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NANOPATTERNED SILICON PHOTOVOLTAIC CELLS OPTIMIZED FOR NARROWBAND SELECTIVE REFLECTIVITY

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ABSTRACT. Photovoltaic (PV) applications require the cell to absorb photons with energies higher than its bandgap and minimize reflection for effective energy conversion. Silicon-based PV cells are usually textured with micro/nano structures to reduce their reflectivity on a broad spectrum range and to increase their light absorption. This approach increases the power output while increasing PV cell temperature (thermalization) at the same time. In this study, a new texture is proposed to reduce the reflectivity only around the bandgap, to increase the power output while suppressing thermalization. Pyramid and square prism nanostructures are implemented and optimized by finite-difference time-domain method and parameter sweep optimization. By using square prism nanostructures, absorption of useful radiation by a 300 µm-thick silicon cell is increased by 20% while limiting the thermalization increase to 15%. The proposed texture optimization can improve power output from solar cells while reducing the cooling load.

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