

1.5 μm Quantum Dots Spectral Hole Burning experiments for dual frequency laser engineering

ABSTRACT n° 10137

Authors :

Name	Email	Country
Brévalle Gaëlle *	gaelle.brevalle@insa-rennes.fr	France
Perrin Mathieu	mathieu.perrin@insa-rennes.fr	France
Paranthoën Cyril	cyril.paranthoen@insa-rennes.fr	France
Léger Yoan	Yoan.Leger@insa-rennes.fr	France
Levallois Christophe	christophe.levallois@insa-rennes.fr	France
Folliot Hervé	herve.folliot@insa-rennes.fr	France
Alouini Mehdi	mehdi.alouini@univ-rennes1.fr	France

Type of presentation : : Oral Communication

Domain : Optical properties of heterostructures

Date of submission : 2018-03-03

[400 Words]

Text

The Terahertz (THz) frequency domain is attractive for numerous applications including phonon spectroscopy, radio-astronomy, imaging, sensing and communication. Nevertheless the development of a compact, tunable, electrically driven room-temperature source operating in the THz band frequency [1-5 THz] remains a challenge. An alternative to low-temperature-cooled Quantum Cascade Lasers is the widely investigated photomixing technique which relies on semiconductor antenna fed by two laser fields beating at the targeted THz frequency. When a highly coherent CW emission is mandatory, a single laser cavity sustaining the oscillation of the two required laser fields is a very attractive approach. Indeed, the phase noises of the two optical fields being inherently correlated, the beatnote exhibits a high spectral purity. Following this paradigm, dual-frequency Quantum Wells (QWs) based Vertical External Cavity Surface Emitting Lasers (VECSELs) architectures have been successfully demonstrated [1][2][3]. Nevertheless, because of the inherent homogeneously broadened gain of QWs, the two laser modes suffer from strong coupling making it necessary to lift the spatial degeneracy inside the active medium. Moreover, the frequency detuning remains lower than in Quantum Dots (QDs).

Accordingly, we have been exploring over the past years the benefits of using wider and potentially less homogeneously broadened gain medium such as Quantum Dots. To this aim, InAs QDs are grown on InP (311B) substrate, and characterized by photoluminescence and atomic force microscopy. The density (from 10^{10} to 10^{11} cm⁻²) and the size of QDs are carefully engineered while keeping a 1550 nm emission wavelength. To evaluate the potential of QDs for dual frequency oscillation, a critical parameter is the homogeneous linewidth. It is measured through Spectral Hole Burning (SHB) experiments using two tunable and continuous-wave lasers. In order to be as close as possible to the laser operation conditions, the SHB experiments are performed at high temperature levels and high carrier densities.

In this talk, we will present our preliminary results from Spectral Hole Burning experiments conducted on both InAs/InP QDs and conventional InGaAs/InP QWs. The dedicated homemade measurement apparatus will be presented as well.

This work is supported by the IDYLIC ANR project (ANR-15-CE24-0034-01).

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