Electrochemical biosensor for glutathione detection in biological fluids using ZnO/reduced graphene Oxide nanocomposite.

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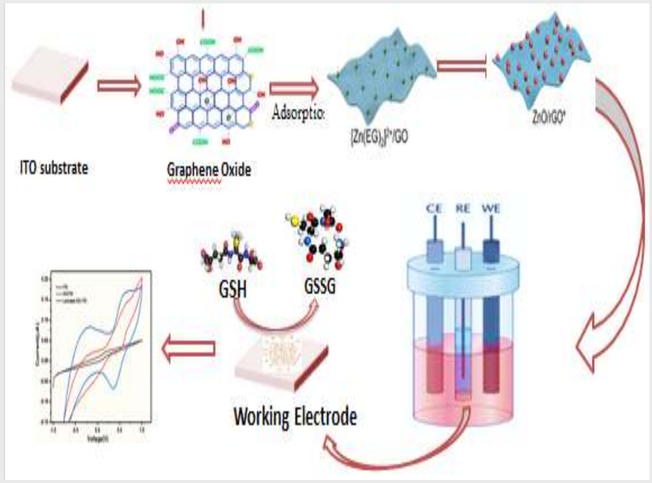
ABSTRACT

Glutathione is a powerful antioxidant found in cells throughout the body. It is a small protein composed of three amino acids: glutamine, cysteine, and glycine. Glutathione plays several critical roles in maintaining cellular health. Herein, we report a novel electrochemical biosensor based on ZnO/Reduced graphene oxide nanocomposite for the detection of glutathione (GSH). Zinc oxide (ZnO) and reduced graphene oxide (rGO) have been extensively researched for a variety of applications because of their interesting physicochemical characteristics. The newly developed sensor exhibits a good response to glutathione with a wide linear range from 0.2µM to 100µM with a limit of detection of 0.2µM with high sensitivity. Additionally, it provides exceptional stability, selectivity, and reproducibility and it is capable of efficiently ignoring interfering candidates that are frequently present in human fluids.

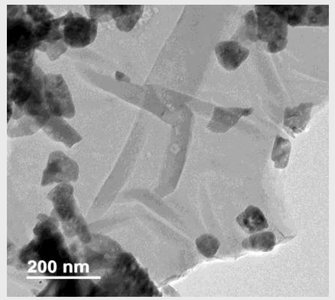
INTRODUCTION

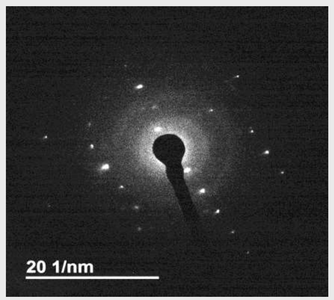
The development of biosensors is receiving a lot of attention in the biomedical field and healthcare fields due to its extensive usage in medicine, clinical care and food processing. Herein, we report a novel electrochemical biosensor based on ZnO/Reduced graphene oxide nanocomposite for the detection of glutathione (GSH). We have synthesized GO, ZNO, ZNO/rGO nanocomposite in this work. The synthesized ZNO/rGO nanocomposite is characterized using techniques like X-ray diffraction (XRD)for crystallographic structure, and Fourier-transform infrared spectroscopy (FTIR) to confirm the presence of functional groups and successful synthesis. Furthermore, the ZNO/rGO nanocomposite was deposited on an indium tin oxide (ITO) substrate by using drop casting method. The study using electrochemical impedance spectroscopy and cyclic voltammetry revealed that the developed sensor has strong electrocatalytic activity toward the oxidation of GSH.

METHODS AND MATERIALS

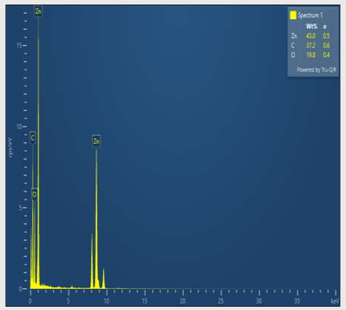


RESULTS

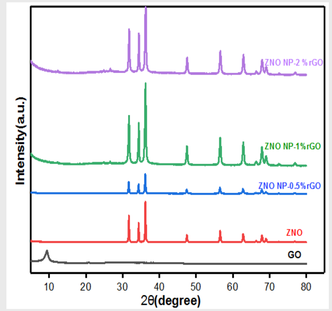




TEM of ZNO/rGO



EDAX of ZNO/rGO

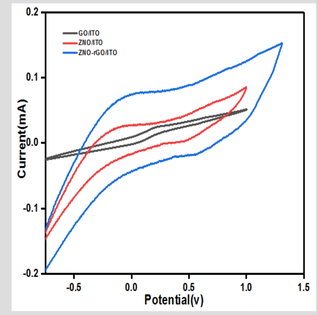


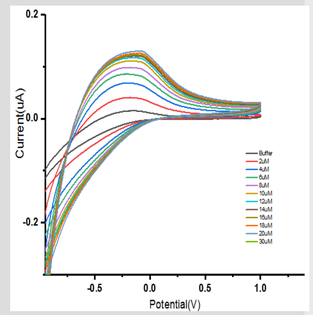
XRD of ZNO/rGO

- The ZnO nanoparticles were implanted on the rGO nanosheet with minimal agglomeration according to the TEM image.
- EDAX spectrum reveals three prominent peaks that stand for zinc (Zn), oxygen (O), and carbon (C). Two additional peaks associated with Zn were detected in the high energy area.
- The rGO/ZnO nanocomposite's XRD pattern shows both the broad peaks associated to rGO and the ZnO related diffraction peaks, suggesting that ZnO retains its identity after integrating with rGO

DISCUSSION

Electrochemical studies on ZnO-rGO/ITO electrodes





CONCLUSIONS

In the present study electrochemical biosensor based on ZnO/reduced graphene oxide nanocomposite is developed for the detection of glutathione. The modified electrode has a high potential for development of novel sensors due to its inexpensive cost of electrode material, simple fabrication method, and high sensitivity to GSH. The findings of this work suggest that GO could be employed as a promising sensing material along with ZNO for detection of GSH.

REFERENCES

a] N. Dhanalakshmi, T. Priya, S. Thennarasu, S. Sivanesan, N. Thinakaran,Journal of Pharmaceutical Analysis (2020)

b] Lu, J., Li, D., Chen, X., Peng, X., Li, J., Yang, Y., Hong, B., Wang, X., Jin, D. and Jin, H., 2022. Journal of Nanoparticle Research, 24(12), p.265.