Mappings of large area PL emission from InGaAs/GaAs and GaAsBi/GaAs multi-quantum wells for VECSEL fabrication

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Nowadays lasers are used in many different fields, and each of them requires a different set of properties. Because of this several types of devices have been developed, such as, solid-state, semiconductor, gas, excimer, and dye lasers.

Vertical-external-cavity surface-emitting lasers (VECSEL) belong to a new family of emitters that were designed to overcome some of the limitations of more conventional designs.

In comparison to both types of electrically pumped vertical-cavity surface-emitting lasers (VCSELs) and laser diodes (LDs), VECSELS are capable to generate high optical power with circular beam quality [1].

The output power of such structures is proportional to the area of the emitting surface. Thus, it is very important to grow large area samples of the highest optical uniformity [2].

In this work InGaAs/GaAs and GaAsBi/GaAs multi quantum well structures were grown to evaluate the emission homogeneity that is a key parameter in the fabrication of high output power VECSELs.

The structures were grown using molecular beam epitaxy (MBE) on semi-insulating GaAs substrates.

Two different types of structures were grown, both with InGaAs, in Figure 1 the two structures are shown.

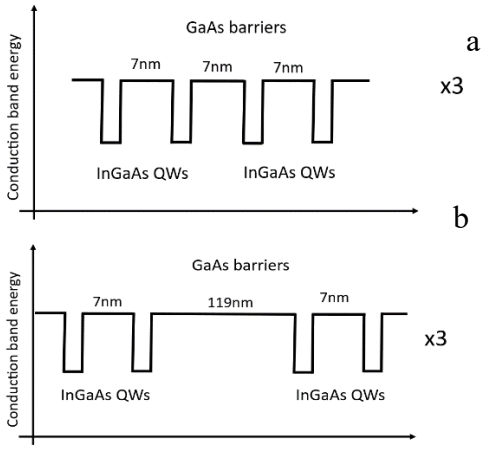

Figure 1 Two types of structure grown with InGaAs/GaAs QW. a) type1 structure, b) type2 structure

The samples were grown with different In content (18-24)% and QW thickness (3.5-7)nm, and the PL emission was mapped after the growth. The PL map of a sample grown with type 1 structure is shown in Figure2. The fabrication of VECSEL structures requires a much higher homogeneity for this reason type 2 structure was designed.

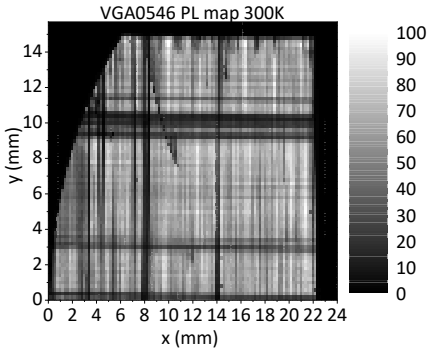

Figure 2 PL Map of a sample grown with structure of type1 shown in Figure 1a

Our results show that this type of structure allows for the growth of QW with high In content, and low dislocation density leading to homogenous emission. This allowed to fabricate VECSELs with an emission wavelength of 975nm.

The second part of the work was focused on the optimization of GaAsBi/GaAs QW for the fabrication of VECSELs with a longer emission wavelengths (1100-1200)nm. The GaAsBi/GaAs structure showed higher homogeneity as shown in Figure 3.

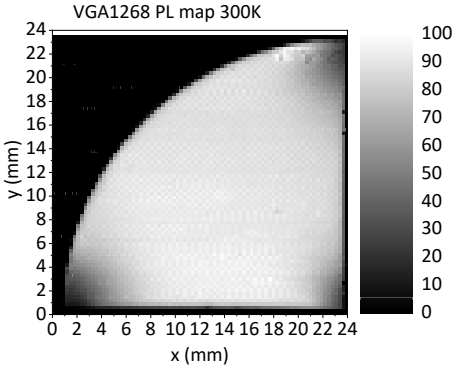

Figure 3 PL Map of a GaAsBi/GaAs structure grown with a type1 like structure

After the growth all structures were investigated by HR-XRD, and the surface roughness was measured by AFM.

References

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