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Beyond 25GHz Directly Modulated 980nm VCSEL with Lateral Optical Feedback

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1. Introduction

Recently, ultrafast VCSELs have been attracting much interest for optical interconnects in dater centers and supercomputers. One path to expand the bandwidth is using the optical feedback effect [1-3]. In this paper, a lateral-coupled cavity scheme for increasing the modulation bandwidth of VCSELs is demonstrated. Results show that the bandwidth is increased to go beyond 25GHz of the photo detector limitation.

2. Device Structure

Figures 1 (a) and (b) show the scheme and the top view of our proposed 980nm coupled cavity VCSEL structure. Lateral optical confinement is formed using an oxide layer and a bow tie un-oxidized connection, which leads to a leaky traveling wave in the lateral direction. The end reflector makes the lateral optical feedback into a VCSEL. The group-velocity of lateral traveling light in a Bragg reflector waveguide can be reduced [4], thus we are able to shrink the external optical feedback resonator.

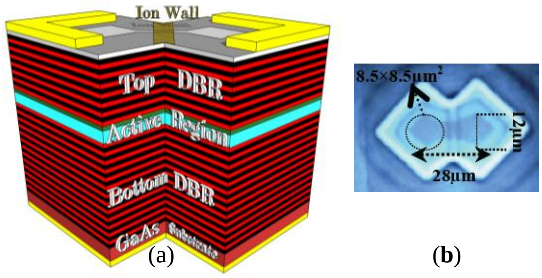

Fig.1 (a) Schematic structure and (b) top view of lateral coupled cavity VCSEL.

3. Results

Figure 2(a) shows the measured small signal response of conventional VCSEL and laterally-coupled cavity VCSEL with the same injection current. It is noted that the feedback current control the phase change, while in wide current ranges we can see 100% enhancement to compare with the conventional VCSEL, the precise control of phase is indispensable to go beyond the photo-detector limitation (25GHz).The result shows that the bandwidth is increased to go beyond 25GHz of the photo detector limitation we used. We measured the lasing spectrum of the VCSEL and the feedback resonator. Figure 2(b) shows the measured L-I curves for different feedback currents while the laser current is varying from 0-10mA. Setting -1V reverse voltage in the feedback cavity indicates the ripple is due to the lateral feedback. A MMF fiber and optics were used so that the output from each cavity is collected independently. We measured the spatially resolved lasing spectrum spectra of the two cavities are coherently coupled and hence show the same lasing wavelength of dominant modes.

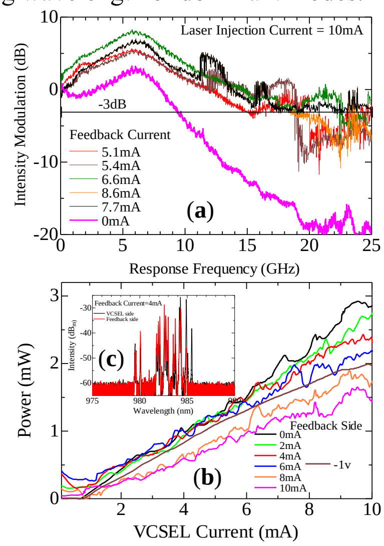

Fig.2 (a), Measured small-signal modulation response of 980 nm conventional VCSEL and lateral coupled cavity VCSEL.(b), Measured L-I curve for the different bias of feedback current while the laser current is varying from 0-10mA, (c) spectrum for 4mA and 6mA current of feedback and laser side respectively.

4. Conclusions

A lateral coupled cavity VCSELs for the bandwidth enhancement was demonstrated. The measured results of small signal responses indicate 250% > improvements in 3dB modulation bandwidths.

References

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