Quantum Dashes: Optical Properties and Application Prospects

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Semiconductor quantum dashes, which can be fabricated using the modern epitaxial technologies and the self-assembled growth mode, is a new class of nanostructures in a shape of strongly elongated in [1-10] direction quantum dots or finite length quantum wires. They have been developed within the last few years and already proven to offer a very beneficial properties from the point of view of exploiting them in the active region of infrared lasers improving their performance, e.g. decreasing the threshold current, enhancing the differential gain, and widening the wavelength tuning. However, there is still a rather limited published information available regarding many of their more fundamental physical properties. We will present the results of optical investigation of quantum dashes obtained in two different material systems (on GaAs and on InP). By employing techniques like modulation spectroscopy, micro-photoluminescnece and time-resolved photoluminescence combined with energy level calculations we will discuss several aspects related to possible extension of the application field for such asymmetric nanostructures:

- linear polarization properties of the so called columnar quantum dashes made of In(Ga)As on InP from the perspective of constructing a polarization insensitive quantum-dot-like semiconductor-based optical amplifier at the fibre telecommunication window of 1.55 μm,
- studies of photoluminescence form a single InAs/InP quantum dash of a high density ensemble able to emit at E, S and C bands spectral ranges and with a support of a few level rate equation model a detection of biexciton emission,
- ensemble and single InGaAs/GaAs quantum dashes optical properties including estimations on the oscillator strength, exciton to biexciton radiative lifetimes and the internal kinetics involving the carrier transfer from the discretized wetting layer to the dashes.