LUND UNIVERSITY | LTH FACULTY OF ENGINEERING

Suggested master degree work within the LTH Profile Area Aerosols 2025

Department of Design Sciences

Degree Project in Aerosol Technology, MAMM05, 30 credits

Low-cost biomass stoves targeted at low-income countries – what are their emissions?

***Contact person*:** Christina Isaxon christina.isaxon@design.lth.se

Project description: Of the 1.1 million deaths in Africa annually due to air pollution, approximately 64 % is caused by Indoor cooking with solid biofuels. Much research and innovation are done to develop less polluting ways of cooking (i.e. more advanced stoves) targeted towards low-income countries, but these stoves are normally too expensive to be a realistic choice for most households. We aim to study two newly developed stoves (one using wood pellets and one using wood sticks) that are sold for only 20-50 USD, and which the producer claims “does not produce any harmful smoke”. This is a laboratory-based project in which the pollution emitted from these stoves shall be measured and characterized in detail, using authentic fuel from Sub-Saharan Africa, and compared to more traditional cooking methods such as open fire or clay stove.

Toxicity screening of particles in real time – laboratory evaluation of novel instrument

Contact person: Aneta Wierzbicka aneta.wierzbicka@design.lth.se

Project description: Reactive oxygen species (ROS) are a group of free radicals which can be either present on the surface of particles or generated through chemical reactions between particles and cells. Exposure to particle induced ROS is believed to be the main toxicity mechanism responsible for the adverse health effects associated with inhalation of airborne particles. Current legislation uses particle mass concentration as a metric, but there is a need for a more health-relevant metric that captures the potential toxicity of the particles. Assessment of ROS has the potential of becoming such a new metric and provides an interesting alternative for pre-screening of particle toxicity. In the Aerosol Laboratory we have built an instrument which can assess ROS on particles in real time (time resolution in minutes) which is a huge advantage in comparison to off-line methods. The thesis work will include laboratory experiments to assess the performance of the newly built instrument and tests on different sources of particles (e.g., secondary organic aerosols, particles from electronic cigarettes, cooking, candles).

Building a vocal folds aerosol generator for respiratory particle investigations

Contact person: Malin Alsved, malin.alsved@design.lth.se

Project description: During the covid-19 pandemic, several superspreading events took place during choir singing. We investigated the exhaled aerosol during singing and it showed that vocalization produces much more aerosol droplets than breathing. This, in combination with an upper respiratory infection (covid-19) that has not yet given rise to any symptoms in the individual, can explain the reason for high transmission during singing and loud talking. This project aims to build a physical simulation of human vocal folds and make them vibrate to generate aerosol droplets. With this vocal chords simulator we can generate more aerosol droplets than with humans and we can also evaluate the effects of liquid

properties on aerosol generation. Project suitable for someone who wants to combine physics with anatomy and some crafty building skills.

Microphysics of exhaled droplets

Contact person: Malin Alsved, malin.alsved@design.lth.se

Project description: Aerosols droplets are formed in our respiratory systems when we breathe and speak, and upon exhalation the water evaporates, leaving a dry solid particle. A large proportion of viruses in these aerosol droplets are inactivated during the drying process, but those that are still infectious in the dry particle often remain infectious for a long time. This project is focused on understanding the microphysics of these complex droplets that contain salts, proteins, lipids, and potentially microorganisms, using microscopy and spectroscopic methods. Thus, it will be a cross-disciplinary project including both laboratory work and theory, with a high degree of freedom and creativity.

A Multi-Assay Approach Linking ROS, Oxidative Potential, and Cell Signaling

Contact persons: Vilhelm Malmborg, vilhelm.malmborg@design.lth.se (main supervisor), Annette Krais (Dept. Chemistry, LTH) and Anda Gliga (KI, Stockholm)

Project description: This master's thesis project will look into the toxicological properties of aerosol particles originating from key anthropogenic sources, including non-exhaust traffic and biomass combustion. You will have the chance to work with existing samples and potentially conduct new field work. This project offers a unique opportunity to contribute to the development of standardized methods for assessing aerosol toxicity. You will be involved in particle extraction and setting up and performing analyses of Oxidative Potential (OP) and Reactive Oxygen Species (ROS) production in our new ROS-TOX lab. You will utilize a range of chemical probes (including DTT, AA, DCFH-DA, BPEAnit) to investigate the role of

different particle constituents in these processes. The optimization and standardization of these assays will be a central part of your work. Furthermore, this project includes an exciting collaboration with Karolinska Institutet (KI) in Stockholm. You will have the chance to investigate how these aerosol particles impact cell signaling pathways in human cells. By cross-validating your findings on OP and ROS production with the cellular responses, you will contribute to a deeper understanding of the toxicological mechanisms and the predictive power of different acellular assays. We are looking for motivated Master's students with a background in chemistry, biomedicine (or related) and some laboratory experience. This project is ideally suited for two students from different disciplines who are interested in collaborative research.

