Group: Advanced Materials for Chemical Sensitivity (AMCS)
Project: **Porous Nanomaterials for Selective Gas Sensor Devices**
Supervisors: Ellen Dautzenberg, Louis de Smet

Introduction

Control about production processes, medical monitoring or environmental and food safety is an important task in daily life, especially for toxic or polluting gases. To achieve this control, it is necessary to measure the corresponding parameters, so gas sensor applications are of high interest. One of the key challenges of sensor research is related to the topic of selectivity: ideally a sensor ("lock") is sensitive to just one target compound ("key"). Applying a so-called affinity layer to the sensor platform has proven to be very useful in controlling selectivity. Recent developments in the chemistry of highly ordered, porous nanomaterials may further boost this, but the integration of such materials and sensor devices is virtually unexplored.

Goal

This project aims to synthesize and functionalize porous nanomaterials top prepare affinity layers for electrical gas sensors (Figure 1).

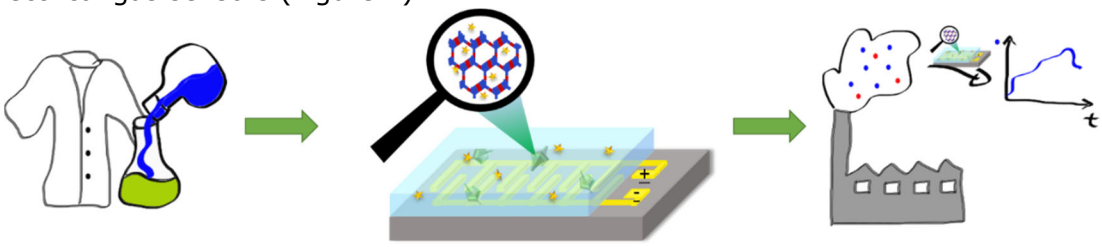

Figure 1. Schematic illustrating (from left to right): preparation of the nanomaterials, a gas sensor device with an interdigitated electrode coated with a porous affinity layer, a sensor experiment on industrially relevant gases.

The aim is to synthesize porous nanomaterials which will be selective to a certain gas. This is partly based on size-exclusion effect, but by functionalizing the building blocks of the nanomaterials the selectivity can be further controlled. The resulting porous nanomaterials will be deposited onto an electrode's surface (here: interdigitated electrode, also known as a "kam-of vingerelektrode" in Dutch) by in-situ growth or by blending them with polymer matrices (mixed matrix membranes, MMMs), respectively. All nanomaterials and coatings will be fully characterized and the sensor devices will be investigated according to their capacitive sensor output. Structural properties of the affinity layer, the effect of the type of polymer matrix and the sensing mechanism will be studied under various controlled conditions using a dedicated gas setup that is available in our laboratory.

Our current focus (early 2019) is on the synthesis of the porous materials and their building blocks as well as on building up the setup for the gas measurements and first measurements of samples.

Project 1 (incl. techniques to be used):

- Synthesis and characterization of porous materials with different functional groups (+NMR, IR, UV/vis);
- Synthesis and characterization of polymer-porous material blends (mixed matrix membranes; PXRD, adsorption studies, XPS, AFM);
- Functionalization of sensor surface with the newly prepared porous nanomaterials.

Project 2 (incl. techniques to be used):

- Measurements of interdigitated electrode with different affinity layers;
- Varying conditions (temperature, gas ratio, pressure, flux) to study the effect on the sensor.

For more information

Ellen Dautzenberg, ellen.dautzenberg@wur.nl, 0317-482375, Helix 7.037.
Louis de Smet, louis.desmet@wur.nl, 0317– 481268 / 82361, Helix 7.034.