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Enhancing Thermophotovoltaics: 2D photonic crystals and Surface Plasmon Resonance to Increase the efficiency of GaSb COREY SHEMELYA, DANTE DEMEO, THOMAS VANDERVELDE, Tufts University — For many years researchers have attempted to efficiently harvest waste heat via thermophotovoltics (TPVs). The low quantum efficiency (QE; i.e. the probability that a photon will be absorbed) in most cells is probably the biggest limiting factor in achieving an economically viable device and directly affects the conversion efficiency (CE; i.e. the probability that a photon will be converted into a carrier that is collected). In many cases, top of the line TPV cells might only have a CE of 20 percent. Recent advances have enabled the creation of novel structures to enhance the absorption and the conversion of the incident thermal photons. In particular, photonic crystals (PhC) and surface plasmon (SP) interface enhancements have been shown to increase the efficiency of photon to current conversions for infrared photodetectors. Here, we report on the enhancement of photon conversion by integration of PhC and SP structures into the TPV cells. Photonic crystals consisting of rods of either air or dielectric surface-passivation material are placed into the base semiconductor TPV cells to increase duration of thermal photon absorption, resulting in significantly enhanced QE and CE. The ability to harvest waste heat for energy will help make many processes more energy efficient, a critical component in ushering the USA into an era of energy independence.

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