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Deep Level Transient Spectroscopy of GaSb/GaAs Quantum Dots

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Abstract content
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Self-assembled quantum dots (QDs) are interesting not only for studying charge confinement in zero dimensional systems, but also for the potential it offers towards the development of opto-electronic devices. In particular, GaSb/GaAs QD structures exhibit type-II band alignment in which the holes are strongly confined while a conduction band off-set creates a barrier to the flow of electrons. This, combined with the special separation between electrons and holes results in enhanced exciton lifetimes and reduced recombination probabilities, rendering these structures particularly suitable for long wavelength opto-electronic and memory device applications [1,2]. However, a thorough understanding of the electrical properties and carrier dynamics of these QD systems is an essential prerequisite for the development of the aforementioned mentioned devices.

In this study, the electronic properties of a GaSb/GaAs QD system, grown by molecular beam epitaxy, are investigated by means of current-voltage (IV), capacitance-voltage (CV) and Laplace deep level transient spectroscopy (L-DLTS). The IV measurements show a significant rectification (˜ 4 orders of magnitude) between -1V and +1V with an ideality factor of 1.75 at 300 K. The reverse bias current of roughly 7nA displays a weak bias dependence up to -3V. Three prominent defects are detected around 140 K, 300 K and 330 K using a rate window of 200 Hz. L-DLTS is used to evaluate the defects around the QDs. The respective signatures and charge carrier dynamics are presented.

[1]. M. Hayne, J. Maes, S. Bersier, Appl. Phys.Lett. 82 (2003) 4355-4357.
[2]. M. Geller, C Kapteyn, L. Muller-Kirsch, R. Heitz, D. Blumberg, Appl. Phys. Lett. 82 (2003), 2706-2708

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