A Polyaniline-based Sensor for the Detection of Formaldehyde

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Sensing Materials and Dopants

Sensing Characteristics

- Sensitivity
- Selectivity
- Crystallinity
- Sensing mechanism
- Dopants
Developing a Sensor

- Analyte?
  - Formaldehyde

- Detection limit?
  - 0.08 ppm

- Type of sensor?
  - Microbalance

- Sensing material?
  - Polyaniline (PANI)

- Dopants?
  - NiO and/or Al$_2$O$_3$

Maximum exposure level for formaldehyde over a span of 30 minutes is 0.08 ppm (WHO)

NiO and Al$_2$O$_3$ were chosen to increase both sensitivity and selectivity.
Testing Potential Sensing Materials

Nitrogen (5.0 Grade) → Manifold mixes gases
- Mass Flow Controller regulates flow rate and concentration of gases tested
- Dilute gases in nitrogen (i.e., 5 ppm formaldehyde in nitrogen) used to both test sensing material response and calibrate sensors

Nitrogen (5.0 Grade) → Mass Flow Controller on one side and a Pressure Controller and Flow Meter on the other side ensure a 50:50 split
- Gas passes through a round bottom flask holding a potential sensing material and onto the GC

Test Chamber holds the sensor as well as commercially available temperature and relative humidity sensors

Specialized Gas Chromatograph (GC) capable of detecting very low concentrations (ppb) and separating chemically similar compounds

Water Bubbler to control the humidity in the Test Chamber
Results

- Eight potential sensing materials were tested for formaldehyde.
- Two materials were chosen to be deposited onto the sensor and tested further.

PANI doped with 5% NiO and 15% Al₂O₃ had good selectivity towards formaldehyde.