TO STUDY THE EFFECT OF ANTI-REFLECTIVE COATING ON SILICON SOLAR CELL USING PC1D SIMULATION

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ABSTRACT

TO STUDY THE EFFECT OF ANTI-REFLECTIVE COATING ON CRYSTALLINE SILICON SOLAR CELL USING PC1D SIMULATION

Anti-reflective coatings (ARC) play a critical role in increasing the efficiency of crystalline silicon solar (c-Si) cells by decreasing the reflection losses and improving light absorption. This study investigated the effect of various ARC materials on the performance of c-Si solar cells using PC1D simulation software. The objective were to simulate and analyze the impact of ARC on overall cell performance metrics, including short-circuit current (I_{sc}), open circuit voltage (V_{oc}), fill factor (FF), maximum power (P_{max}) and efficiency (μ), and to analyze IV curve of silicon solar cell with different ARC. Several ARC materials with various refractive indices and thicknesses were simulated. The results showed that upgrading ARC configurations significantly improved the short-circuit current and overall efficiency due to reduced surface reflectance. Among the materials studied, Si_3N_4 displayed the highest efficiency which is 23.04% at 600nm wavelength in solar cell output. With the thickness 74.257nm and refractive index 2.02, Si_3N_4 generates short circuit current (I_{sc}) of 0.7532A, open circuit voltage (V_{oc}) of 4.608V with maximum power (P_{max}) of 4.608, and the value of fill factor (FF) of 0.8583. This study suggest that proper selection and design of ARC layers can help increase the efficiency of photovoltaic device.