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Photodetection Mechanism in Mid/Far-Infrared Dual-Band InAs/GaSb Type-II Strained-Layer Superlattice

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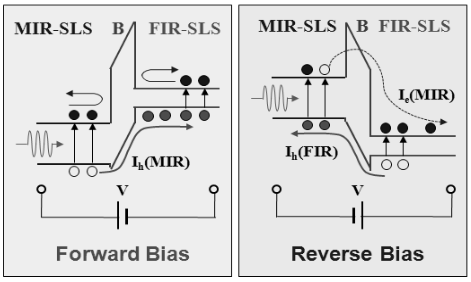
Owing to many advantages on indirect intersubband absorption from the hole miniband to the electron miniband based on the type-II band alignment in InAs/GaSb strained-layer superlattice (SLS), InAs/GaSb SLS infrared photodetector (SLIP) has emerged as a promising system to realize high-detectivity quantum photodetector operating up to room temperature in the spectral range of mid-infrared (MIR) to far-infrared (FIR). In particular, n-barrier-n (n-B-n) structure designed for blocking the majority-carrier dark current makes it possible for MIR/FIR dual-band SLIP whose photoresponse (PR) band can be exclusively selected by the bias polarity. In this study, we present the MIR and FIR photoresponse (PR) mechanism identified by dual-band PR spectra and photoluminescence (PL) profiles taken from InAs/GaSb SLIP. In the MIR/FIR PR spectra measured by changing bias polarity, each spectrum individually shows a series of distinctive peaks related to the transitions from the hole subbands to the conduction one. The PR mechanism at each polarity is discussed in terms of diffusion current, and a superposition of MIR-PR in the FIR-PR spectrum is explained by tunnelling of electrons activated in MIR-SLS. The effective FIR-PR spectrum decomposed into three curves for HH1, LH1, and HH2 has revealed the edge energies of 120, 170, and 220 meV, respectively, and the temperature variation of the MIR-PR edge energies shows that the temperature behavior of the SLS systems can be approximately expressed by the Varshni empirical equation.



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