Characterization of Active Region Design High Power Quantum Cascade Superluminescent Emitters

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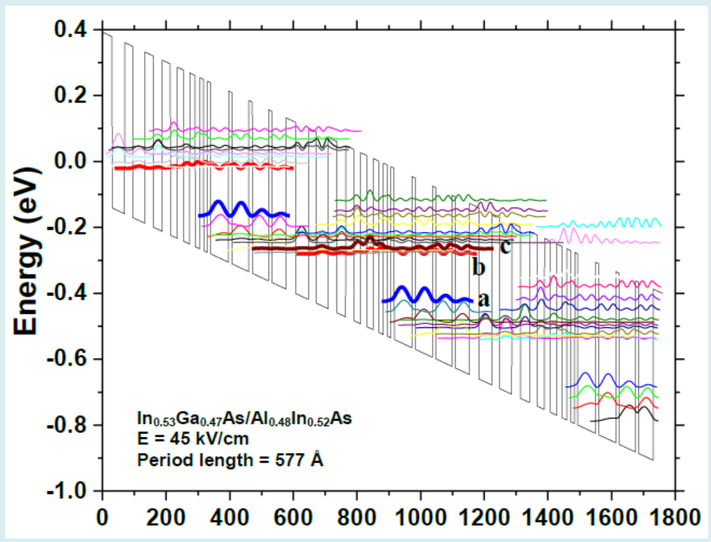
Introduction

A Quantum Cascade Superluminescent (QCSL) emitter with a novel active region design has been developed in our lab[1].

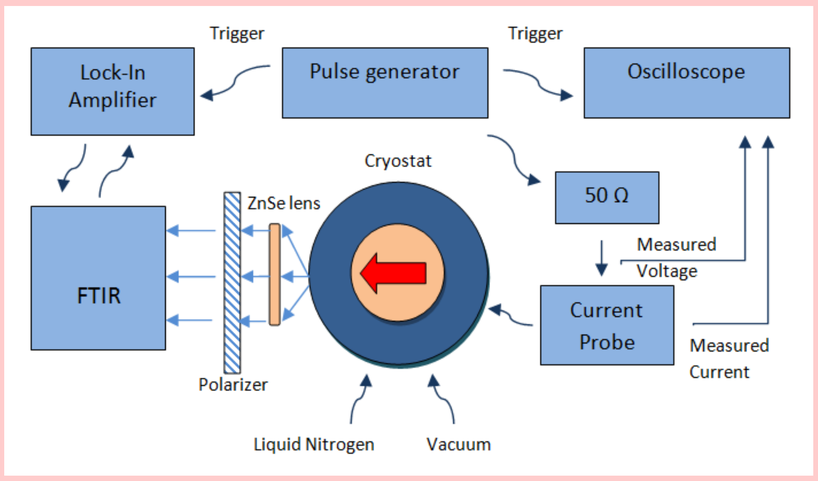


QSCL design characteristics:
- Increased dipole matrix element
- Active region doping for a broader gain
- Wavelength of operation around 8μm

Initial characterization revealed an additional ~5μm peak and current- voltage (I-V) characteristics that arise due to possible growth anomalies.

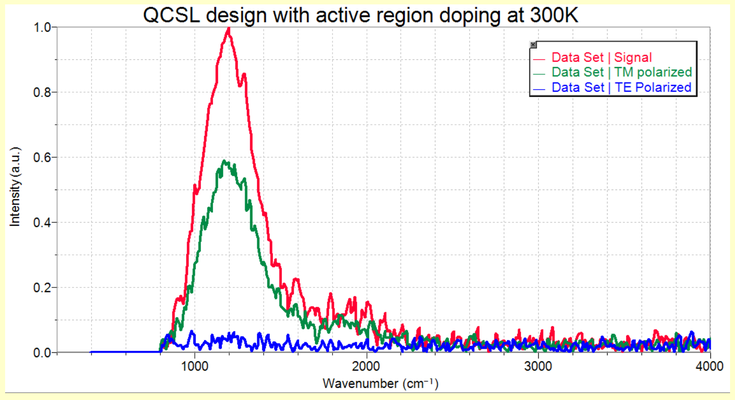
Methods

A Fourier Transform Infrared (FTIR) spectrometer was used to measure the spectra. Measurements were taken at 80K and 300K. Each device was tested with four or five different input currents.



