Graphene-Driven Biosensing: Functionalized Aptasensors and Immunosensors for Scalable Clinical and Environmental Detection

Dr. Shimaa Eissa
Department of Chemistry, Khalifa University of Science and Technology, Abu Dhabi, P.O. Box 127788, United Arab Emirates
Shimaa.eissa@ku.ac.ae

Graphene and its derivatives have emerged as powerful materials in biosensor development due to their exceptional conductivity, high surface area, and versatile surface chemistry. These properties make them ideal for creating highly sensitive aptasensors and immunosensors targeting clinically and environmentally relevant analytes. A significant component of this research involves immobilization techniques, particularly antibody and aptamer functionalization, which enhance both the specificity and stability of graphene-based biosensors. Such functionalization strategies are critical for reliable detection in complex biological matrices, increasing the clinical and practical relevance of these devices.

This presentation will highlight recent developments in the integration of graphene with advanced materials such as metal-organic frameworks (MOFs) and polymelamine, enabling redox probe-free detection and enhanced signal performance. We will showcase applications targeting COVID-19 biomarkers, Moneybox virus, cancer antigens, glycated hemoglobin, pesticide residues, and other emerging contaminants [1-4].

In addition to performance improvements, this talk will address scale-up challenges, focusing on strategies for fabrication reproducibility, device miniaturization, and translation into portable, low-cost platforms for real-world deployment. These advancements position graphene-based aptasensors and immunosensors as key tools in the future of healthcare diagnostics, food safety, and environmental monitoring.

References

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Figures

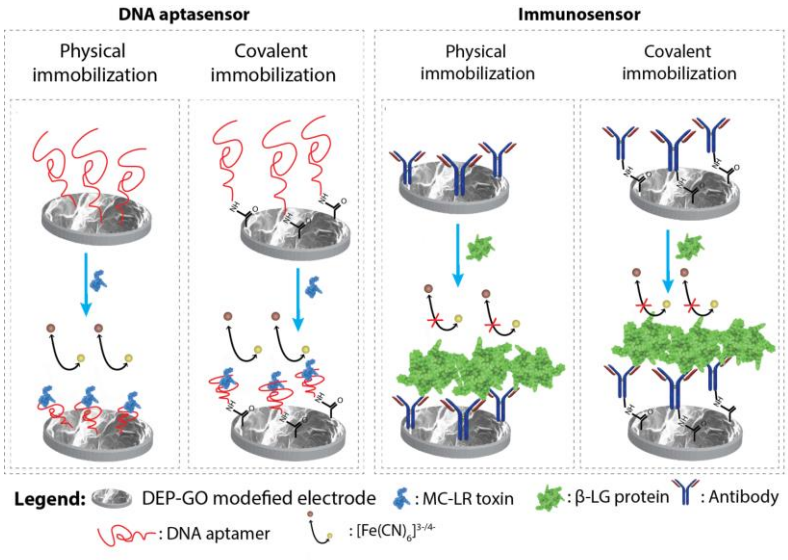

Figure 1: immobilization techniques of DNA aptamers and antibodies on graphene electrodes