GRAPHENE AND 2DM VIRTUAL CONFERENCE & EXPO
10 ANNIVERSARY
Graphene online 2020
October 19-23

A facile growth of few-layer Graphene using chemical vapour deposition for gas sensing applications

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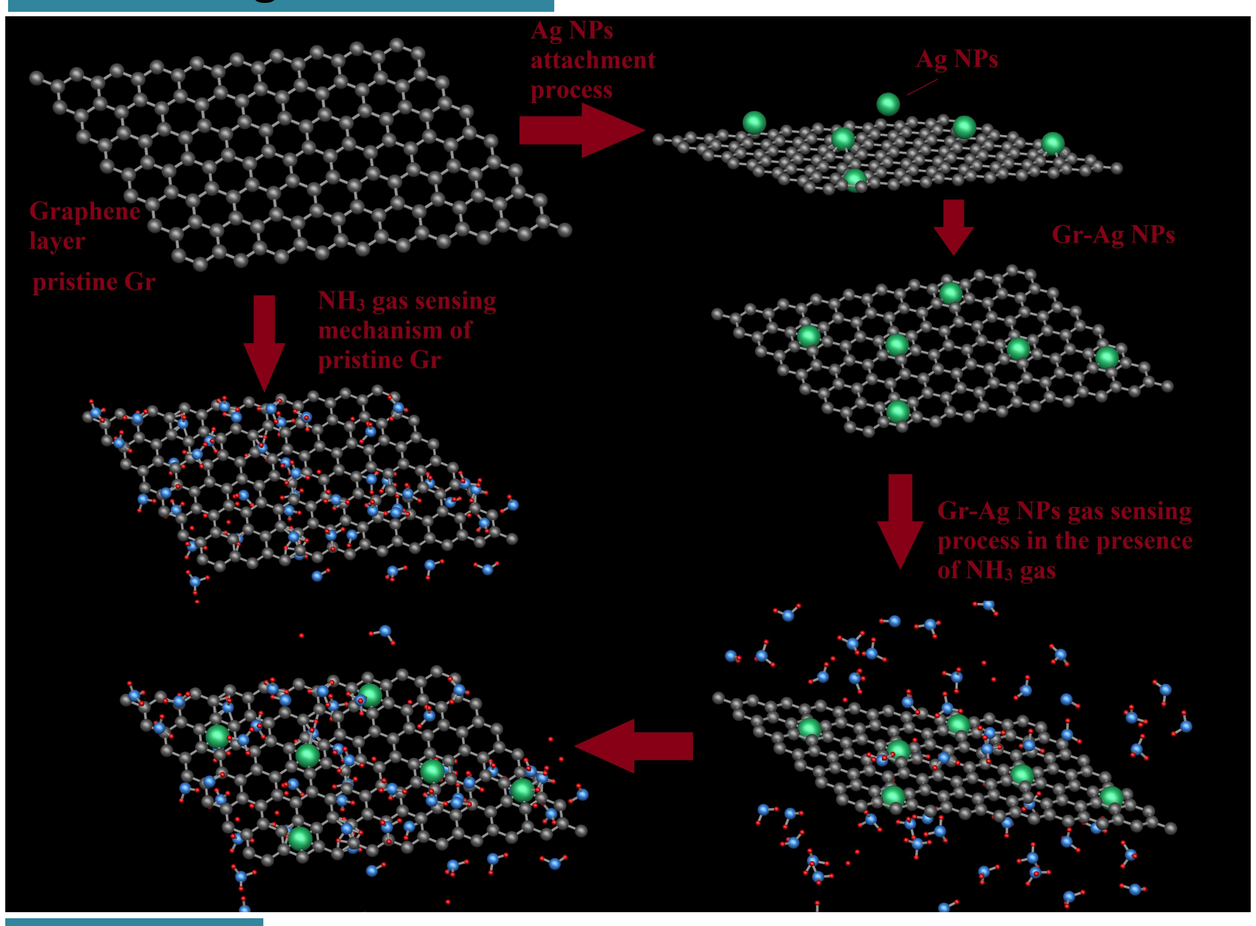
Abstract

A two-dimensional (2D) atomically thin layer novel material called Graphene, having a high surface to volume ratio due to its planar structures in which carbon atoms are arranged in a honeycomb hexagonal lattice [1,2]. Graphene having the large active surface area which is widely useful for gas sensing applications. Toxic gases are harmful to human beings and animal life, to tackle this problem we need a sensor to detects the minutes of gases. In gas sensing process, absorption and desorption mechanism takes place on the surface of Graphene, it is known as surface phenomena [3]. In this work, we have followed the bottom-up approach for the synthesis of graphene using the low-pressure chemical vapour deposition (LP-CVD). We have fabricated the pristine Graphene (Gr) and Graphene-Ag NPs (silver nanoparticles)(Gr-Ag NPs) sensors. In characterizations, we have performed the Scanning electron microscope (SEM) and transmission electron microscope (TEM) for the analysis of morphology and internal structure. Raman spectroscopy, to investigate the quality and graphitic nature along with the electronic properties of the as-synthesized sensors [4]. When analyte particles are attached on the surface of graphene then it changes the electronic properties of the graphene sheet. In gas sensing, we measure the responsivity, recovery time, sensitivity, stability, and repeatability of the as-synthesized sensors.

