

Towards Normal Incidence Intersubband Infrared Detection

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ABSTRACT

We propose a new intersubband infrared photodetector concept, the island insertion infrared detector, with the aim of achieving improved normal incidence absorption characteristics over the quantum well infrared photodetector (QWIP). The lack of normal incidence absorption in typical QWIP structures is the direct consequence of the in-plane translational symmetry of the quantum well. The active region of our proposed detector structure consists of a quantum well as in QWIPs, but inserted with submonolayers of a lattice mismatched semiconductor. The insertion of submonolayers should not disrupt epitaxial growth, while the presence of strain would promote the formation of embedded islands. The embedded islands introduce lateral (in-plane) variations in the quantum well wave function, which in turn enhance inter-conduction-subband absorption of normal incidence radiation. Specific implementations include the insertion of submonolayers of InAs, InSb, GaSb, AlSb, or AlAs in GaAs quantum wells. Results of preliminary model calculations show that InAs island insertions can indeed induce substantial lateral variations in GaAs quantum well wave functions, provided that the island sizes are comparable to or larger than the electron deBroglie wavelength.