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Novel heterojunction bipolar transistor architectures for the practical implementation of high-efficiency three-terminal solar cells

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Abstract

Practical device architectures are proposed here for the implementation of three-terminal heterojunction bipolar transistor solar cells (3T-HBTSCs). These photovoltaic devices, which have a potential efficiency similar to that of multijunction cells, exhibit reduced spectral sensitivity compared with monolithically and series-connected tandem solar cells. In addition, the simplified n-p-n (or p-n-p) structure does not require the use of tunnel junctions. In this framework, four architectures are proposed and discussed in this paper: 1) one in which the top cell is based on silicon and the bottom cell is based on a heterojunction between silicon and III-V nanomaterials; 2) one in which the top cell is made of amorphous silicon and the bottom cell is made of an amorphous silicon-silicon heterojunction; 3) one based on the use of III-V semiconductors aimed at space applications; and 4) one in which the top cell is based on a perovskite material and the bottom cell is made of a perovskite-silicon heterostructure.

Keywords:

Photovoltaics, electronics, multijunction solar cells, three-terminal, bipolar junction transistor

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