Ultrasensitive Electrochemical Biosensor Based on Zn/S Graphene Hybrids for SARS-CoC-2 Antigen Rapid Detection

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The Coronavirus disease, commonly referred as COVID-19, is an infectious disease cause by the SARS-CoV-2 virus. Presently, the Quantitative Reverse Polymerase Chain Reaction (qRT-PCR) Method has been implemented as the primary technique used to detect COVID-19 due its capability of providing an early and prompt diagnostic. The following method, however, imposes issues in time effectiveness and selective usage. This leads to the development of an ultra-sensitive electrochemical biosensor based on Zinc Sulfide and Graphene (ZnS/ Graphene) nano composites that would rapidly detected COVID-19 antigens.

The nano composites used within this experiment are developed from a one-step procedure that implements a microwave-based heating approach. The COVID-19 antigens are detected from electrochemical probes designed to find hybridized SARS-CoV-2 Deoxyribonucleic Acid (DNA) samples. In this study, both clinically and laboratory synthesized DNA samples were studied and thoroughly examined. Furthermore, the technique used to perform the following studies was additionally experimented in hopes to determine the most efficient method.

Experimental results revealed that the following biosensor could detect primarily low concentrations of SARS-CoV-2 antigens, specifically the S, N, ORF 1a, and ORF 1b genes, when using a Graphene-based nanocomposite. Similarly, it was determined that the one-step hybridization technique was presented to be the most time efficient. This ultra-sensitive electrochemical biosensor based on ZnS/Graphene, has the potential to lead inspiration for innovating applications within COVID-19 research and future infectious diseases. More details of the research can be found in the authors' published work.

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More details on the work presented in this Highlight can be found in authors' publication [1].

Statement of Research Advisor

The results from this project promoted significant advance in biosensor fabrications, fundamental understanding of interactions between paired DNA molecules and the electrochemical biosensor surfaces. This approach resulted in high sensitivity and selectivity detection of the COVID-19 viruses. It will lead to fast, inexpensive, and facile detection for large biological molecules and biomarkers in the future.
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References

[1] Sarwar, S., Lin, MC., Amezaga, C. et al. Ultrasensitive electrochemical biosensors based on zinc sulfide/graphene hybrid for rapid detection of SARS-CoV-2. Adv Compos Hybrid Mater 6, 49 (2023). https://doi.org/10.1007/s42114-023-00630-7

Authors Biography

Carolina Amezaga is a senior-year student pursuing a B.S. degree in Materials Engineering at Auburn University. She has conducted research under her mentor, Dr. Xinyu Zhang, for two years and has research interests in electrochemistry, plasma-synthesized nanomaterials, and nanobiotechnology

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Xinyu Zhang is a Professor in Department of Chemical Engineering at Auburn University. His work focuses on interfacial science and surface engineering of sustainable, multifunctional nanocomposites, and their applications in electrochemical energy and biosensor related areas. Before Joining Auburn University in 2008, he studied in the Chemistry Department at the University of