POTENTIAL OF ETHANOL GAS SENSORS | IN BIOMEDICAL APPLICATIONS

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Abstract. *A major problem in the medical field is detecting one or another disease. To make a fast decision and apply the correct treatment, it is necessary to understand the exact problem. Thus, many researchers respond to the challenge of detecting different diseases beforehand using distinct biomarkers. Various researchers in this field are motivating others to make corresponding sensors and to comply with the actual necessities. In this direction, appealing research is on ethanol gas sensors, which have the potential to show several diseases. While there are multiple technologies for gas sensors, such as optical sensors and electrochemical cell-based with good results, a promising approach could be metal-oxide based sensor.*

Keywords: *gas sensors, ethanol, diagnostics, biomarker, polymer.*

Introduction

Technological progress knows no bounds, because every day a lot of new research comes out. From medical discoveries of the human body to new treatment technologies, an interesting topic remains non-invasive diagnostics. To meet this challenge, a lot of research is being done on biomarkers and their links to different diseases [1–5].

From this point of view, a lot of work is being done on sensors that are able to detect these different biomarkers. A new approach is to develop gas sensors that could selectively detect different concentrations of different biomarkers in order to understand which treatment the patient should follow. Such sensors, being relatively new, have made significant progress in various works. For example, in a similar study [4] a TiO_2 structure with PTFE showed good opportunities for detecting 2-propanol, which is associated with lung cancer, along with butanol. Another study [3] showed an even better opportunity to develop a sensor for both diagnostics and the food industry, a "two-in-one" sensor for detecting ammonia and hydrogen.

However, ethanol is a special case as it is mainly found in various beverages, associated with drunkenness [6] and is not so valuable as a biomarker, although it has recently emerged that it may have some bond to oral cavity cancer to certain percentage and oral auto-brewery syndrome which being a very rare disease somehow can disturb daily life [7].

Ethanol sensors

Ethanol detection structures have been made by different methods and using a variety of different materials. In this paper, data collected from a TiO_2 sensor coated with a special polymer are presented. The data showed that a good response can be observed for ethanol, which can detect 100 ppm ethanol at different operating temperatures. Similar data were presented in a corresponding study by colleagues in a joint laboratory, but on a different structure, ZnO:Ag columnar films [8,9]. The data presented show that the production potential of ethanol detectors is not limited to a particular range of materials and depends on different structures, materials and hybrid materials and many different tuning processes.

Obtained results

For this study, data obtained from measurements on TiO_2-based gas sensors pre-cured at 610 °C, functionalized with noble metal particles and annealed at 450 °C and 430 °C are presented below.

From Figure 1 it can be observed that the value of response to ethanol is about 50% from the value of air applied to sensor, through the same formula from [3,10]. The gas was applied for about 15 seconds, after which a reaction time of 12 seconds was observed, while the recovery time was about 30 seconds. These characteristics may propose a low power sensor for practical applications, however, as can be seen, there is a lot of noise, therefore the data may not always be practical.

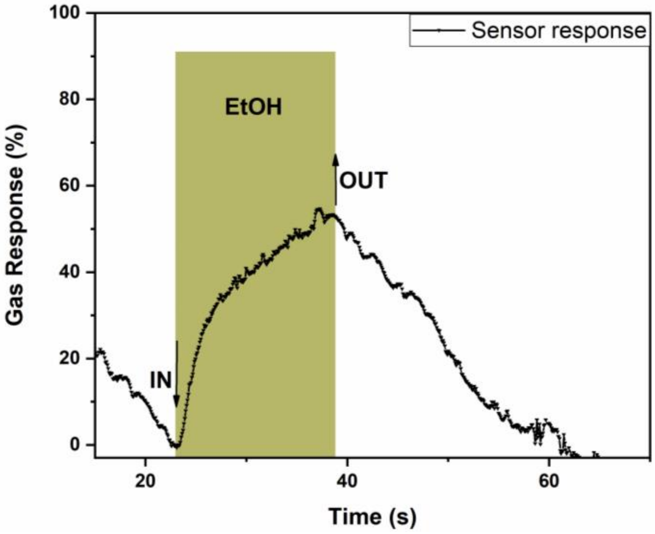

Figure 1. Dynamic response of gas sensing structure based on TiO_2 thin film, functionalized with Ag and Pt nanoparticles, coated with PV4D4 and annealed at 450 °C, at operating temperature of 350 °C to 100 ppm of ethanol

From Figure 2 it can be observed that the value of response to ethanol is about 110% from the value of air applied to sensor, through the same formula from [3,10]. The gas was applied for about 30 seconds, after which a reaction time of 5 seconds was observed, while the recovery time was about 27 seconds. This time the obtained characteristics look smoother and show a better, low-noise, accurate signal as a response to the applied ethanol on gas sensing structure.

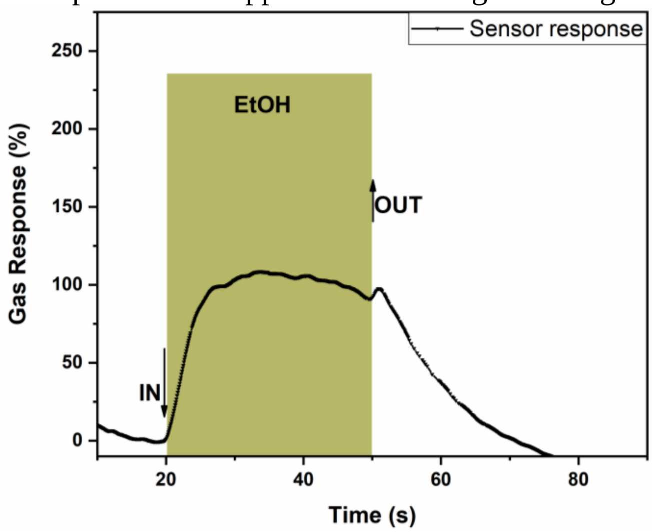

Figure 2. Dynamic response of gas sensing structure based on TiO_2 thin film, functionalized with Ag and Pt nanoparticles, coated with PV4D4 and annealed at 430 °C, at operating temperature of 350 °C to 100 ppm of ethanol

Conclusions

As can be seen, the results of this modest work show that different nanostructures, whether thin films or columnar films, whether specific materials or hybrid materials, it is possible to tailor a sensor in the manufacturing phase to achieve a different gas response. Ethanol has already been known through various other works, but the application of the data obtained in the medical field. Manufacturing a sensor at different temperatures has a very strong impact on the characteristics, so this research will continue step by step with medical research, creating new opportunities for both industry and the medical field.

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