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Enhancing photovoltaic efficiency through radiative cooling of solar cells below ambient temperature. TAQIYYAH SAFI, JEREMY MUNDAY, University of Maryland — Sunlight heats up solar cells and the resulting elevated solar cell temperature adversely effects the photovoltaic efficiency and the reliability of the cell. Currently, a variety of active and passive cooling strategies are used to lower the operating temperature of the solar cell. Passive radiative cooling requires no energy input, and is ideal for solar cells; however, previously demonstrated devices still operate above the ambient, leading to a lower efficiency as compared to the ideal Shockley-Queisser limit, which is defined for a cell in contact with an ideal heat sink at ambient temperature (300 K). In this talk, we will describe the use of radiative cooling techniques to lower the cell temperature below the ambient temperature. We show that by combining specifically designed radiative cooling structures with solar cells, efficiencies higher than the limiting efficiency achievable at 300 K can be obtained for solar cells in both terrestrial and extraterrestrial environments. We show that these structures yield an efficiency 0.87% higher than a typical PV module at operating temperatures in a terrestrial application. We also demonstrate an efficiency advantage of 0.4-2.6% for cells in an extraterrestrial environment in near-earth orbit.

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