

Development of Single-Mode Wide Tunable External-Cavity Quantum-Cascade Laser at 5 μm

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Quantum cascade lasers (QCLs) are semiconductor light sources based on intersubband transitions in heterostructures. The emission wavelength of these devices can be easily adjusted by modifying the well and barrier thickness, and it becomes possible to cover a very wide mid-IR range using the same material system. This technology is particularly suitable for the realization of compact, high resolution, ultra-sensitive, multi species trace-gas sensor based on absorption spectroscopy. For such applications distributed feedback (DFB) single-mode devices have been used. DFB quantum cascade lasers have been effective for gas sensing, but their relatively narrow tuning range makes them not very versatile devices and reduce their usefulness for spectroscopic research.

In this work the progress of the development and characterization of mid-infrared quantum cascade lasers operated in grating-coupled external cavity configuration is presented (EC-QCL).

To achieve stable, single mode emission in wide range of wavelengths external resonator in Littrow configuration is proposed. EC-QCL system allows broad tuning of $\sim 224\text{ cm}^{-1}$ ($\sim 513\text{ nm}$) at center emission wavelength of 2100 cm^{-1} ($4.8\text{ }\mu\text{m}$). In the experiment lasers were operated in pulsed mode regime at room-temperature with thermoelectric stabilization. Laser facets were coated with high-reflection (HR) and anti-reflection (AR) coatings.

The extensive discussion of further optimization and the potential of external-cavity system design will be described.

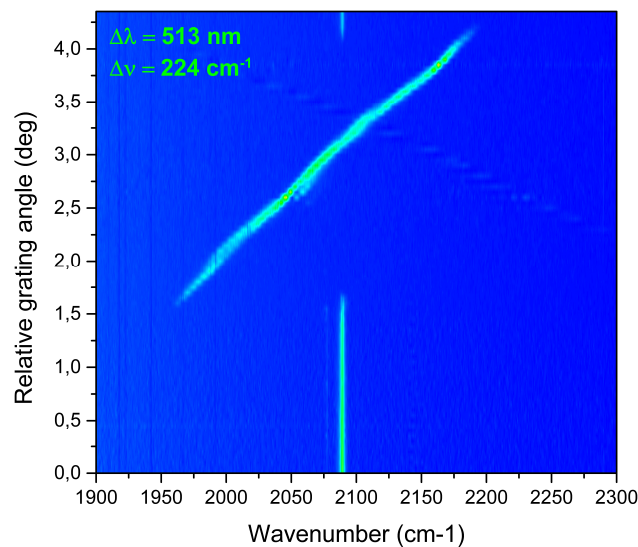


Fig. 1. Map of spectra intensities in function of diffraction grating angle. Image shows tuning range of external-cavity QCL.