





## INTRODUCTION

Carbon nanostructures are studied in great depth because they have unique properties and can be used in many ways. There are many types of carbon, but graphene is one of the most talked-about right now because it has some really great properties [1,2]. Graphene is very good at conducting electricity, being strong, and keeping heat in. The area of graphene's surface is 2620 m<sup>2</sup>. It has a strength of 130 GPa and a Young's modulus of 1 TPa. At room temperature, it has a very high electronic conductivity, and the speed at which electrons can move through it is  $2.5 \times 10^5$  cm<sup>2</sup>/Vs. About 3000 Wm/K is how much heat it moves. The special two-dimensional structure of graphene is made up of a single layer of sp<sub>2</sub> hybridized carbon atoms. Transferable graphene with a single layer A first step in making nano sheets was to mechanically peel off bulk graphite using the Scotch tape method [3]. Nanotechnology is any technology that works on a nanoscale and can be used in the real world. Nanotechnology is made up of. The construction and implementation of physical, chemical, and biological systems on submicron to atomic or molecular scales, in addition to the incorporation of the resultant nanostructures into larger systems in the early twenty-first century, nanotechnology, similar to information technology, semiconductor technology, and cellular and molecular biology, is anticipated to exert a significant influence on both society and the economy. Materials and manufacturing, Nano electronics, medicine and healthcare, energy, biotechnology, information technology, and national security all stand to benefit from nanotechnology research. The fourth industrial revolution is widely regarded as nanotechnology [4].

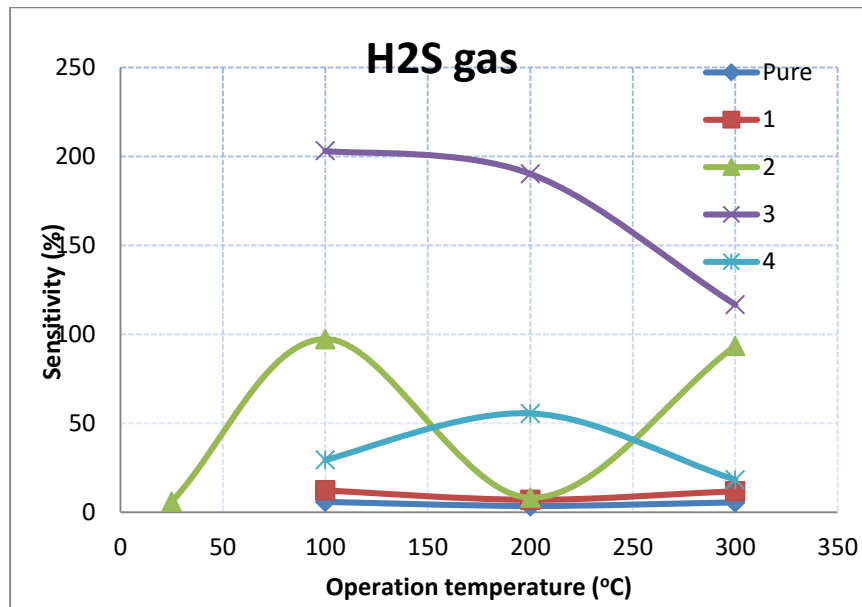
## EXPERIMENTAL

A thin film of Cu:GO was created using the spin coating method at rotation speeds of 3000, 4000, 5000, 6000 rpm and 700 rpm and rotation times of 10 s. In 5 ml of dimethyl sulfoxide (DMSO), 0.1 g of Cu was dissolved. At room temperature, the solution was then applied to a glass slide. To summarize, cleaning the glass substrate is a good way to go. Scrub the surface of the substrate gently with a water-based cleaner to remove any oil or dust that has adhered to it. Rinse for 15 minutes in an ultrasonic unit with distilled water in a clean beaker. The second step is then repeated, but this time the distilled water is replaced with pure alcohol, which reacts with contaminants such as grease and some oxides. The slices are then blown dry and wiped with fine paper. As a research substrate, interdigitated electrodes (IDEs) are used. Detector of Gases The variation in resistivity caused by exposing the thin film surface to gas (H<sub>2</sub>S,NO<sub>2</sub>) is measured. Using this simple and inexpensive method of work, we obtained satisfactory results on high surface energy, high tensile energy, and high adsorption energy. The following tests were carried out: After opening the test chamber, place the sensor on the heater. When necessary, electrical connections are made between the fed pin, the spring-loaded sensor pins, and the thermocouple. When you do this, the test chamber is closed. The circulating pump is then used to evacuate the test chamber. A temperature controller is used to set the required operating temperature of the sensor. Using needle valves, the flow rate of the carrier gas flowmeters is then adjusted and tested. The gas of known concentration in the chamber is allowed to flow into the test chamber by opening the valve. The variance of the sensor resistance is measured for a known concentration of a gas ratio. Digital Mustimeter (UNI-UT81B) PC Testing The digital