Oxidative Potential of Non-Exhaust Traffic Emissions: Focus on Brake, Tire, and Road Wear

Contact person: Vilhelm Malmborg,
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Project description: With the upcoming integration of Oxidative Potential (OP) into EU air quality monitoring, understanding its sources is more critical than ever. This master's thesis project will focus on a key area of concern: Non-Exhaust Emissions (NEE) from traffic. As traditional exhaust emissions decrease due to technology and electrification, wear particles from brakes, tires, and roads, as well as resuspended road dust, are increasingly recognized as significant sources of air pollution and potentially major contributors to ambient OP. You will begin by participating in carefully designed laboratory experiments to generate authentic samples of brake, tire, and road wear particles. This will provide you with a strong foundation in the experimental methodologies used to study these important non-exhaust emission sources. You will then move to the ROS-TOX lab to investigate their toxicological potential. Here, you will perform a comprehensive assessment of their Oxidative Potential (OP) and the production of related Reactive Oxygen Species (ROS) using established and potentially novel methodologies. We are looking for a

student with background in chemistry, physics, environmental science, or a related field and a strong interest in air pollution, its health effects, and policy.

Occupational exposure to wear particles in a Swedish mine – influence of non-exhaust emissions

***Contact person**:* Joakim Pagels, *joakim.pagels@design.lth.se*

Project description: Efforts to remove tail pipe emissions from vehicle transport are a significant part of the green transition but will likely increase the importance of non-exhaust emissions (NEE), including particle emissions from brake-, tyre- and road wear. These emission sources are generally understood to have a significant impact on human health. However, the sources are both less studied and less regulated than exhaust emissions. This project aims at investigating workplace exposures of NEE, exhaust and other wear particles in a Swedish iron ore mine (1300 m below ground). You will investigate how the transition toward electrification will impact the risk of exposure in the mine environment where ventilation is limited. We have previously conducted similar measures with renewable diesel fuels as the main interest. As a thesis worker, your main responsibility will be to analyze parts of the data from this measurement campaign (size distribution, metal content, particle shape by microscopy)– but there might be a possibility to join during the measurements. The project is funded by AFA Insurance. You will be involved in discussing the results with the social partners (industrial companies, labor unions and regulators).

Department of Physics

Constructing an Optical Tweezer Raman Microscopy system for applications in studying single nanopollutants

Contact person: Kim Cuong Le, thi_kim_cuong.le@fysik.lu.se

Project description: Nano pollutants have gained increasing attention for their potential environmental and health impacts. Among them, black carbon, originating from incomplete combustion processes, poses a significant threat. These ultrafine particles not only contribute to climate change by absorbing sunlight, but also contaminate the air, water, and soil, with detrimental effects on both ecosystems and human health. Raman spectroscopy (RS) is a powerful technique widely employed for structural characterization. However, it typically necessitates thick samples to obtain discernible Raman signals while mitigating interference from substrates. This poses a challenge, particularly for environmental pollutants with low concentrations. Our aim is to facilitate the study of individual nanopollutants by advancing the use of Optical Tweezer Surface Enhanced Raman Spectroscopy. Optical tweezers enable the manipulation of single particles, while SERS shows promise due to its substantial enhancement of inelastic light scattering by molecules, with factors of up to 10^8 or greater. Requirement: The master's thesis work will encompass the initial phase of the project, which involves constructing an Optical Tweezer Raman Microscopy system. The student is expected to possess a foundational understanding of lasers, optics, and programming. A strong willingness to delve into topics of personal choice and interest is essential.

Aerosol sources in the Arctic

Contact person: Pontus Roldin, pontus.roldin@fysik.lu.se

Project description: In this project you will study the sources of aerosol particles in the Arctic. You will learn to run an atmospheric chemistry transport model. The results from the model will be combination with aerosol particle observations during the

ARTofMELT Oden icebreaker expedition and from research stations on Svalbard and Greenland. The aim is to get a better understanding of how natural and anthropogenic emissions of gases and particles influence the aerosol particle concentrations and cloud droplet number concentrations in the Arctic.
Requirement: Some experience and interest in programming. Basic knowledge in atmospheric chemistry and interest to learn more about the formation of atmospheric aerosol particles.

Department of Experimental Medical Science, Medical Faculty

Toxicity and health related effects to ambient particle exposures

Contact person: Anna-Karin Larsson Callerfelt, Anna-Karin.Larsson_Callerfelt@med.lu.se

Project description: Exposure to air pollution may cause development and progression of chronic lung diseases. This project focuses on evaluating the toxicity and health effects of collected ambient particles from Gothenburg and London. *In vitro* lung cell culture experiments with ambient particles will be performed by the student investigating cell viability, oxidative stress, remodeling and inflammatory responses. I*n vitro* data will be linked to *in vivo* data from individuals living nearby where the ambient particles were collected.
External partner: Gothenburg University, Imperial College London
Requirement: The student should have some laboratory experiments working in vitro

Division of Occupational and Environmental Medicine, Medical Faculty

Air quality from point sources in Ecuador

Contact person: Ebba Malmqvist, ebba.malmqvist@med.lu.se

Project description: This project is in collaboration with a local NGO, Accion Ecologica, defending the rights to clean air. They work with communities in Quito affected by living near a waste burning site in Quito and in Amazonia with communities impacted by gas flaring from the oil industry. We have equipped them with local sensors and your project would be to help them with planning of monitoring and analyses of data (with support of course).

External partner: Local NGOs in Ecuador

Requirement: If you can speak some Spanish, it is an asset, but not a must. Need to be able to work with Excel or other statistical programs. An interest in working for and a respect for marginalized communities is a must.