Graphene-based NO_2 gas sensor: Synthesis and Characterisation

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Graphene-based structures have been investigated comprehensively since the discovery of graphene in the last decade. Despite the advantages of chemically modified graphene-based gas sensors, such as low energy consumption and stability in the environment, they still suffer from poor recovery after gas exposure [1]. In this research, a graphene-based NO_2 gas sensor with complete recovery is fabricated. Chemically prepared graphene oxide via modified Hummer's method [2], exposed to hydrazine hydrate at 100 °C, drop casted on alumina substrate with platinum electrodes for conductivity measurement (Figure1). This fabrication procedure results in p-type graphene sheets, with oxygen-containing functional groups shown in the EDX analysis of the samples (Table 1). The response of the sensor is measured as $(R_a\text{-}R_g/R_a) \times 100$, as R_a stands for sample resistivity in dry air and R_g stands for sample resistivity in the presence of gas. The gas sensing results show a high response of 21% to 2 ppm NO_2 at 100°C (Figure 2). The increase in sample electrical current could be attributed to the reduction of graphene sheets in the presence of NO_2 species. Low response time (T_{res}) and recovery time (T_{rec}) and full recovery of the sample exposed to NO_2, is promising for future graphene-based gas sensors (Table 2).

References:

[1] S. Basu and P. Bhattacharyya, *Sensors Actuators B Chem.*, **173** (2012) pp. 1–21,.
[2] D. A. Dikin, S. Stankovich, E. J. Zimney, R. D. Piner, G. H. B. Dommett, G. Evmenenko, S. T. Nguyen, and R. S. Ruoff, *Nature*, **448**, (2007) pp. 457–460.

Figures and Tables:

Table 1. EDX analysis of graphene sheets on alumina substrates.

Element	Weight%	Atomic%
C	7.01	11.22
O	46.25	55.52
Al	46.74	33.27
Totals	100.00	100.00

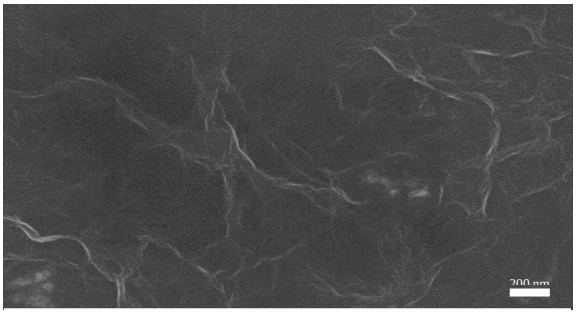

Figure 1. FESEM image of graphene sheets on alumina substrate.

Table 2. Gas sensing characteristics of graphene sheets.

NO_2 gas concentration (ppm)	Response	T_{res}(sec)	T_{rec}(sec)
0.5	1.7445	1447.5	50
1	13.6375	752.5	385
2	21.32	640	517.5

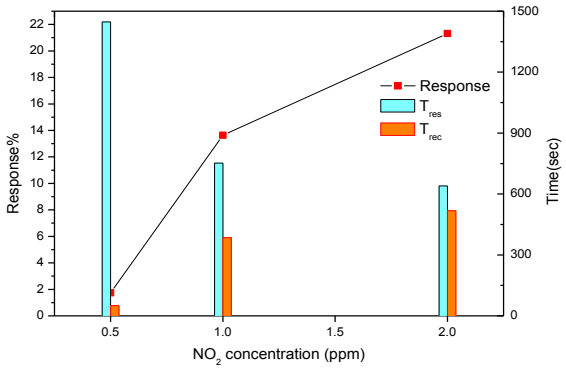

Figure 2. Graphene sheets response to different NO_2 gas concentrations at 100 °C.