Title: Unlocking the potential of Cd-based perovskite solar cells: An in-depth study on performance optimization

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Abastact: Perovskite solar cells (PSCs) are an intriguing field of study due to their unique characteristics. This study aims to utilize the SCAPS-1D simulator to study the behaviour of absorbers in perovskite photocells that incorporate silver cadmium fluoride ($AgCdF_3$). In this study, $AgCdF_3$-based absorber material combined with 4 distinct ETLs namely $PC_{60}BM$, SnS_2, ZnSe and CdZnS and $C_6TBTAPH_2$ HTL in the structural proposed configuration of FTO/ETL/$AgCdF_3$/$C_6TBTAPH_2$/Au. The materials have been chosen based on the proper band alignments. The influence of thickness, acceptor density, defect density for both HTL and absorber layer in addition to the donor density, defect density, and thickness of the ETLs are observed carefully. Several parameters including the thickness of absorber and ETL and acceptor density of absorber layer is optimized to find best performances. After all the optimization, the FTO/$PC_{60}BM$/$AgCdF_3$/$C_6TBTAPH_2$/Au structure has provided the highest power conversion efficiency (PCE) of 31.32 %, along with 0.86 V of open circuit voltage (V_{OC}), 41.90 mA/cm^2 of short circuit current (J_{SC}) and 86.65 % of fill factor (FF). This simulation research allows scientists to develop cost-effective and efficient PSCs, advancing solar technology.

Keywords: $AgCdF_3$-absorber , ETL ,HTL, Efficiency , Numerical simulation, SCAPS-1D

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