Anisotropic modal gain of a GaAs self-assembled quantum-wire laser structure on a (775)B GaAs substrate

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Self-assembled quantum-wires (QWRs) grown on (775)B GaAs substrates by molecular beam epitaxy (MBE) have large anisotropic optical gain and are expected to lift the problem that the polarization-direction of light emitted from vertical-cavity surface-emitting-lasers (VCSELs) switches by 90 degrees dependent on the excitation current.[1] Recently we have demonstrated room-temperature lasing of self-assembled quantum-wire VCSELs without polarization switches.[2] Actual anisotropy of the gain of the QWRs, however, has not been measured. In this work, we have fabricated a QWR laser structure and measured the anisotropic modal gain.

We grew a edge emitting laser structure consisting of 5.5 sets of a nominally 3-nm-thick (775)B GaAs QWR layer and $(GaAs)_4(AlAs)_2$ barrier layer. Two 500-μm-long segmented stripe contacts were formed.[3] Fig. 1 shows amplified spontaneous emission (ASE) spectra when single segment (Seg 1) or double segments (Seg 1+2) were excited. An excitation current of 710 mA passed through each contact. Modal gain spectra were deduced from two ASE spectra [3], and a peak modal gain of 10 cm^{-1} was obtained. Peak modal gain as a function of current density and stripe direction are shown in Fig. 2. The result indicates that the (775)B GaAs QWRs has a large anisotropy of the modal gain.

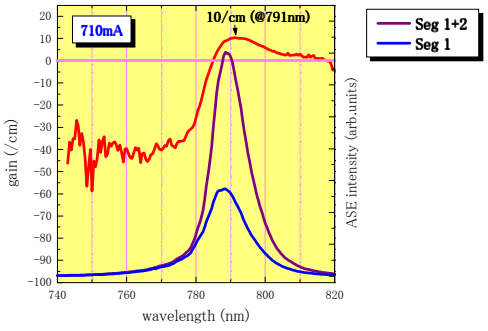

Fig.1 Amplified spontaneous spectra (ASE) when single 500-μm-long stripe (Seg 1) or double stripes (Seg 1+2) were excited. Modal gain spectrum is deduced from the two ASE spectra.

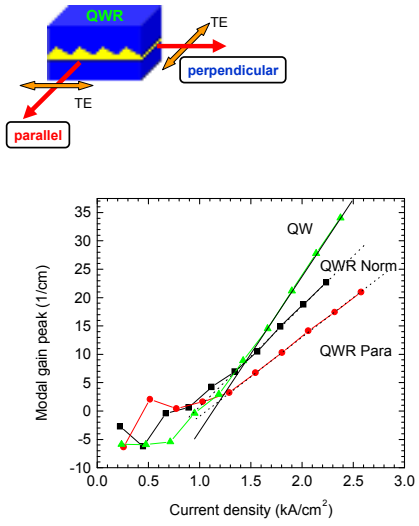

Fig.2 Modal gain peak as a function of current density and stripe direction for (775) QWR. Data for a (100) quantum well lasers simultaneously grown are shown.

References

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