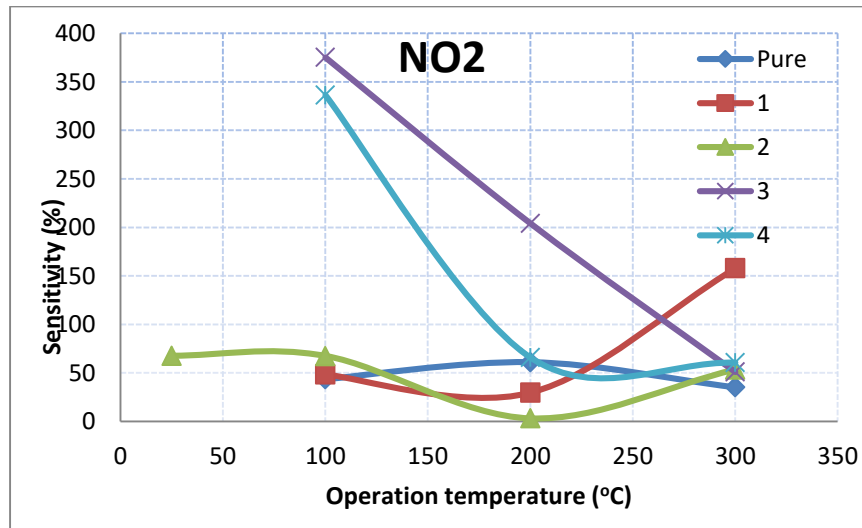




the advantage of operational feasibility at ambient temperatures [9]. The user has provided a numerical reference.

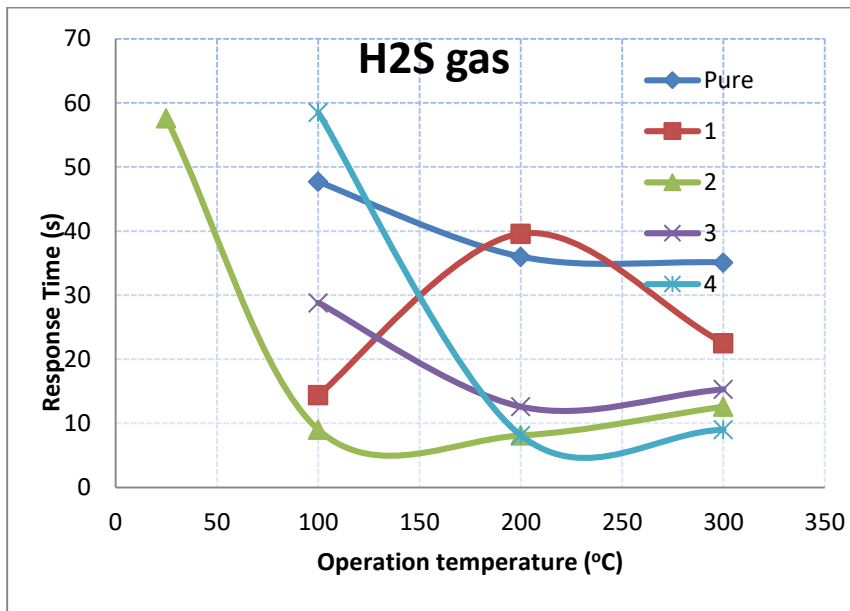


**FIGURE 1.** The sensitivity varies with the operating temperature of the 1- pure Cu<sub>1</sub>% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt , GO 4% wt thin films (H<sub>2</sub>S gas).

