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Title:Microscopic approach for intersubband-based thermophotovoltaic structures in the terahertz and mid-infrared
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Abstract:This paper describes microscopic calculations of photocurrent generation spectra due to intersubband transitions in semiconductor heterostructures that can extract energy from photons in the terahertz and mid-IR ranges. As expected in the mid-IR, the interconduction conduction band transitions dominate the photocurrent. However, the numerical results presented here show that in the far-IR there is a range in which valence-band-based transitions dominate the photocurrent, and these can be sustained under perpendicular incidence. This would lead to devices that do not need prisms and couplers in contrast with conduction band-based intersubband absorbers. Examples for different quantum well structures and different thermal source temperatures are compared and contrasted numerically. It is further demonstrated that many body effects, so far ignored in simulations of materials for photovoltaic and thermophotovoltaic applications, are shown to be of relevance for both conduction (TM mode) and valence-band based (TE mode) configurations. © 2011 Optical Society of America.