TANDEM SOLAR CELLS

Dawn of the three-legged beast

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Tandem solar cells and modules are a much researched strategy to improve the efficiency of photovoltaic conversion. By stacking solar cells that each absorb a different portion of the solar spectrum on top of each other, one of the main loss mechanisms is avoided and both the efficiency and the power output per unit area are increased. Traditionally, two different tandem configurations are fabricated: the four-terminal configuration consists of stacked cells that are electrically independent and the two-terminal configuration connects the stacked cells in series. The conditions in which each configuration is favourable are different. A third configuration also exists — three-terminal tandems. Now, Erik Garnett and colleagues from AMOLF in the Netherlands propose a three-terminal design for perovskite/silicon tandem solar cells.

The proposed device consists of an interdigitated back-contact silicon solar cell, on top of which a perovskite layer is deposited. Between both materials, a patterned, embedded nanogrid contact made of NiO_x and gold collects the holes generated in the perovskite, whereas electrons tunnel to the silicon solar cell through a thin layer, made of $n^+\text{Si}$ for example. This design removes current-matching requirements that limit the operation of two-terminal devices, and also reduces the number of transparent and conducting layers that induce losses in four-terminal tandems. The researchers developed coupled optoelectronic simulations, and find that an optimal perovskite/silicon three-terminal tandem cell using their design could reach up to 32.9% efficiency, higher than the efficiencies of both two- and four-terminal tandem solar cells.

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