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Injection locking of mid-infrared quantum cascade laser by direct microwave modulation

Maria Amanti
Université Paris Diderot, France

Compact laser sources emitting in mid infrared spectral region with stable emission are important for applications in spectroscopy and wireless communication. Quantum cascade lasers (QCL) are unique semiconductor sources covering mid infrared frequency range. Based on intersubband transitions, the carrier lifetime of these sources is in the ps range. For this reason their frequency response to direct modulation is expected to overcome the limits of standard semiconductor lasers. In this context a fundamental requirement is therefore the optimization of the laser cavity in order to fully exploit the high frequency properties of the intersubband dynamics. In this work a new architecture for mid infrared QCL waveguide is presented. This structure reduces microwave losses and increases the overlap of the modulation signal with the active region, compared to a standard design, while preserving the performances of the laser. By merging microwave and semiconductor laser technologies, the laser cavity is embedded in a microstrip line and a flat frequency response up to ~15 GHz for a device operating at 77 K emitting at 9 μm. Improved frequency response of the microstrip device has been exploited to study injection locking of the laser roundtrip frequency. Inter modes laser frequency separation is stabilized and controlled by an external microwave source. Locking frequency range over MHz at 13.7 GHz is demonstrated. Numerical solutions of injection locking theory are discussed and presented as tool to describe experimental results.

Biography

Maria Amanti has completed her PhD at the age of 26 years from ETH Zurich. She is actually Assistant Professor at the University Paris 7 in Paris. She has published more than 20 papers in reputed journals on her active research on quantum cascade lasers (QCL). She has demonstrated leading results in the control and improvement of the performance of QCL emitting in the THz. Her actual interest is the high frequency modulation of mid-infrared QCL towards mode locking of these sources.

ma.amanti@gmail.com