al/AZO/CdTe/FeSi2/Ni) using the Cell Capacitance Simulator solar-1D (SCAPS-1D) has been carried out. The effect of the thickness and carrier concentration of the first and the second absorber layer was studied. The thickness and concentration of carriers for the CdTe layer varied from 0.4 to 1 µm and from 〖10〗^13 to 〖10〗^15 cm^(-3) respectively, it was found that PCE decreases 0.22% with increasing thickness. The thickness and concentration of carriers in the second absorber layer varied from 0.1 to 1 µm and from 〖10〗^14 to 〖10〗^18 〖cm〗^(-3), respectively. It was observed that by increasing the thickness of the FeSi2 layer from 0.1 to 1 µm, PCE increased by 7.66%, while by increasing the concentration of carriers from 1014 to 1018 cm-3 in this layer, PCE increased by 2.81%. It was also observed that by increasing the defect density at the FeSi2/CdTe interface from 1010 to 1017 cm-2, PCE decreased by 22.1%. Finally, a maximum power conversion efficiency (PCE) of 26.34% is achieved with an open circuit voltage (Voc) of 0.62 V, short circuit current density (Jsc) of 51.43 mA/cm^2 and a fill factor (FF) of 82.24 %, obtained with a thickness and concentration of carriers of 1 µm and 〖10〗^18 〖cm〗^(-3) for the FeSi2 layer and for the CdTe layer the thickness and concentration of carriers was 0.4 µm and 〖10〗^15 cm^(-3), respectively. The above results provide design guidelines for a solar cell based on two absorber layers CdTe and FeSi2 and window layer of AZO with high efficiency.

Keywords

solar cells simulation, two absorber layer, SCAPS-1D

Reference

Performance simulation of solar cell based on AZO/CdTe heterostructure by SCAPS 1D software. José Carlos Zepeda Medina. Heliyon, 9 (marzo 2023) e14547

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Author approval

I confirm

Author will attend

I confirm

Author: ROSENDO ANDRÉS, Enrique (Benemérita Universidad Autónoma de Puebla)

Co-authors: Dr MORALES RUÍZ, Crisóforo (Benemérita Universidad Autónoma de Puebla); Dr CAMACHO ESPINOSA, Eduardo (Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, Unidad Mérida); Dr ZEPEDA MEDINA, José Carlos (Benemérita Universidad Autónoma de Puebla); Dr TREVIÑO YARCE, Leticia (Benemérita Universidad Autónoma de Puebla); Dr GALEAZZI ISASMENDI, Reina (Benemérita Universidad Autónoma de Puebla); Dr ROMANO TRUJILLO, Román (Benemérita Universidad Autónoma de Puebla)

Presenter: ROSENDO ANDRÉS, Enrique (Benemérita Universidad Autónoma de Puebla)

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