Characteristics of the new Modulated Grating Y laser (MG-Y) for future WDM networks

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During the past years widely tunable laser structures that can be used in future telecom networks were designed and fabricated within the IST project NEWTON. This paper introduces the device principle and the measurement results of the new widely tunable MG-Y laser concept. With measured characteristics such as a 40nm tuning range, a side mode suppression of more than 40dB and a high output power this design has the same qualities as non-tunable lasers. Its wide tunability makes it possible to add extra flexibility, functionality and performance to the network.

Introduction

Telecom operators worldwide are facing an increasing bandwidth demand; a problem which they hope to solve by purchasing low cost components with a high functionality, high flexibility and easy control. A good widely tunable laser concept can answer those needs. With tunable lasers that have the same quality as non-tunable lasers, operators will be able to reconfigure their network very fast and at low cost: they add extra flexibility, functionality and performance to the network.

The many advantages have led to a multitude of tunable laser concepts in the past years, but not one of these concepts has the same qualities as (non-tunable) DFB lasers, i.e. high output power and high side mode suppression, and is widely tunable, easily controllable and easily manufacturable. In the following paragraphs we introduce a widely tunable laser, the Modulated Grating Y laser, which does fulfill these requirements.

Laser Concept

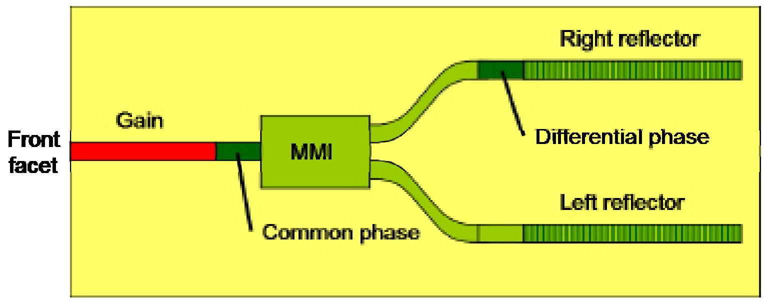

Figure 1. Schematic drawing of the Modulated Grating Y laser

In the Modulated Grating Y laser concept [1], the different functions are separated into different sections (Figure 1). The gain section amplifies the light, the MMI splits the light into 2 equal beams, the bends increase the seperation between the waveguides and the reflectors filter out certain frequencies. The differential phase section guarantees that the reflected beams are added up in phase. And the common phase section is responsible for the alignment between the cavity mode and the reflected peaks.

The additive Vernier effect is used to select one lasing frequency. Both reflectors have a slightly different peak spacing so the frequency where both peaks overlap will reach the laser threshold first. By tuning one reflector, the reflection spectrum will move to lower wavelengths and the overlapping peaks will occur at a higher frequency. Taking a couple of design rules into account [1], we can obtain a higher side mode suppression than with the multiplicative Vernier effect (used with the SSG-DBR laser), because the neighboring peaks add partly out of phase. This is illustrated in Figure 2, which shows the reflection spectra of the individual reflectors as well as the reflection spectra of their multiplication and coherent addition.

