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Simulation and Testing of Type-II Strained-Layer Superlattices for Low Temperature Thermophotovoltaic Cells. DANTE DEMEO, COREY SHEMELYA, THOMAS VANDERVELDE, Tufts University — The focus of this paper is the characterization of a novel, low band gap, long-wavelength, Thermophotovoltaic (TPV) cell design. These cells are based on type-II strained layer superlattice (SLS) structures where the effective bandgap is adjustable and a function of the thickness of the individual layers, creating minibands. Additionally, the type-II nature of the SLS causes the charge carriers to be spatially separated, which minimizes Auger recombination, allowing for the creation and operation of lower temperature TPV cells. The simulation was done using nextnano, while the testing was done on a custom-designed, cryogenic, high vacuum thermal simulator, specifically developed for characterizing low temperature TPV. These cells have the ability to extract energy from long wavelength photons, which will enable devices to harvest energy from more common sources than previously possible. Through this work, energy harvesting could occur at body temperature and below. Here, we characterize several TPV samples with wavelengths up to 10 microns. The capability to extract energy from longer wavelengths opens up new possibilities for TPVs, such as cooling microprocessors and other low temperature applications, or enabling devices like wireless sensors and biological implants to power themselves using heat from their ambient surroundings.

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