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Broadly Tunable External Cavity Quantum Cascade Laser

~ for Hyperspectral Imaging ~

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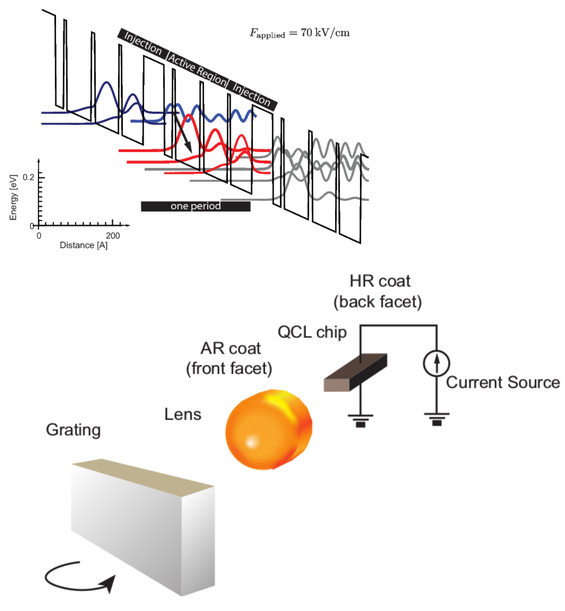
Introduction

Background

Molecular vibrational imaging is attractive for **early stage cancer diagnosis**. For this technique, a **broadly tunable mid-infrared light source** is mandatory, and the **external cavity quantum cascade laser** (**EC-QCL**) will fulfill the requirements for this application.



Longterm Goals

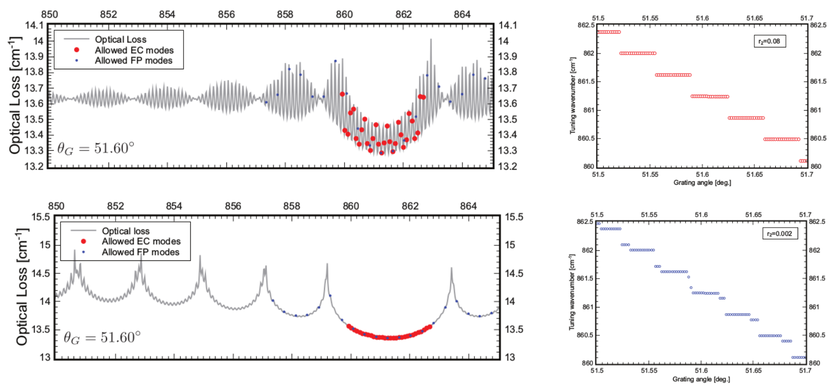
Our aims in Mid-TECH project are,

- High performance **anti-reflection (AR) coating** for continuous tunability
- Design of **wide-gain active region** for broad tuning range
- **Compact and versatile EC-QCL system**

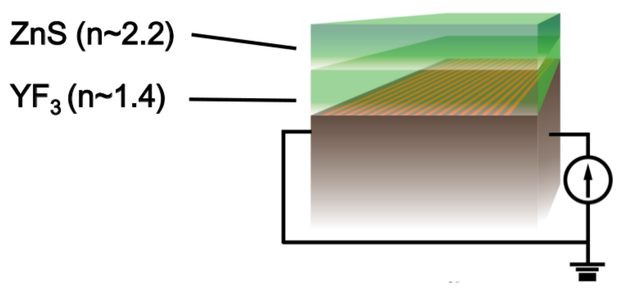
Current Results

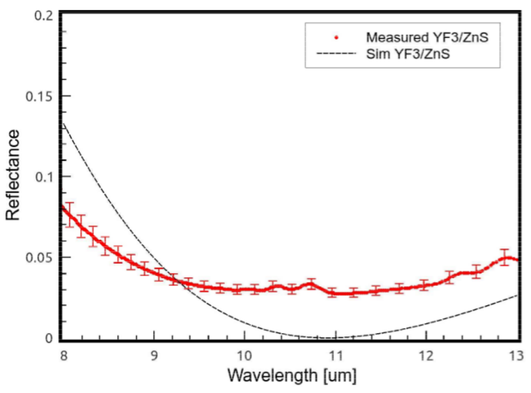
Design & Fabrication of Anti-Reflection Coating

For continuous tuning in EC laser operation, high performance AR coating is required. We designed AR coating for the target wavelength, and demonstrated its performance.



Optical loss with different reflectivity of QCL facet and its tunability:
Lower reflectivity contributes for fine tuning



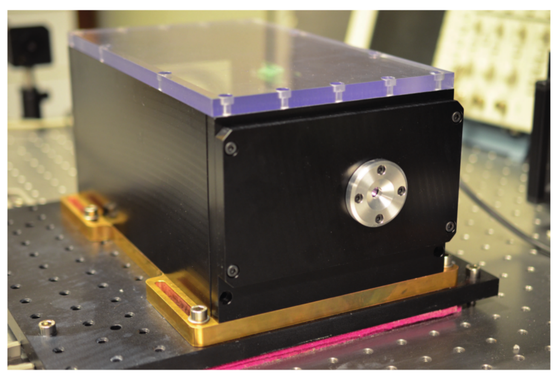


Reflectance of AR coating

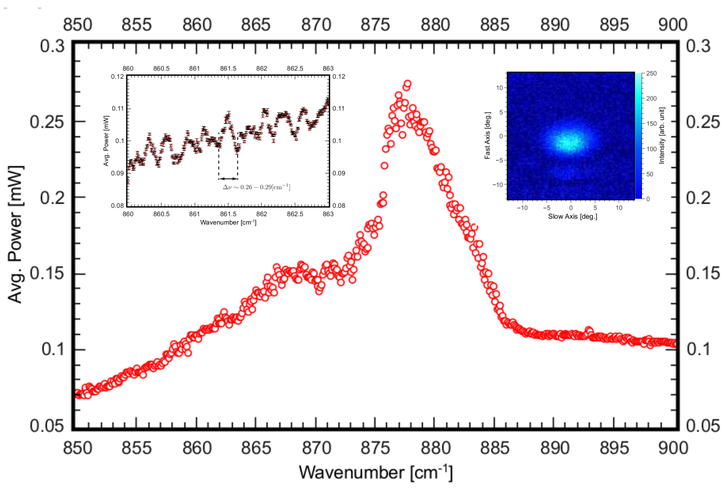
Development of EC-QCL system for the Project

We developed EC-QCL system for Hyperspectral Imaging

- QCL processing for the stable operation
- High quantum efficiency QCL laser
- Tuning range: ~ 11 μm (860-890 cm^{-1})
- Wavenumber resolution: 0.26 cm^{-1}



Laser Head of EC-QCL sytem



P-wavenumber spectrum & beam profile

Planned Secondment

➢ **DTU M27**
Upconversion imaging test

➢ **EXON M33/34**
Demonstration of Hyperspectral Imaging

Future Research Plans

- Multilayer AR coating for higher performance
- Wider tuning range QCL design
- Compact EC-QCL demonstration