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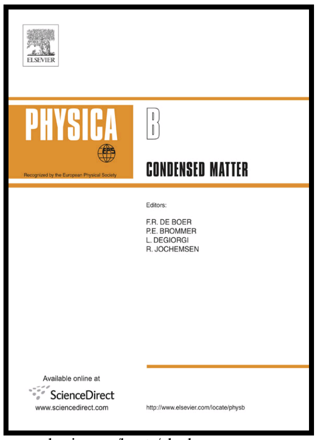

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PII: S0921-4526(17)30308-3
DOI: http://dx.doi.org/10.1016/j.physb.2017.06.007
Reference: PHYSB309985

To appear in: *Physica B: Physics of Condensed Matter*

Received date: 20 April 2017
Revised date: 18 May 2017
Accepted date: 2 June 2017

Photoluminescence and structural properties of unintentional single and double InGaSb/GaSb quantum wells grown by MOVPE

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Abstract

The structural and photoluminescence (PL) characterization of InGaSb quantum well (QW) structures grown on GaSb substrate (100) using atmospheric pressure Metalorganic Vapor Phase Epitaxy (MOVPE) is presented. Both structures (single and double-InGaSb QWs) were *inadvertently* formed during an attempt to grow capped InSb/GaSb quantum dots (QDs). In this work, 10 K PL peak energies at ~ 735 meV and ~ 740 meV are suggested to be emissions from the single and double QWs, respectively. These lines exhibit red shifts, accompanied by a reduction in their full-widths at half-maximum (FWHM) as the excitation power decreases. The presence of a GaSb spacer in the double QW was found to increase the strength of the PL emission, which consequently gives rise to a reduced blue-shift and broadening of the PL emission line observed for the double QW with an increase in laser power, while the low thermal activation energy for the quenching of the PL from the double QW is attributed to the existence of threading dislocations, as seen in the bright field TEM image for this sample.

Keywords: *Quantum well; Photoluminescence; Quantum dots; Substrate; Semiconductor.*

Introduction

Remarkable progress has been made in the fabrication of lattice-mismatched heterostructures with ultra-thin layers. However, precautionary measures should be taken in order to avoid the introduction of misfit defects which are usually generated as the number of deposited layers increases. There has also been an increasing interest in the modification of semiconductor band structures through the reduction of their dimensions, which simultaneously increases the band gap energy of the material and gives rise to flexibility to alter device properties. Advances in III-V antimony (Sb) based semiconductor fabrication have triggered the quest for extension of the emission/ absorption wavelength range of this family of compounds for optoelectronic devices operating in the mid-infrared region of the electromagnetic spectrum. Over the years, mercury cadmium telluride (HgCdTe) has been the leading material system for medium wavelength infrared (MWIR) and long wavelength infrared (LWIR) photo-detectors but this material system is characterized by instability and non-uniformity challenges over larger areas resulting from the high Hg vapour pressure [1]. Sb-based materials III-V semiconductors are therefore being considered as possible alternatives to HgCdTe. The growth of Sb-based compounds using