EFFECT OF HIGH MAGNETIC FIELD UP TO 45T ON EMISSION INTENSITY OF InAs/AlSb QUANTUM CASCADE LASERS

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Introduction

The application of a strong magnetic field has proven to be a sensitive tool to study electronic structure and intersubband transitions in quantum cascade lasers (QCLs) [1, 2]. In this work we study InAs/AlSb QCLs. Due to the small effective mass in InAs, this system can ultimately yield low laser thresholds and high operating temperatures. However, insufficient knowledge of their electronic structure and intersubband relaxation mechanisms result in poor control of InAs-based QCLs. This knowledge can be drawn from magneto-transport and magneto-optical experiments.

Experimental

Our previous experiments were conducted at magnetic fields up to 30T. This time, we used 45T hybrid magnet in order to reveal possible spin-split effects. We report results obtained for two QCL samples emitting at wavelengths of 4.4μm (D63) and 4.8 μm (D70). Preparation and characterization of QCL structures is described in Ref. [3]. Measurements have been performed in pulsed mode (pulses of ~1μs at ~1 KHz) at temperatures between 5 K and 100 K. Spectral measurements have been performed using the Bruker-66 infrared spectrometer.

Results and Discussion

As was expected after previous measurements, light emission power *P* strongly depends on the magnetic field. When the magnetic field is raised beyond 10 T, pronounced oscillations of *P* are observed. These are due to magnetic field-induced variations of the life-time of the laser transition's upper state. The minima on the *P(B)* curve are attributed to an enhanced non-radiative inter-subband relaxation with LO-phonon emission (intersubband magneto-phonon resonance).

Approximately above 30T , the oscillation pattern is changed, showing a clear beating effect and splitting of oscillation maxima (Fig. 1). At this time, the exact origin of this behavior is still unclear. This could imply the influence of additional elastic scattering mechanisms or the involvement of spin-splitted Landau levels. A detailed analysis of the experimental data and in-depth band structure calculations are currently in progress.

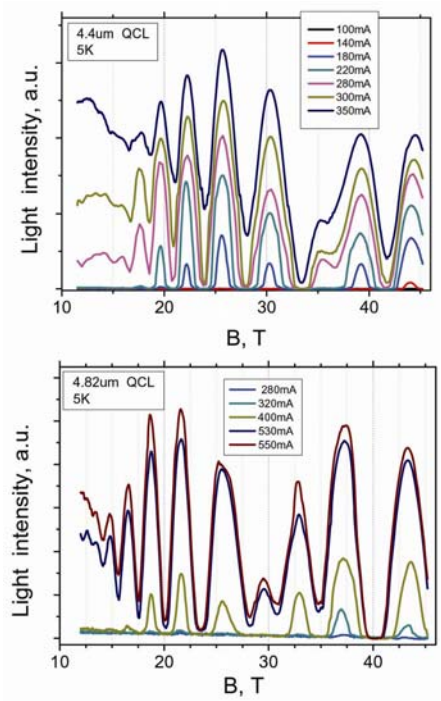

Figure 1. Emission intensity of InAs/AlSb QCLs as a function of the magnetic filed up to 45T.

Acknowledgements

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References

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[2] S. Blaser, *et al.* Appl. Phys. Lett. **81**, 67 (2002)
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