

ASYMMETRIC QUANTUM WELL STRUCTURES FOR ENHANCED INFRARED PHOTON ABSORPTION

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ABSTRACT

Infrared (IR) photodetectors play vital roles in thermal imaging and sensing, which has important commercial and defense applications. Understandably, mechanisms and material considerations and characteristics that may lead to improved photondetection in the infrared regime have been rigorously investigated. Among those, quantum well structures have been shown to be the most versatile for infrared detection, as by merely changing the material composition, one can tune the detection wavelength. The quantum well photodetectors are fabricated using Molecular Beam Epitaxy (MBE), which is a well matured materials growth and process technology capable of producing ultra-pure and thin films on larger substrates.

In this dissertation, we have investigated quantum well structures, with a particular emphasis on the *asymmetric* ones that can be used as QWIPs, composed of high electron mobility material like InGaAs, that has certain asymmetry introduced through either stepped well formed by of different materials or spatial variation of doping in the well region. Use of stepped quantum wells can also improve the wavelength tunability of the QWIP. The high electron mobility and hence drift velocity in InGaAs, along with low carrier recapture lifetime, is expected to improve the absorption efficiency of the device.