INFLUENCE OF STRAIN ON THE OPTICAL PROPERITIES IN BULK AND LOW DIMENSIONAL SEMICONDUCTOR HETEROSTRUCTURE BASED DEVICES

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ABSTRACT

In this paper we review the most important achievements in optoelectronics during the last decade. Especial emphasis will be given to strain adjusted devices and the consequences of strain on the performance of these devices. Two strain assessment tools, the high-resolution x-ray 2-D reciprocal space mapping (2D-RSM) and Raman spectroscopy, are given. The invention of strain $Si_{1-x}Ge_x/Si$ has opened a door for Si technology in optoelectronics. We first present Si-based infrared detectors based on Schottky junctions. More Si-based infrared detectors including heterojunction internal photoemission (HIPs), quantum well infrared detectors (QWIRD) are presented. The effect of strain on the performance of these detectors is discussed. A detailed example of strain adjustment through different relaxation levels and the corresponding infrared detection is shown. Other aspects and achievements of strain-correlated devices in Si are mentioned, these are mainly efforts of growing relaxed Ge buffer layers on Si to integrate GaAs on Si technology or fabricate Ge photodetectors. III-V strained heterostructure lasers are mentioned. The optical properties of some of our recent results on strained $Al_{0.5}Ga_{0.5}As/In_{0.25}Ga_{0.75}As/GaAs$ quantum wire and InAs quantum dot are then given. In addition strain related achievement in light emitting diodes, lasers, and detectors for both II-VI and III-nitrides is discussed. Finally, we present some of our theoretical results from Terahertz laser operation of both $Si_{1-x}Ge_x/Si$ as well as and $In_{1-x}Ga_xAs/GaAs$ quantum well heterostructures.