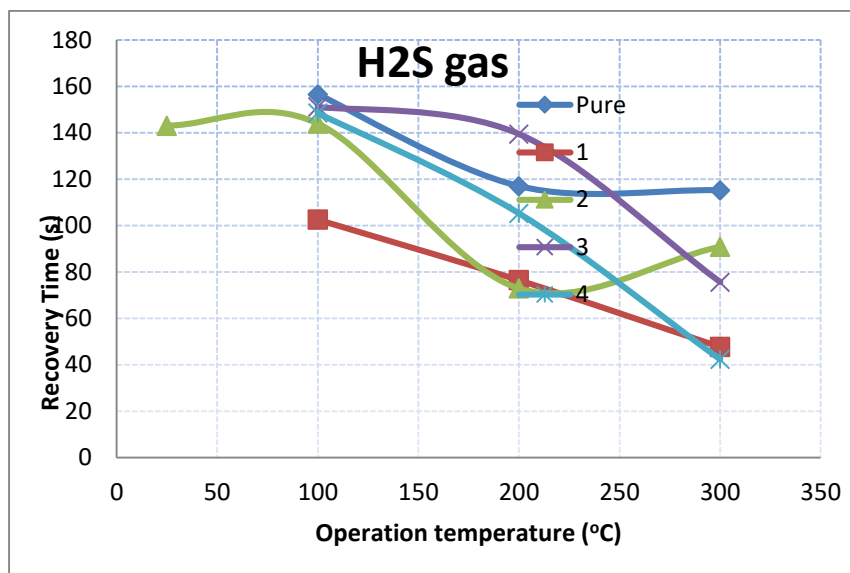


**FIGURE 2.** The sensitivity varies with the operating temperature of the 1- pure Cu<sub>1</sub>% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt , GO 4% wt thin films (H<sub>2</sub>S gas).





**Figure 3a.** The variation of Response time with 1- pure Cu<sub>1</sub>% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt thin films (H<sub>2</sub>S gas).



**Figure 3b.** The variation Recovery time with 1- pure Cu<sub>1</sub>% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt thin films (H<sub>2</sub>S gas).

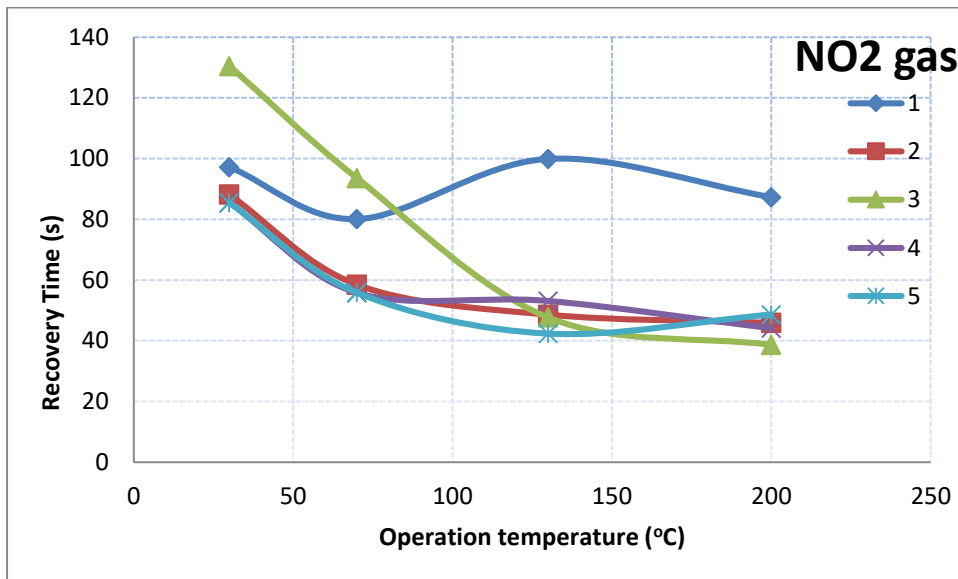


Figure 4a. The variation of Recovery time with - pure Cu1% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt thin films ( NO<sub>2</sub>gas).

