Enhancing N-PERT Solar Cells under the Atacama Desert Solar Spectrum

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Abstract: In the Atacama Desert, solar radiation deviates from the global standard, boasting high irradiation levels with intense ultraviolet content. Given the spectral dependence of photovoltaic (PV) technologies, optimizing PV devices mandates consideration of local conditions and technology type. Solar cells are typically optimized for standard conditions, but our study focused on adapting them for Atacama's unique spectrum. We optimized an n-type bifacial passivated emitter and rear totally diffused solar cell (n-PERT) by adjusting geometrical and doping parameters using a hybrid genetic algorithm. Six parameters—cell and emitter thicknesses, back surface field thickness, and doping concentrations—were optimized for both Atacama spectrum (AM 1.08) and standard conditions (AM 1.5). Validating our model, we found the computed and experimental efficiencies to differ by less than 1% under standard conditions, affirming accuracy. Our optimization revealed the necessity of tailored configurations and doping for Atacama deployment. Reducing layer thicknesses and increasing doping led to a 5.4% efficiency boost under AM 1.08. Finally, we emphasize the potential impact of metallization and the feasibility of thinning the emitter and back surface field, opening avenues for enhanced PV technology in extreme environments.

References:

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