P14

Luminescence properties of GaAsBi MQWs for VECSELs

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GaAsBi quantum well (QW) structures have a lot of favourable properties for optoelectronic devices operating in the near-infrared (NIR) region, such as reduced temperature sensitivity of the bandgap and significant red shift of emission with an increase in bismuth content [1]. The incorporation of Bi induces strong spin-orbit splitting, surpassing the bandgap energy at Bi content above ~11%, which helps suppress Auger recombination [2]. However, the complicated growth of GaAsBi often leads to low crystal quality and reduced luminescence intensity. To optimize the growth of GaAsBi structures it is necessary to investigate optical properties of it.

This work presents detailed optical study on GaAsBi/GaAs multiple quantum well structures, grown as an active area for Vertical-External-Cavity Surface-Emitting Lasers (VECSELs) [3]. These investigated structures represent new optimized growing method for active area for VECSELs, where the pairs of QWs are placed periodically to match the antinodes of the optical standing wave to have thinner structures with higher homogeneity and enhanced photoluminescence (PL) intensities.

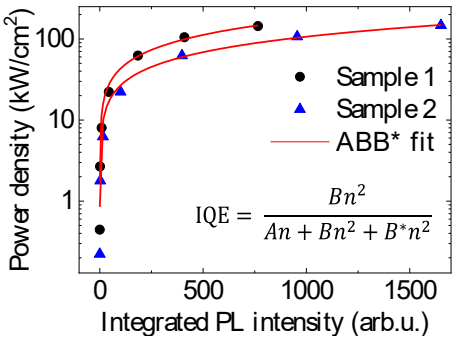

Fig. 1 IQE evaluation using ABB* method.

Observed PL bands in the room temperature PL measurements of ~1.1 eV were assigned to optical transitions in QWs of GaAsBi. The results from temperature dependent PL measurements (4 – 300 K) revealed S-shaped temperature dependence of PL peak positions in both structures. This was explained by the high localization effect (>30 meV), which is present even at room temperature. Additionally, for the first time, the internal quantum efficiency (IQE) was evaluated for the GaAsBi structures. The IQE values of ~10 m% were acquired by absolute method and compared with a relative excitation power dependent ABC method and a newly developed ABB* method (see fig.1), which includes contribution from trap-assisted Auger-Meitner non-radiative recombination.

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