Experimental Results

Polarization measurements

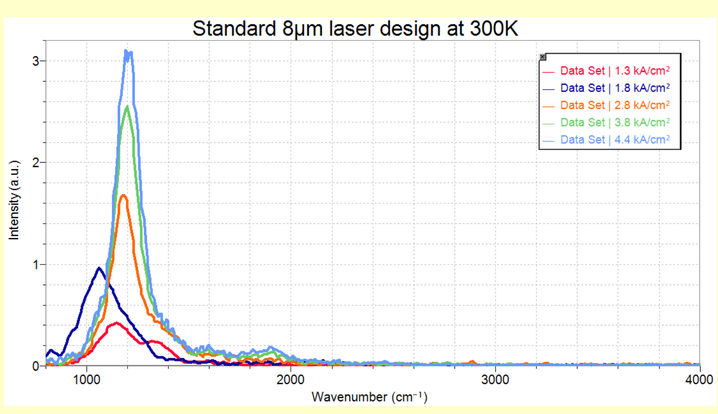


Hypothesis :

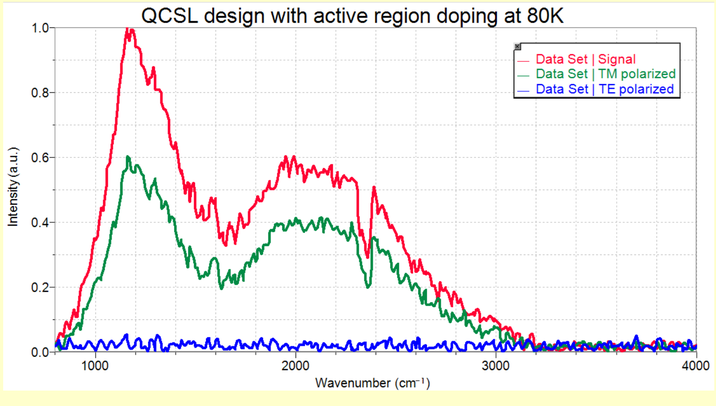
The peak at 5 μm could be due to non-radiative transitions. Heat radiation is not polarized

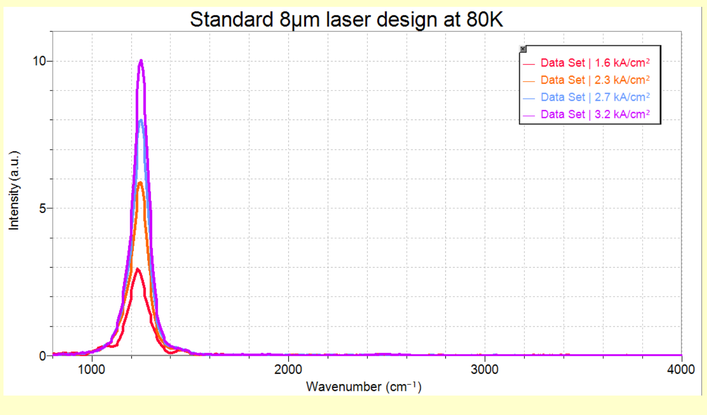
New growth measurements

New mesas are being grown and characterized to rule out growth anomalies.



Polarization measurements can help determine the nature of the transition.





Spectra were taken for a standard 8 μm laser design to evaluate the growth quality.

Conclusions

- Polarization measurements reveal that the shorter wavelength emission is an intersubband (ISB) transition.[2]
- FTIR characterization for the new growth of an 8 um standard design shows a single peak at ~8 um, which is promising for the active region and injector region designs to be grown.

Future Work

- An active region doped QCSL design and a conventional injector region doped QCSL design will be grown.
- Spectral and I-V characterization of the new designs will be analyzed.
- QC superluminescent emitters will be fabricated and characterized provided that, after the analysis, the mesas are well-understood.

References:

[1]Abanti Basak, "*Active Region Design for High Power Quantum Cascade Superluminescent Emitters*" Thesis. Princeton University

[2] G. Bastard, "*Wave mechanics applied to semiconductor heterostructures*" Les editions de physique, Les Ulis, France (1988).

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