IMPACT OF THICKNESS AND MATERIAL OPTIMIZATION IN DOUBLE-LAYER ANTIREFLECTION COATINGS (DLARCs) ON THE PERFORMANCE OF SILICON SOLAR CELL USING PC1D SIMULATION

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ABSTRACT

IMPACT OF THICKNESS AND MATERIAL OPTIMIZATION IN DOUBLE-LAYER ANTIREFLECTION COATINGS (DLARCs) ON THE PERFORMANCE OF SILICON SOLAR CELL USING PC1D SIMULATION

Surface reflection losses that restrict light absorption and lower total energy conversion and have a major impact on silicon photovoltaic (PV) cell efficiency. This study examines how double-layer antireflection coatings (DLARCs) affect silicon solar cells' performance by using numerical software through PC1D simulation. The impacts of different material pairings, such as TiO_2 as a top layer with the bottom layer which are SiO_2, ZnO, Si_3N_4, SiC, and ZnS, on PV performance parameters including I_{sc}, V_{oc}, FF, P_{max} and efficiency were analysed by modelling. With an efficiency of 24.265% at 500 nm, the simulation results show that the TiO_2/SiO_2 combination has the best antireflection performance. This research shows that solar cell efficiency can be increased and reflectance significantly decreased by optimising the thickness and refractive index of DLARCs. The results help advance sustainable energy technologies and encourage the adoption of simulation-based techniques for the low-cost design and optimisation of high-performance PV cells.

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