

Modelling and Optimization Analysis of Silicon/MgZnO-CBTSSe Tandem Solar Cells

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Abstract : We report a tandem solar cell model with Silicon as the bottom cell absorber material and $\text{Cu}_2\text{BaSn}(\text{S}, \text{Se})_4$ (CBTSSe) as absorber material for the top cell. As a first step, the top and bottom cells were modelled and validated by comparison with the experiment. Once the individual cells are validated, then the tandem structure is modelled with Indium Tin Oxide(ITO) as conducting layer between the top and bottom cells. The tandem structure yielded better open circuit voltage and fill factor; however, the efficiency obtained is 7.01%. The top cell and the bottom cells are investigated with the help of electron-hole current density, photogeneration rate, and external quantum efficiency profiles. In order to minimize the various loss mechanisms in the tandem solar cell, the material parameters are optimized within experimentally achievable limits. Initially, the top cell optimization was carried out; then, the bottom cell is optimized for maximizing the light absorption, and upon minimizing the current and photon losses in the tandem structure, the maximum achievable efficiency is predicted to be 19.52%.

Keywords : CBTSSe, silicon, tandem, solar cell, device modeling, current losses, photon losses

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