

Towards an absolute NH₃ analyzer for ambient applications using an open design to eliminate sampling problems

Jari Peltola¹, Andrea Pogány², Tuomas Hieta¹

Introduction

- The measurement of ammonia in air is a sensitive and priority issue as it has a large impact on the environment and human health
- Ammonia concentration in air is typically in the low parts-per-billion (ppb) range depending on the location
- MetNH3 project will develop and characterise laser based optical spectrometric standards applying extractive and open-path (sampling free) approaches
- The aim is to investigate whether sampling-free spectroscopic measurement techniques are suitable to be used as an optical transfer standard in ambient ammonia measurements

Concept

- Due to reactive nature of ammonia, a significant part of the uncertainty in the measured molar fraction stems from the sampling system itself
- Sampling-free or open instruments are completely exposed to ambient environmental conditions and thus do not suffer from reactive nature of ammonia
- By combining tuneable laser absorption spectroscopy (TLAS) with an open multipass structure, it is possible to achieve absolute and trace level detection of ammonia
- Absolute ammonia spectrometer requires traceable determination of ammonia transition parameters
- The optimal ammonia feature at close to 1103 cm⁻¹ consist of six transitions as shown in figure 1 which need to be characterised

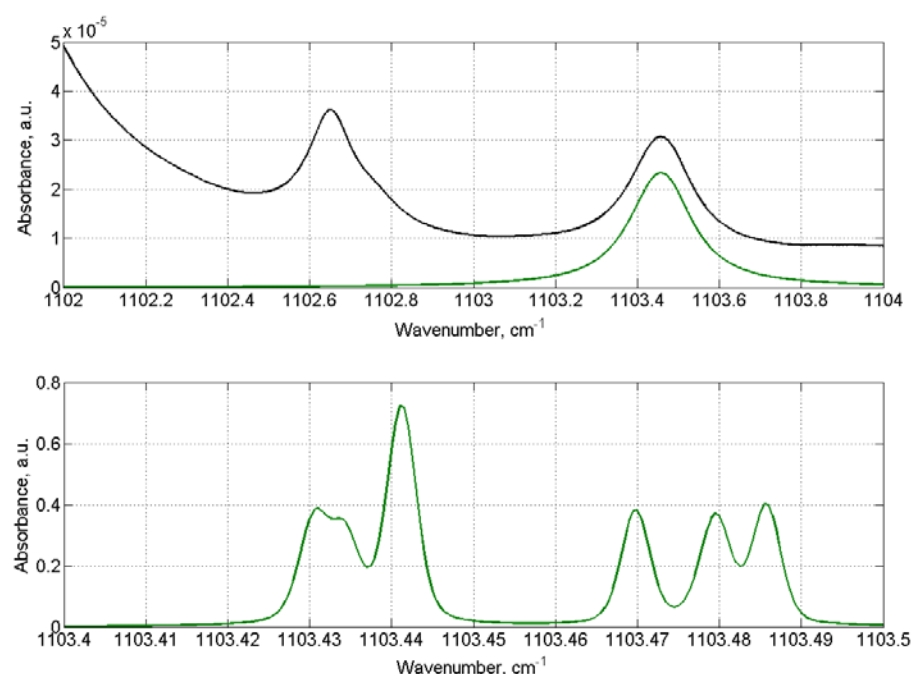


Figure 1. a) Simulated absorption spectrum of 5 ppb ammonia at ambient air around 1103 cm⁻¹. b) Simulated absorption spectrum of 1% ammonia in ambient air for 10 cm path length at 10 hPa.

Instrumentation

- The core of the instrument consist of a QCL, two MCT detectors and a Herriot type multi-pass cell
- Software controlled linear movement enables continuous frequency axis validation using an etalon
- A dither mirror system reduce the problems caused by interference fringes
- Target detection limit below 1 nmol/mol (ppb) using one minute sampling time

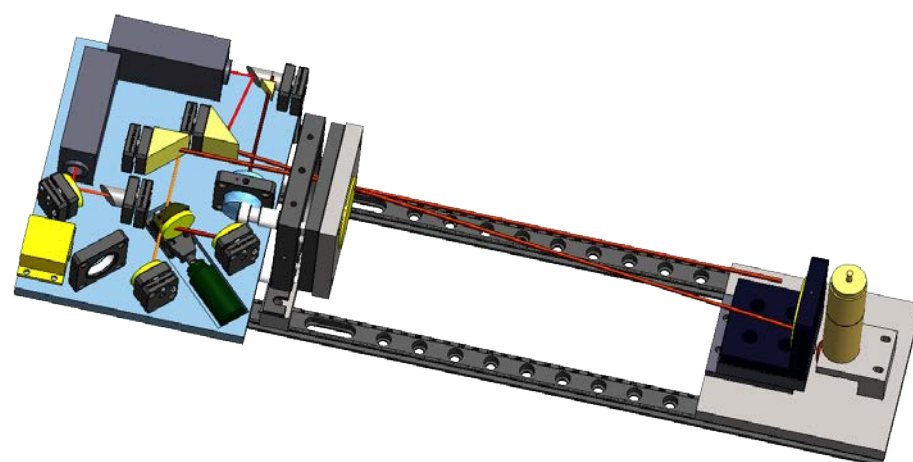


Figure 2. Preliminary desing of the sampling-free spectrometer for ambient ammonia measurements.