SEMI-QUANTITATIVE CLASSIFICATION OF TWO OXIDIZING GASES WITH GRAPHENE-BASED MULTIPIXEL GAS SENSOR

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Air pollution kills an estimated seven million people worldwide every year[1]. Being able to detect pollution gases, such as NO_2 and O_3, in the air can help significantly to improve our health and well-being. For example, when buying real estate or choosing a route to work in the city. Graphene-based multipixel gas sensors are promising candidates for achieving accurate polluting gas detection in a user-friendly and portable manner.

Individual chemiresistive sensors have limited stability and selectivity, especially for gases with similar chemical properties. This is where machine learning comes in. We use artificial neural networks (ANN) as a model to distinguish small concentrations of NO_2 and O_3 in the air.

We generated synthetic air containing precise amounts of NO_2 and O_3 and measured sensors' responses in it (see Fig. 1). We then trained an ANN model and predicted the five different gas concentrations. The achieved precision, recall and F1-score were all around 90% (see Fig. 2).

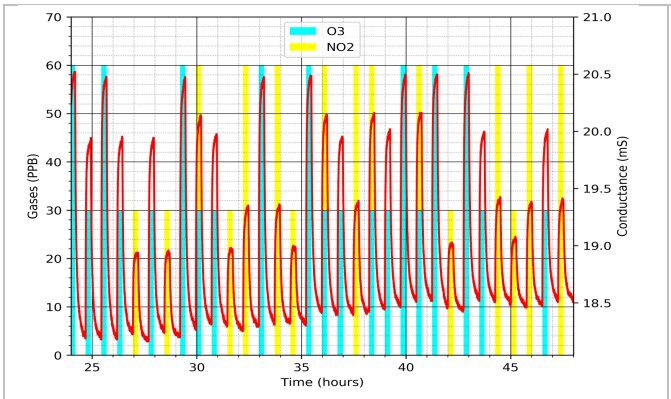

Fig. 1. Responses (red line) of one of the sensors exposed to the five different combinations of O_3 and NO_2. The bar chart indicates the concentrations of the gases.

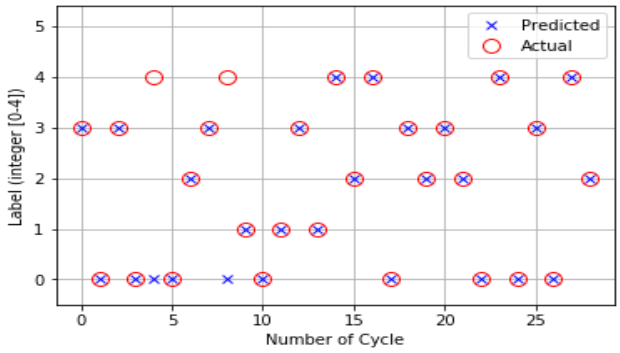

Fig. 2. Predicted and actual gas labels. The duration of one cycle was 45 minutes:

0. 30 ppb of O_3,
1. 60 ppb of O_3;
2. 30 ppb of NO_2;
3. 60 ppb of NO_2;
4. 30 ppb of both NO_2 and O_3.

[1] https://www.who.int/health-topics/air-pollution, viewed 29 April 2021

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