Flexible reduced graphene oxide gas sensor deposited by electrospray

E. Xuriguera[1,2,3], O. Monereo[1], A. Varea[1], A. Cirera [1]

1

[1] MIND/IN2UB, Electronics Department, Universitat de Barcelona, Martí i Franquès 1, 08028 Barcelona, Spain
[2] IN2UB, Diopma, Materials Science and Metallurgical Engineering Department., Universitat de Barcelona, Martí i Franquès 1, 08028 Barcelona, Spain
[3] DIOPMA S.L., Baldiri i Reixac 1, 08028 Barcelona, Spain
xuriguera@ub.edu

Abstract

In the last decade, flexible gas sensors are a great of interest because of its inherent characteristics such as adaptability and conformability. If these properties are combined with integration of graphene-based material onto these device and low-cost fabrication techniques, like inkjet printing and electrospray, a new generation of sensors with a wide range of applications can be produced.

Inkjet printing technique is one of the most used techniques for flexible electronic printing which really cover the gap between standard thick film and thin film technology [1].

On the other hand, graphene solutions can be used to deposit the material onto a desired substrate and electrospray technique can work under room temperature and ambient pressure, i.e. it does not require vacuum and high temperature equipment, it is scalable, and a wide variety of substrates can be used.

The aim of this work is to present the deposition of carbon-based compounds such as reduced graphene oxide (rGO) film by means of electrospray and show the gas sensing properties of the film.

Interdigitated electrodes and heater resistance, in the backside, were inkjet printed on flexible polyamide film using silver ink. The rGO was dispersed in isopropanol and electrosprayed over silver interdigitated electrodes with a mask to delimit the deposition area (Figure 1).

Structural and morphological properties of the deposits are correlated with the electrospray parameters. Also, it demonstrated that electrospray is a feasible and reliable technique to deposit small- and large-areas of rGO with a good thickness control and spatial resolution.

In order to study the response of the sensors to humidity, two gas tests were performed. The first test consists of twelve pulses with duration of half hour, all of them with a concentration of 50% of relative humidity at room temperature. This sequence allowed us to check detection capacity and study the repeatability and stability of the signal. Figure 2 shows a typical dynamic response of a conductometric gas sensor device [2]. The rGO sensor detects water vapor with a signal drift. Furthermore, all the pulses have an excellent repeatability, except the first one.

In the second test, pulses of relative humidity with different concentration were applied to the device, consisting of four pulses of increasing concentration from 25 to 100% followed by two pulses of 50%. The test was repeated at different operation temperatures. As it can be observed, Figure 3 displays that low temperature, close to room temperature, is enough to achieve a suitable stability and a good sensing response.

In conclusion, low-cost flexible humidity sensors based on rGO can be produced using cost-effective techniques such as inkjet printing and electrospray.

References

[1] P. G. Su et al, Sens. Actuators B **139** (2009) 488
[2] G. Lu et al, Nanotechnology **20** (2009) 445502

Figures

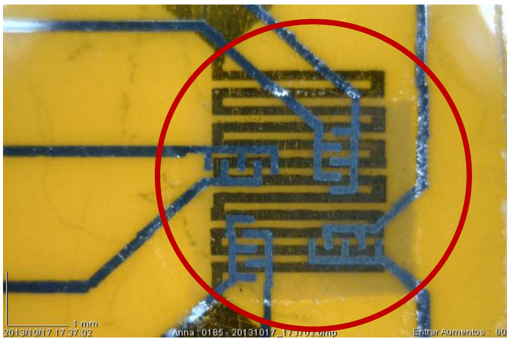

Figure 1. View of four sensor array in top side with the deposit of rGO and heater in the backside

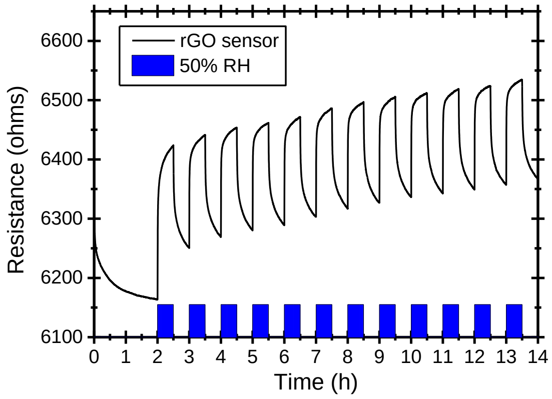

Figure 2. Gas response to pulses of relative humidity of 50% obtained at room temperature.

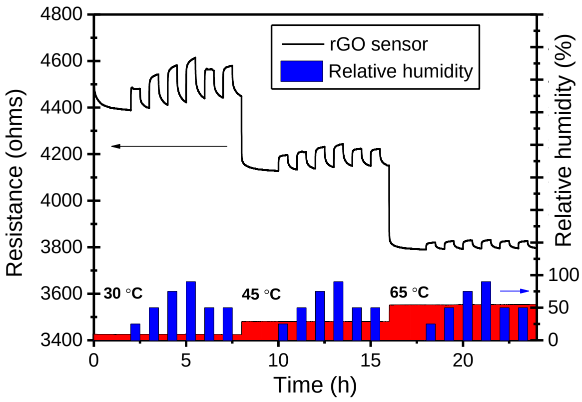

Figure 3. Response of the sensor to different concentration of humidity at different temperatures.