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**Efficiency Analysis and Demonstration of Split-Junction Photovoltaic Solar Cells** HAN CHEN, EMIR MAGDEN, CHANDLER DOWNS, THOMAS VANDERVELDE, Tufts University — Recently, it has been proposed that separating solar radiation with a split-junction solar cell can result in higher overall conversion efficiencies, than are possible for monolithic designs. This hypothesis is investigated by simulating and analyzing 2+1 split junction cells for efficiency comparisons with theoretical and actual multi-junction cells. Ideal band-gaps for simultaneously operating photovoltaic and thermophotovoltaic cells have been determined. With the new configuration, it is shown that the efficiency achievements previously set by Ge/InGaAs/InGaP cells can be surpassed. A total increase in power output is observed during field tests using a Cassegrain split-junction concentrator with a dichroic lens (1.1 micron cutoff wavelength). Proposed benefits such as reduced heat load on the solar cell and ease of lattice constant matching in cell design are also validated. Additionally, with the flexibility of the concentrator assembly, it is shown that similar split-junction configurations with matching dichroic lenses allow for significant improvements in high efficiency solar cell technology.

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