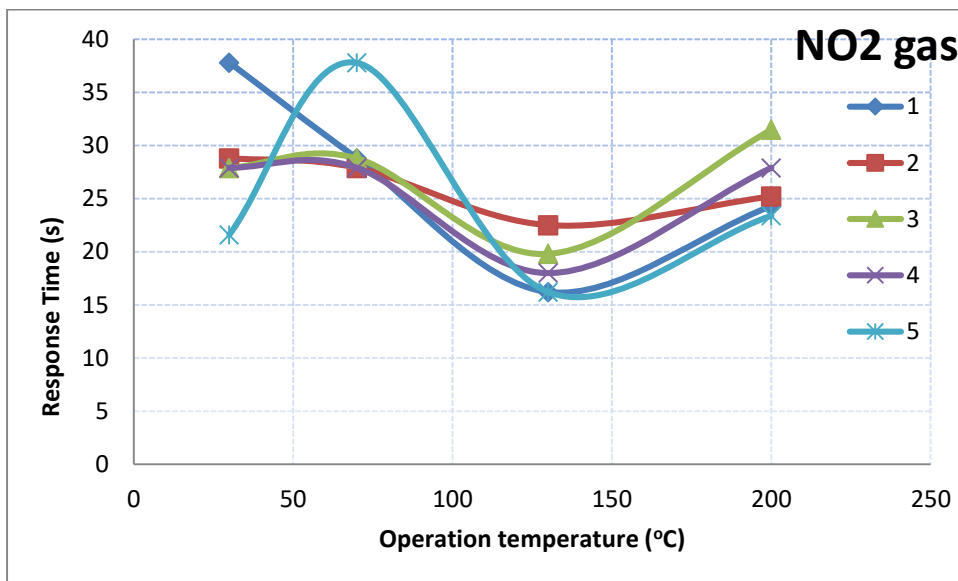


FIGURE 4b. The variation of response time with - pure Cu1% 2- Cu 9% wt, GO 1% wt 3- Cu 8% wt GO 2% wt 4- Cu 7% wt , GO 3% wt 5- Cu 6% wt thin films ( NO<sub>2</sub>gas).





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## الخلاصة

### مقدمة

المادة: أغشية رقيقة نانوية مركبة من أكسيد الجرافين المُطعم بالنحاس (Cu:GO).  
التقنية: الطلاء بالدوران، الذي تم اختياره لسرعته وبساطته وقدرته على إنتاج أغشية عضوية رقيقة متجانسة على ركائز مسطحة

### طرق العمل

متغير العملية: تم تغيير سرعة الدوران بشكل منهجي عند 3000، 4000، 5000، 6000، و7000 دورة في الدقيقة (مع تغييرات مقابلة في وزن/سُمك الفيلم).

الغازات المستهدفة: كبريتيد الهيدروجين ( $H_2S$ ) وثاني أكسيد النيتروجين ( $NO_2$ ).  
ظروف الاختبار: درجات حرارة تشغيل ثابتة تتراوح من 100 درجة مئوية إلى 200 درجة مئوية.

### النتائج

لوحظت علاقة عكسية واضحة بين درجة حرارة التشغيل وحساسية الغاز. انخفضت الحساسية مع ارتفاع درجة الحرارة ضمن النطاق المختبر (100-200 درجة مئوية).

تأثير على حركية المستشعر: أثرت زيادة درجة حرارة التشغيل سلبًا على الأداء الديناميكي للمستشعر: زيادة زمن الاستجابة: استغرق المستشعر وقتًا أطول للوصول إلى أقصى استجابة له عند تعرضه للغاز.

### الاستنتاجات

تُظهر المواد النانوية Cu:GO المُحصَّرة إمكانات قوية كمستشعرات غاز فعالة لغازي كبريتيد الهيدروجين وثاني أكسيد النيتروجين. وقد أثبتت طريقة الطلاء بالدوران أنها تقنية تصنيع ممتازة وقابلة للتطوير لإنشاء منصة استشعار موحدة. تُعدّ درجة حرارة التشغيل معيارًا حاسمًا يتطلب التحسين، حيث إنها تُشكّل مفاضلة: فارتفاع درجات الحرارة قد يُحسن حركية التفاعل، ولكنه في هذه الحالة يُقلّل من الحساسية الإجمالية والاستجابة. يُقدّم هذا العمل منصة واعدة للكشف الحساس والانتقائي عن الغازات، مع تطبيقات محتملة.

**الكلمات المفتاحية:** غشاء رقيق، درجة حرارة التشغيل، الحساسية، مستشعر غاز، طلاء بالدوران