Gain measurements of Se-based II-VI multiple quantum well structures for vertical-external-cavity surface-emitting laser applications

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Vertical-external-cavity surface-emitting lasers (VECSELs), also known as semiconductors disk lasers (SDLs), have captured the interest of many researchers due to their unique features, such as high output power, ultrashort pulse operation, thin gain region, and wide spectral coverage. VECSELs based primarily on III-V quantum wells structures have been well developed. However, it is still challenging to achieve devices working in the yellow and green wavelengths. Se-based II-VI materials such as ZnCdSe and ZnCdMgSe grown lattice matched to InP are attractive materials for this application. Recently our groups have reported some initial results pertaining to the optically pumped lasing potential of these materials. However, optimizing the materials for the very stringent structural requirements of the VECSEL requires a better understanding of the optical properties of the Se-based II-VI materials.

We report on the growth by molecular beam epitaxy of multiple quantum well (MQW) ZnCdSe/ZnCdMgSe structures for application as VECSELs devices operating at 565 nm. X-ray diffraction (XRD) 2θ-ω scan obtained along the (002) reflection, with clear evidence of thickness fringes, confirms the excellent crystalline quality of the samples. The structures were characterized using a pump probe technique from which the optical gain of the material could be estimated. For these measurements it was necessary to remove the absorbing InP substrate by a selective chemical etching technique. Gain values of ~9% were obtained for near-lattice matched samples. We will present results of the effect on gain of structural parameters, such as strain. The results will inform the design of the optimum VECSEL structure.

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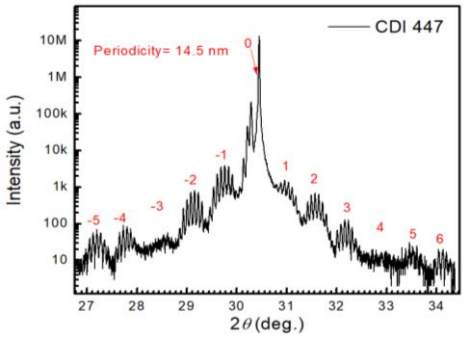

Figure 1: XRD scan along the (002) reflection for a MQW ZnCdSe/ ZnCdMgSe gain structure

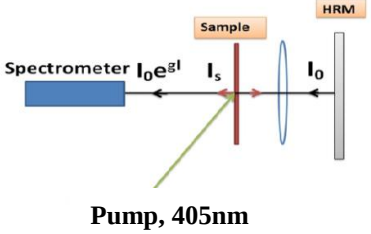

Figure 2: Schematic of the pump-probe set-up for gain measurements

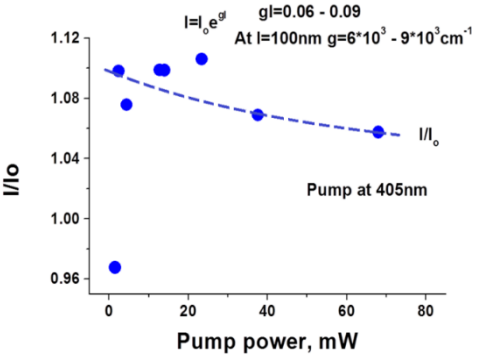

Figure 3: Gain as a function of pump power for a near-lattice matched MQW structure