Gas Sensors on Flexible Polyimide, Rigid Alumina and Silicon substrate for the Nitrogen dioxide (NO_2) and Ammonia (NH_3) Gas Detection

Kamran Syed[a], Eduard.llobet[b], Mile Ivanda[a]

[a] Laboratory for Molecular Physics and Synthesis of New Materials, Ruđer Bošković Institute, Croatia

[b] Department of Electronic, Electric and Automatic Engineering (DEEEA) of Universitat Rovira i Virgili, Spain

* Corresponding author ksyed@irb.hr

Gas related accidents such as toxic gas leakage in Industries, carbon monoxide leakage of boilers, or toxic gas suffocation during manhole cleaning continue to claim lives and cause injuries, gas sensors are life. Developing a sensor that can quickly detect toxic gases or biochemical is still an important issue in public health, environmental monitoring, and military sectors[1]. However, conventional gas sensing devices are not widely used due to their high cost of being made with complex machines and electronic devices. In addition, commercial gas sensors have limitations in that they are difficult to use, and have poor portability and reaction speed[1]. Wearable electronics is expected to be one of the most active research areas in the next decade. Today, flexible and stretchable sensing devices are in great demand due to their promising applications in wearable electronics, especially for healthcare industries. People like to use nanomaterials for sensing because their large surface-to-volume ratio makes them highly sensitive[3]. Nanomaterials like Zinc Oxide and Graphene has major role in fabricating flexible gas sensors for the detection of various hazardous gases, including nitrogen dioxide (NO_2), ammonia (NH_3), hydrogen (H_2), carbon dioxide (CO_2), sulfur dioxide (SO_2), and humidity in wearable technology[4].

In this contribution, three different Sensor configuration has been used for the detection of Nitrogen dioxide (NO_2) and Ammonia (NH_3) Gas. Firstly, we use simple and cost effective spray coating method to coat the wearable flexible Graphene/PANI on polyimide substrate working at room temperature. Secondly, the Zinc Oxide NWs were grown by Chemical vapor deposition (CVD) on Silicon substrate, the sensor based on printed circuit board (PCB). In the last we used commercial platinum screen-printed interdigitated electrodes (IDE) substrate to coat thin film of Zinc Oxide and Single wall carbon nanotube (SWCNT), Aerosol Assisted Chemical Vapor Deposition (AA-CVD) and slide coating method were used for coating respectively. Specifically, commercial alumina substrates were used to deposit these nanomaterials. The concentrations tested were obtained by diluting the gases on synthetic air. The NO_2 and NH_3 gas exposure has 10 min pulses of 10,20,30,40,50 ppm.

ACKNOWLEDGEMENTS: I would like to acknowledge CONTEXT (CA17107) for support.

REFERENCES

[1]. Wang, T. et al. A Review on Graphene-Based Gas/Vapor Sensors with Unique Properties and Potential Applications. Nano-Micro Lett. 8, 95–119 (2016).
[2]. Kinkeldei, T., Zysset, C., Cherenack, K. & Tröster, G. A Flexible Gas Sensor for the Integration into Smart Textiles. AIP Conference Proceedings 1362, 245–246 (2011).
[3]. Alrammouz, R., Podlecki, J., Abboud, P., Sorli, B. & Habchi, R. A review on flexible gas sensors: From materials to devices. Sensors and Actuators A: Physical 284, 209–231 (2018).
[4]. Wang, X.-X., Li, H.-Y. & Guo, X. Flexible and transparent sensors for ultra-low NO2 detection at room temperature under visible light illumination. J. Mater. Chem. A 8, 14482–14490 (2020).
[5]. Casanova-Cháfer, J., García-Aboal, R., Atienzar, P. & Llobet, E. Gas Sensing Properties of Perovskite Decorated Graphene at Room Temperature. Sensors 19, 4563 (2019).
[6]. Kumar, R., Al-Dossary, O., Kumar, G. & Umar, A. Zinc Oxide Nanostructures for NO2 Gas–Sensor Applications: A Review. Nanomicro Lett 7, 97–120 (2014).