Experimental Works

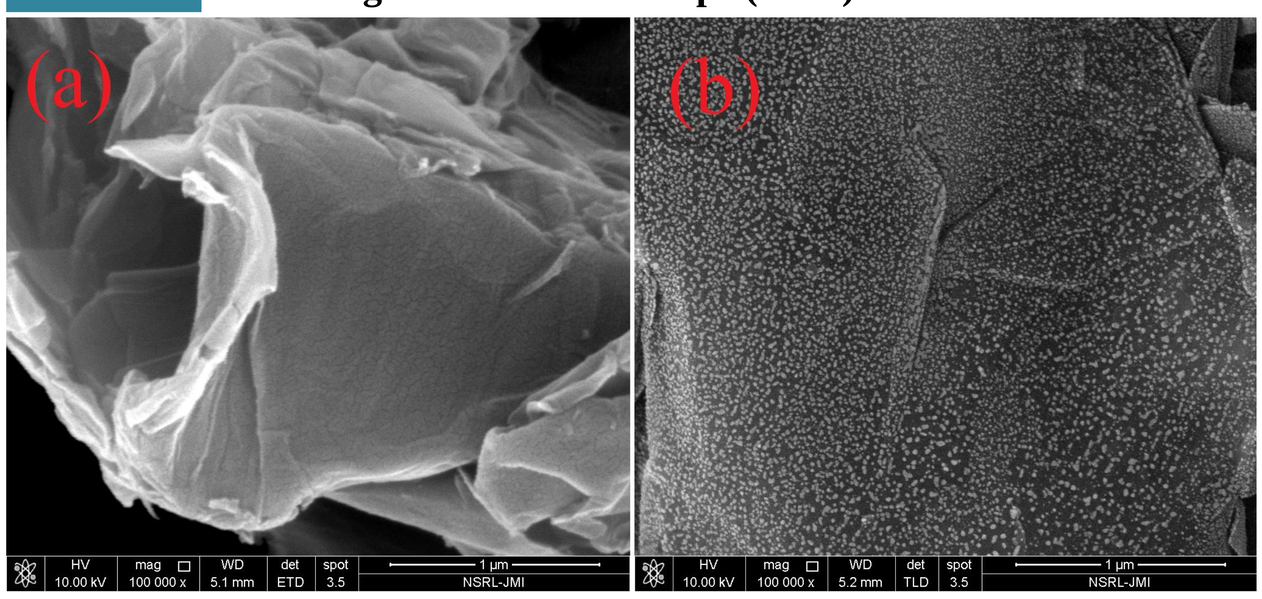
Synthesis of Graphene (pristine Gr) by LPCVD → Ag NPs attached on pristine Gr by Thermal evaporation (Gr-Ag NPs) → Data curation and Gas sensing process in the presence of NH_3 gas

