Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
https://doi.org/10.5194/amt-2022-110-RC1, 2022

Comment on amt-2022-110

Anonymous Referee #1

Referee comment on "Characterization of inexpensive metal oxide sensor performance for trace methane detection" by Daniel Furuta et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-110-RC1, 2022

It is an interesting manuscript, especially to researchers who're building distributed or airborne monitoring systems with MOx gas sensors. Several similar papers have been published in AMT. So, the manuscript is a good fit to the journal. As a former user of TGS26XX sensors, I don't see major technical problems. My specific comments are as follow:

- Why did the authors select a 10-kΩ voltage divider (resistor)? As shown in Figure 2, most MOx sensors had a resistance (R_s) far greater than 10 kΩ during the experiment. From a circuit standpoint, a voltage divider with resistance close to typical R_s values would make the measurement more sensitive or accurate. A relevant question is – why 10-kΩ for all sensors?
- Figure 1: What was the inlet airflow rate? To my understanding, the LI-7810 analyzer has a sampling airflow rate of 0.25 LPM. Did this go back to the testing chamber?
- (Again) Figure 1: What was the response time of the LI-7810 analyzer, considering the length of tubing, averaging time, and so on? Did the authors synchronize the readings from MOx sensors and the LI-7810 by considering response time differences?
- (Again) Figure 1: I saw quite a few capacitors on the PCB. Please briefly explain their purpose (to avoid unnecessary confusion regarding the measurement circuit).
- Please provide the ADC's bit info for LabJack T7. As per the company, a LabJack T7 may use an ADC from 12 to 24-bit. The number of bits can have a large influence on the resolution of acquired data, especially for high R_s
- Line 149: V_s is a bit misleading. It is the voltage drop across the 10-kΩ voltage divider instead of the sensor (R_s). I suggest the authors use a different subscript.
- Equation 2: Even though the sensors are heated, they still suffer from temperature variation, which in turn would influence the sensors' resistance. That being said, why was temperature not included in the calibration equation?
- Figure 2: A side note – The highest R_s we observed for TGS2600 at ~2 ppm was close to 800 kΩ. That was achieved by filtering out all VOCs and water vapors.
- Line 187: As per Figure 2, the relative humidity decreased with an increase in temperature. To me, this is related to the temperature dependency of vapor pressure. I would suggest the authors remove "likely as the result of a condensation and evaporation cycle."

- Line 195-196: I suggest the use of r instead of R for Pearson's correlation coefficients, to avoid unnecessary confusion (R versus R^2).
- Figure 4: Were all the three sensors of the same model coming from the same batch of products? Different batches of sensors could differ in response factors.
- I would suggest the authors offer a discussion about the potential application scenarios of those CH_4 sensors for ambient air and source measurement towards the end of the manuscript.
- A final thought: As per the Figaro Company, the TGS26XX sensors' response is nearly linear (R_s/R_0 versus gas concentration) on a log-log graph. I just feel there could be a calibration equation better fitting the experimental data than equation 2. Here comes a question – why was general linear regression used to build the calibration curve?