The Thermochemical Energy Conversion Laboratory (TEC-Lab) announces thesis work:

**Design and implementation of an advanced Breath Sampler**

TEC-Lab is part of the Department of Applied Physics and Electronics and associated with The Chemical Biological Centre (KBC) at Umeå University. The core mission of the laboratory is fundamental research on thermochemical conversion of (biomass) fuels, but TEC-lab is also concerned with investigating the effects of emissions from (biomass) combustion processes on environment and health. A novel, non-invasive method to assess health effects is to detect molecules with biological relevance (so-called biomarkers) in exhaled breath. Breath analysis for medical diagnostics is a rapidly evolving research field.

The **Applied Laser Spectroscopy Group** within TEC-Lab develops laser-based spectrometers for fast and accurate detection of atomic and molecular species in gas-phase. The optical sensors are employed for in-situ combustion diagnostics in flames and reactors to study ash chemistry or for quantification of biomarker concentrations in exhaled breath.

We are currently constructing an instrument based on absorption spectroscopy using a quantum cascade laser (QCL) for real-time detection of carbon monoxide (CO) in exhaled breath. A QCL is a novel laser source emitting in the mid-infrared spectral region, where many molecular species have strong absorption lines. Exhaled breath CO (eCO) is a potential biomarker for the effects of air pollution on human health. To be able to compare obtained eCO concentrations of the same and between individuals, it is important to standardize the breath sampling procedure.

The aim of the thesis project is to design and test an online sampling system for human breath. The Breath Sampler should comprise a buffer tube, and a capnograph and flow meter for real-time measurement of exhaled CO$_2$ and tidal volume, respectively. A LabVIEW program will be developed that controls the data acquisition and provides audio-visual feedback for patients to keep a constant tidal volume and respiration rate. In a first study to evaluate the eCO QCL sensor, the Breath Sampler will be tested by collecting samples from several volunteers.

The project is suitable for students interested in instrumental design and data acquisition who have experience with programming in LabVIEW and Matlab. The student will have the opportunity to get involved not only with breath analysis, but also with laser spectroscopy and the experimental setup of the eCO QCL sensor.

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