Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER

Agroscope
Nachhaltigkeitsbewertung und Agrarmanagement (NBA)

Masterthesis

Collection and Analysis of Plant Volatile Emission by Metal-oxide Gas Sensors

One of the most fascinating defense responses of plants to herbivore attack is their emission of specific 'odors' to attract the natural enemies of the herbivores [Kessler et al, Science 2001]. The detection of these herbivore-induced odors in agricultural crop fields may allow identification of herbivore infestations at an early stage and enable more effective and environmentally friendly plant protection, e.g. through the targeted release of predatory insects. Currently, identification of the individual organic volatile compounds (VOCs) in the released odors requires time consuming laboratory analyses such as gas chromatography coupled with mass-spectroscopy, which are not the best suited for application in the field. State-of-the-art, commercial VOC sensors based on metal-oxide (MOX) are a potential alternative, where a collection of non-compound-specific sensors may reveal information on the complex mixture, and the typical increase in volatile emission signaling "plant cries for help", using the intrinsic (or engineered) variety in their individual sensor responses.

In this project, the candidate shall investigate how plant emitted VOCs can be measured in-situ using inexpensive, state-of-the-art commercial MOX gas sensors. Towards this goal, the candidate will:

1. Familiarize with the commercial sensor, *i.e.* setup the measurement electronics, and establish a small sensor test environment for reference VOC measurements (e.g. with pure ethanol vapor).
2. Plan a suitable setup to collect plant VOCs with MOX sensors and validate it against standard methodology used for VOC collection, *i.e.* dynamic headspace collection at the University of Zurich (UZH).
3. In collaboration with FiBL and UZH, carry out experiments with maize plants exposed to herbivores.
4. Ideally, analyze the measured time series using different statistical or machine-learning methods.
5. Assist in growing maize plants at Agroscope Reckenholz (Affoltern, Zurich) needed for the experiments.

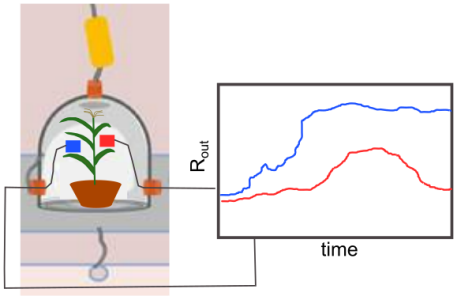
We are looking for a candidate with background in engineering or applied science (e.g. physics, chemistry, biology) with passion for sensors and their data. Further, a hands-on mentality and interest in agriculture will be beneficial. We provide a social working environment and the possibility to smell some farm air.

The project is a collaboration between the "Digital Production" group at the Swiss center of excellence for research in the agriculture and food sector Agroscope, and the "Plant Protection - Entomology & Agroecology" group of the Research Institute of Organic Agriculture FiBL.

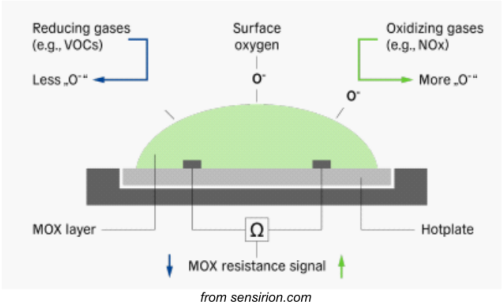
Starting date
Flexible, ideally May 2024.

Application
Please send us an email with a short description of your background and motivation for this project.

Contact
Ralph Stoop (Agroscope): ralph.stoop@agroscope.admin.ch, +41 58 481 91 28
Dani Lucas-Barbosa (FiBL): dani.lucas-barbosa@fibl.org, +41 62 865 04 93



A. Schematic of the envisioned measurement setup for in-situ monitoring of plant VOC emission.



from sensirion.com

B. Schematic of the VOC sensor. VOCs' reaction on the oxide surface introduces a shift in channel conductance of the underlying semiconductor.