Gas Sensing Mechanism

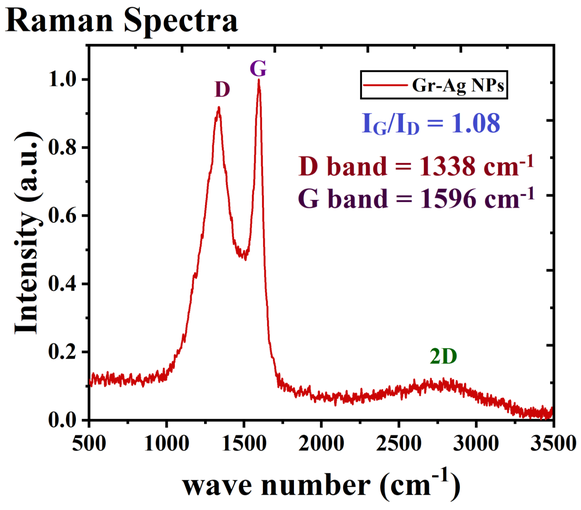


Results

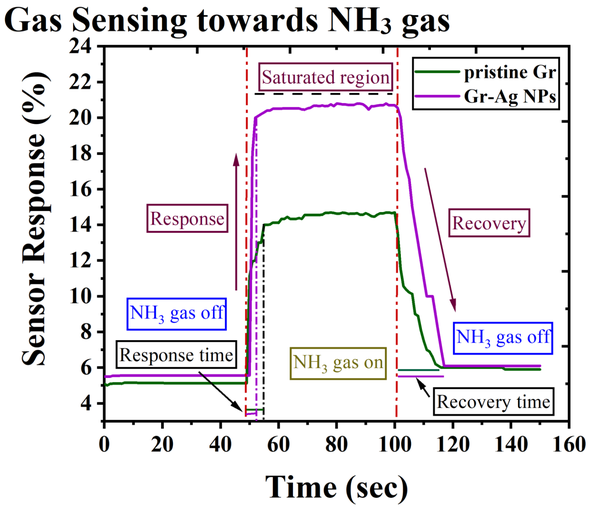
Scanning Electron Microscope (SEM)



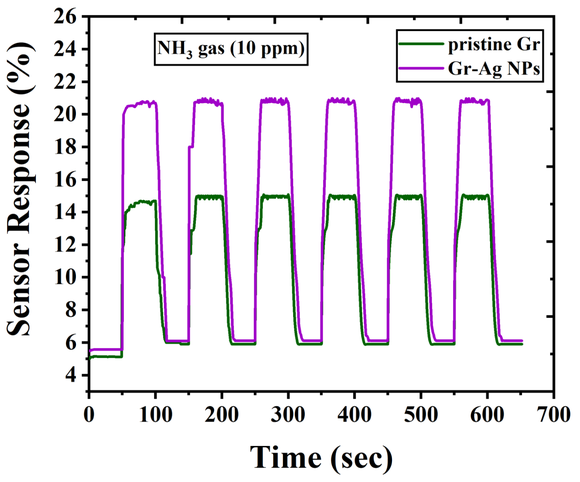
Raman Spectra



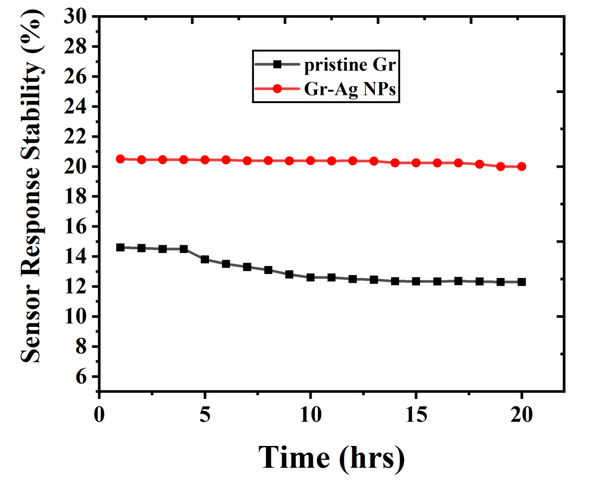
Gas Sensing towards NH_3 gas



Gas Sensing Repeatability



Gas Sensing Stability



Samples	Response time (sec)	Recovery time (sec)	Sensor Response (%)	Stability (%)	
				Mean	S.D.
pristine Gr	5	14	14.5	13.05	0.87
Gr-Ag NPs	3	16	21.6	20.31	0.14

Conclusion

- We successfully synthesized the pristine Graphene (Gr) and decorated the Gr with Ag NPs (nanoparticles) as confirmed by the SEM and Raman spectra.
- Gr-Ag NPs shows the fast sensor response within 3 sec at room temperature towards NH3 gas molecules (10 ppm).
- Future scope of the work Gr-Ag NPs used as a gas sensing sensor device. The sensor response and recovery time, and sensitivity can be tuned by altering the morphology and control the density of Ag NPs on Graphene sheet.

Acknowledgement

Author (J. Ali) thanks to UGC for providing financial assistance in the form of UGC-BSR Start-up Research Grant [Sanction No. F.30-359/2017 (BSR)].

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REFERENCES

1. A. K. Geim, K. S. Novoselov, Nature Materials, 6(2007) 183–191.
2. X. Li, W. Cai, J. An, S. Kim, J. Nah, D. Yang, R. Piner, A. Velamakanni, I. Jung, E. Tutuc, S.K. Banerjee, L. Colombo, R.S. Ruoff, Science 324(2009) 1312-1314.
3. M.Y. Lone, A. Kumar, S. Husain, M. Zulfequara, M. Harsha, Husain, Physica E 87(2017) 261–265.
4. C. Ferrari, J.C. Meyer, V. Scardaci, C. Casiraghi, M. Lazzeri, F. Mauri, S. Piscanec, D. Jiang, K.S. Novoselov, S. Roth, A.K. Geim, Phys. Rev. Lett. 97(2006) 187401–187404.

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