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| **Title:** | Efficiency enhancement of an ultra-thin eco-friendly all-inorganic CsGeI3 perovskite photovoltaic cell using SCAPS-1D | | |
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| **Abstract:** |  |
| CsGeI3 perovskite is an eco-friendly alternative to organic-inorganic hybrid perovskites for photovoltaic (PV) cell design. This work has optimized an ultra-thin (1.86 µm) lead-free all-inorganic novel n-i-p PV cell structure using the SCAPS-1D simulator. Comparative analyses of cell performance data of the current optimized structure with experimental and simulated data obtained from the literature have been carried out. To investigate the impacts of variables on the performance of the device, several parameters such as absorber defect density, absorber thickness, the doping concentration of hole transport layer (HTL), electron transport layer (ETL) and absorber, the thickness of HTL, ETL, and capture cross-section areas at ETL-absorber, HTL-absorber interfaces are examined carefully. The fundamental structure has a power conversion efficiency (PCE) of 17.12%. Optimization of the structure results in an outstanding PCE of 26.28% with short circuit current density (Jsc), open-circuit voltage (Voc), and fill factor (FF) of 24.245 mA cm–2, 1.242 V, and 87.28%, respectively. The simulation results of this work may be useful in fabricating an eco-friendly, cost-effective, and highly efficient all-inorganic perovskite PV cell. | |