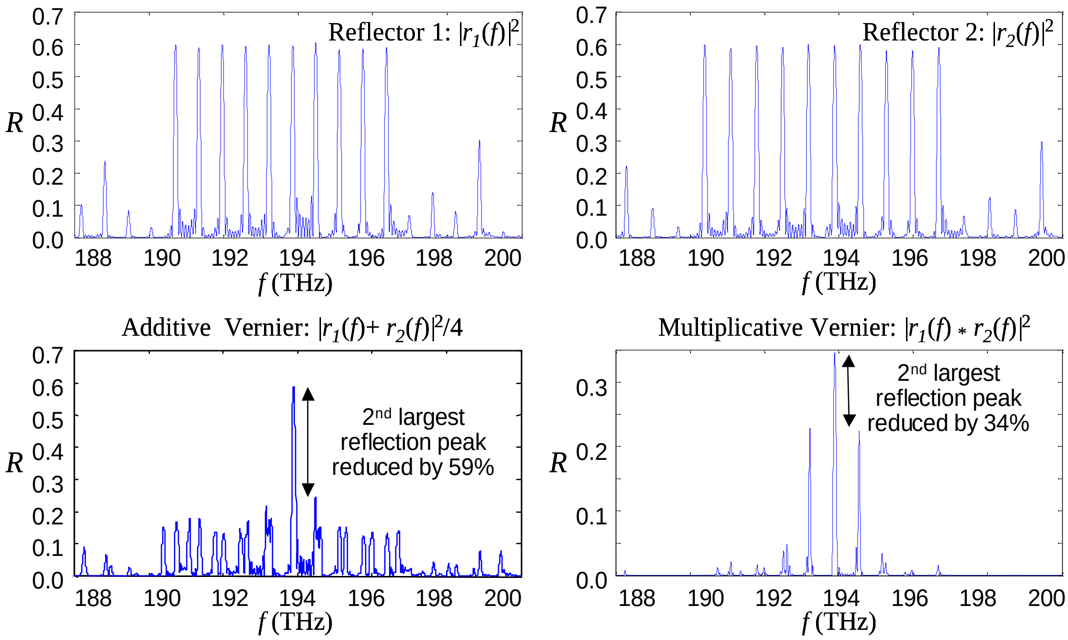

Figure 2. Reflection Spectra of the two reflectors (top figures) and the comparison between the additive (MGY) and multiplicative (SSG-DBR) Vernier effect (bottom figures)

The 2 reflectors are at the back of the laser so a high output power and a low power variation can be expected. The fabrication is very similar to that of a DBR laser and thus relatively simple. On the other hand, the 4 independent tuning currents of the original concept are a potential disadvantage, because the characterisation becomes time consuming. However, with a careful design of the gratings and a careful processing of the branches, the differential phase section can be eliminated so that only 3 independent tuning currents remain.

Measurements

Figure 3 shows maps of the output frequency and the side mode suppression (SMSR) in function of the reflector currents and measured at a gain current of 100mA and a common phase current of 0mA. Due to the design, no differential phase section is needed for the main repeat modes, where reflection peaks of the same order are aligned.

This is demonstrated by the high SMSR in the central diagonal band. For the other supermodes an adjustment of the differential phase is needed to obtain in-phase addition of the reflection peaks. A further adjustment of the reflector design can improve this in the future. Even without the neighboring repeat modes a large continuous tuning range of more than 5THz (40nm) can be reached while the side mode suppression remains above 40dB.

The power was also measured for the devices. Due to a very low coupling efficiency of the setup and a drift on the piëzo-controllers, an output power map couldn't be measured, but measurements at some random points showed an output power of 7mW and more. The output power is further increased by adding an anti-reflection coating [2].

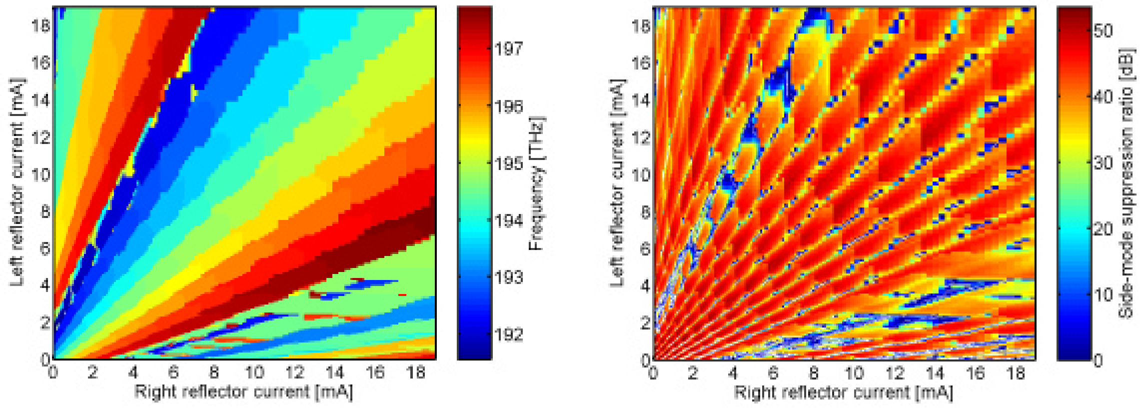

Figure 3. Measured contour maps of the frequency and the side mode suppression in function of the two reflector currents

Conclusions

The performance of the first batch of MGY-lasers was examined. These devices show a large tuning range of 5THz (40nm) and more and a side mode suppression higher than 40dB.

Acknowledgements

Part of this work is supported by the EU via the IST project NEWTON.
Reinhard Laroy acknowledges the Flemish Institute for the Industrial Advancement of Scientific and Technological Research (IWT) for a specialisation grant.

References

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