Widely tunable twin-guide laser diodes at 1.55 µm

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Abstract

Widely tunable twin-guide laser diodes at 1.55 µm are presented. The devices require only two tuning currents and provide full coverage of a 40 nm-tuning range with SMSR and output power above 30 dB and 10 mW, respectively.

1 Introduction

Widely tunable laser diodes with a tuning range of several tens of nanometers have become valuable light sources for optical communications as well as various sensing applications. However, practically all presently available monolithic widely tunable lasers require at least three tuning currents, which makes device control and characterization time-consuming and expensive. A reduction of the number of tuning currents is of course desirable as long as the device performance is not impaired. The widely tunable twin-guide laser[1,2] has been designed to this end. While offering competitive device performance, it requires only two tuning currents.

2 Device structure and design

The device is based on the tunable twin-guide (TTG) laser diode with distributed feedback (DFB)[3]. In the widely tunable twin-guide laser diode, the tuning region is longitudinally split into two tuning sections that contain sampled gratings (Fig. 1) in order to make the device capable of Vernier-effect tuning[4]. Due to the transverse integration of active and tuning section, a phase tuning section, which is required in longitudinally integrated tunable lasers to adjust the cavity mode position, is redundant. Hence, the device requires at least one tuning current less than comparable monolithic widely tunable lasers.

To suppress spurious reflections from the facets that would interfere with the sampled grating reflection spectrum, window structures in combination with antireflection coatings are employed at both ends of the device.

The sampled gratings have been designed to obtain reflection peak spacings of 5.0 and 5.5 nm in the front and rear reflector, respectively.

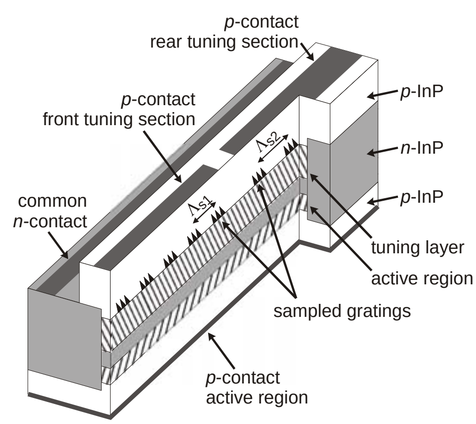

Fig. 1: Schematic drawing of a widely tunable twin-guide laser diode with sampled gratings (SG-TTG).

3 Device characteristics

The results shown in this paper have been obtained from 1200 µm-long devices that were mounted on Cu heatsinks. Characterization was carried out at 20 °C and at a laser current of 250 mA.

The wavelength map shown in Fig. 2 reveals the location of the various supermodes. Within these supermodes, the emission wavelength can be continuously tuned by up to 8.2 nm. Continuous tuning can be conveniently carried out by tuning front and rear reflector by similar amounts. In doing so, only minor variations in the side-mode suppression ratio (SMSR) are observed.

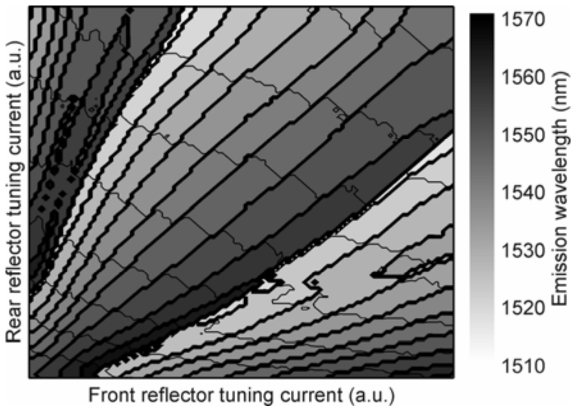

Fig 2: Wavelength map of an SG-TTG laser. The various supermodes are enclosed by thick solid lines. Thin solid lines indicate iso-wavelength contours that are spaced by 1.0 nm.

The wavelength as function of the rear reflector tuning current has been extracted from the wavelength map for the nine central supermodes and is shown in Fig. 3. As can be seen, the spacing of the supermodes as well as the wavelength change within each of the supermodes is absolutely regular.

Due to the high tuning efficiency of the TTG laser only small tuning currents are needed. For the present devices, a maximum tuning current of 45 mA is already sufficient to obtain tuning over a 40 – 50 nm wavelength range.

The front facet output power and SMSR are depicted in Fig. 4 as function of the emission wavelength. Over a wavelength range of 41 nm (from 1520.5 to 1561.5 nm) the SMSR and output power remains above 30 dB and 10 mW, respectively.

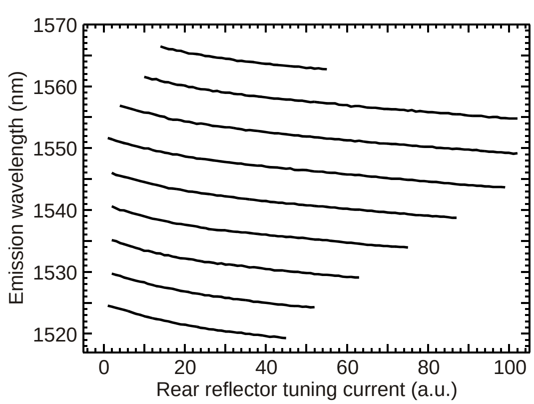

Fig. 3: Wavelength vs. rear reflector tuning current.

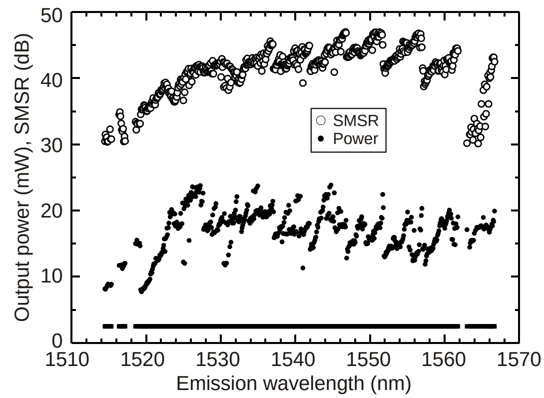

Fig. 4: Front facet output power and SMSR vs. emission wavelength. The bold horizontal line at the bottom of the graph is shown as a visual guide to easily locate gaps within the tuning range. Full wavelength coverage is achieved over a tuning range of more than 40 nm.

4 Conclusions

In conclusion, we realized widely tunable twin-guide laser diodes at 1.55 µm that are quasi-continuously tunable over a wavelength range of more than 40 nm and require only two tuning currents. Moreover, the lasers provide high spectral purity as well as high output power.

5 Acknowledgments

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6 References

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