STUDY OF INTERACTIONS OF CHEMIRESISTORS ARRAYS TOWARDS VOCs

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Gas sensors are key elements in many aspects that affect the quality of our life as well as the efficiency of industrial production[1]. Within different classes of gas sensors, resistive gas sensors are found to be one of the most investigated type of electrochemical gas sensors. They gained much attention based on their possibility to be employed under atmospheric conditions, cost efficiency and flexibility in production. Their working principle is based on the change of the resistance that the gas-sensing material experiences once it is exposed to the target analytes. Due to their simplicity and tuneability, many different gases are detectable by this principle. In this work we study and compare the interaction between volatile organic compounds (VOCs) with two different sensor arrays. The first array were made out of four commercial metal oxides (MOx) chemiresistors (Figure 1 a,b,c), while the second one were based on chemiresistors with four tailored organic semiconductors (OSs) (Figure 1,d) as sensitive layer.

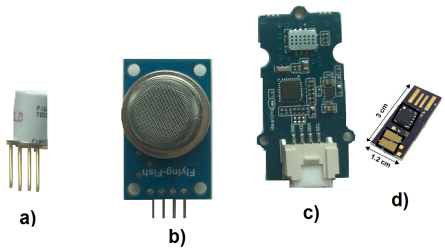

Figure 1: In figure are shown the commercial MOx sensor (a,b,c) and the OS sensor (d).

MATERIALS AND METHODS

The core part of the monitoring system is based on an Arduino UNO microcontroller and connected with four sensors as well as with a temperature and humidity sensor (Figure 2). Arduino is an open-source electronics platform based on easy-to-use hardware and software[2]. The Arduino UNO board is based on the ATmega328 - 8- bit microchip, which has 14 digital input/output pins and 6 analog inputs, which allow the connection of up to 6 different sensors. The open-source Arduino Software (IDE) is a cross-platform Software, whose environment is written in Java and based on an open-source software[2]. Also, Arduino Software contains several libraries that are easily accessible and free, allowing easy programming. During the measurements, which gives the opportunity to plot the signal in real time based on the serial communication. Within the experiments several different OSs were used and the sensors were prepared by casting some microliters of a OSs solution in chloroform on each electrode arrays [3]. Based on the different nature of the different OSs, different responses for our target analytes were finally achieved.

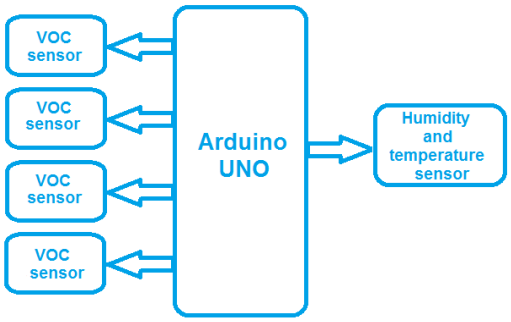

Figure 2: Hardware module of the systems

RESULTS AND DISCUSSION

Commercial MOx sensors usually have a wide detection range between 1 ppm (parts per million) and 1000 ppm. The sensing element is in most cases based on SnO_2. MOx sensors are easily accessible on the market, prices are affordable and according to the datasheets, they own a long stability in time.

In contrast to them, the use of OSs are a promising and already used technology in organic electronic devices. This is mainly based on their intrinsic affinity towards reducing and oxidizing analytes.

In our experiments, we are employed two types of resistive gas sensors: commercial ones based on MOx[3] and some tailor-made sensors on OSs[4]. In both cases, the materials undergo changes in the electrical resistance when interacting with gases and vapors. In order to optimize the sensing responses, we examined the sensing performance under same conditions measuring simultaneously. We employed an array of four commercial MOx sensors and array four OSs sensors. In addition, we monitored the humidity and the temperature in our experiments in order to achieve reproducible results. The arrays behave different due to the diverse characteristic of the sensing materials. The MOx based sensors showed slow operation time due the required pre-heating step, since their operating temperature is in the range of 300 - 450 °C. Once the analyte is removed, this high temperature allows to achieve a full recovery of the signal. The platform made with OSs are faster and more reactive, but in some cases, they have slower and inefficient recovery. For both materials there are still controversial opinions about the charge transfers mechanisms and the resulting sensor signal. With this work we were therefore aimed to establish a simple sensor platform which could be utilized with different sensor types in order to create tailor-made sensor arrays within scientific and industrial applications.

CONCLUSION

In our work we compared the behaviours of two different arrays of chemiresistors towards VOCs. Advantages and disadvantages between sensors based on MOx and OSs will be shown. Further experiments will be performed using other toxic gases like CO, NH_3, NO_2 and the influence of humidity and temperature will be studied.

REFERENCES

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