

Design parameters for nanowire-planar tandem solar cells

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Abstract

A modified form of detailed balance theory is applied to a tandem semiconductor solar cell formed from a vertical nanowire array on a planar substrate. The concept of an effective packing fraction is introduced to account for the light trapping properties of the nanowire array. Our model provides important design criteria for the nanowire-planar system, including the requirement for optimum performance of a lower energy nanowire bandgap than in an ideal all-planar tandem cell. Using realistic design parameters for a III–V nanowire-silicon bottom cell system we predict an efficiency enhancement of 22–27% relative to a planar silicon cell.