sensors-898288

Dual oxygen and temperature luminescence learning sensor with parallel inference

Reply to Reviewer 2

The authors would like to thank the reviewer for the positive feedback and for the constructive questions and suggestions.

Please find below the answer to the single points.

1) There is an approach which detect all parameter of interferences simultaneously on the solid phase absorbance detection for gas analysis. This may be cited. (Analytical Chemistry, 81, 4183-4191 (2019).)

The authors thank the reviewer very much for this interesting paper. We added the citation to the paper.

2) It is not clear about the temperature. Is this for sample gas, sensor , or whole system include sample gas?

The temperature mentioned in the paper refers to the temperature of sample gas in contact with the sample. The text in section 2.2 was updated to make it clearer.

3) Relative humidity may also be effects to the response. Did you concern about RH effects?

Humidity may affect in general affect a sensor response. In this work the effects of RH were not investigated. All the experiments were performed mixing dry air and nitrogen. (The H2O concertation in dry air is according to the supplier below 2 ppm).

4) "AE" is described in the main text. But it was not explained in figure caption. It is better the figure can be understand separately.

Thank you for noticing this. We updated the caption to include a short explanation.

5) It is better to put the basic sensor performance after the optimization. LODs, reproducibility, and response speed?

The authors have developed the new metric described in the paper (Error Limited Accuracy) precisely to quantify the accuracy of the sensor after the optimization (after the training). The LOD was not explicitly tested. The limiting factors for the LOD are the sensitivity of the spot (in this work Pt-TFPP), which is more sensitive in the entire range relevant for bio applications

(Figure 2 of the paper), and the gas mixing device which is currently designed for the range 1% air (saturation) or equivalently 0.2% O2 to 100% air or 20 % O2.

It should not be forgotten that all the results shown in the paper have been obtained by a very large number of measurements and, therefore, when we discuss the distributions of results, we discuss exactly reproducibility (by discussing how wide are the distributions of the results for the AE is). Since we don't have any information on the functional form of the distributions, we decided to give the worst possible results (by giving the maximum value of the Absolute Error in the distributions) instead of only the standard deviation.

The response time of the sensor is due to the sum of two contributions: the actual measurement time of the phase shift and the time needed by the algorithm to calculate the oxygen concentration and temperature. The measurement time for 50 frequencies with our setup was below 1 minute but could be easily improved by reducing the time delays in the communication between the various instruments. The time needed by the algorithm is of the order of milliseconds on a modern computer. This text was added to the paper in section 3.2.

6) Also the sensor resolution on the concentration should be shown. Because the tiny difference of the response by temperature was discussed.

The sensor resolution, described in this paper by the new metric Error Limited Accuracy, is always better than the value $\bar AE$ as described in the article (at line 151). This value is the highest possible error considering all the temperatures and oxygen concentrations used. The sensor resolution may be higher in specific ranges of the oxygen concentration, but this was not studied in detail enough to make a definite statement.