Nanocomposites and nanomaterials

Influence of low-defective buffer on photoelectric properties of InAs/InGaAs and InAs/GaAs quantum dot structures

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Photoluminescent and photoelectric properties of InAs/$In_{0.15}Ga_{0.85}As$ quantum dots (QDs) grown on metamorphic buffers (MBs) and InAs/GaAs QDs were studied. Bottom contacts on both vertical structures were made: i) on the GaAs substrates and ii) on the bottom buffer layers (InGaAs or GaAs). The last configuration allowed to avoid the flow of electrical current through the *n*-InGaAs/*n*-GaAs and *n*-GaAs/substrate interfaces. The InAs/InGaAs structures showed an effective photoluminescence from QDs close to the 1.3 μm telecommunication spectral window. Luminescence spectra showed bands related to QDs and wetting layers, whereas also the features from other layers were observed in the photovoltage (PV) and photocurrent spectra of the structures with the bottom contacts on buffer layers. In addition, there was an essential contribution of EL2 defects to the photoelectric spectra in the case of the substrate bottom contacts. It was shown that the EL2 defects and a n^+-GaAs layer between the MB and substrate had a negative impact on the total PV signal from other layers of the structures; such an effect is related to features of the band structure at the interfaces. The PV of the structures with bottom contacts on MB for different wavelengths showed: i) a linear dependence of charge carrier density on intensity at higher power densities, ii) a superlinear dependence at low power densities which evidences that weak Shockley-Read recombination apparently occurs through the defects. The obtained results allow to conclude that thick MBs have a positive role on the charge carrier collection to the QDs rather than their capture and subsequent recombination through the defects.