PEDOT:PSS modified graphite electrodes developed for electrochemical monitoring of interaction between cyanotoxin and DNA

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Sustainable agriculture is an urgent requirement in the modern era in order to reduce environmental contamination and maximize resource efficacy. Silindrospermopsin (CYN) is a cyanotoxin produced by certain blue-green algae in aquatic environments and can be found in agricultural irrigation water and other water sources. The detection of contaminants like CYN in agricultural water sources is essential for monitoring water quality and ensuring the safety of agricultural products. Investigating the interaction between CYN and DNA can contribute to the efficient management of this contaminant in agriculture and the protection of water quality. The demonstration of CYN's interaction with DNA electrochemically will also shed light on its genotoxic properties.

PEDOT:PSS(poly(3,4ethylenedioxythiophene):poly(styrenes ulfonate)) is a conductive polymer widely used in electrochemical applications [1]. In this study, PEDOT:PSS-modified pencil graphite electrodes (PGE) were used to investigate the interaction between CYN and DNA. After modification of the electrode surface by passive adsorption of PEDOT:PSS, DNA was immobilized on the electrode surface [2,3]. Subsequently, the DNA-PGE surface was then immersed in CYN solution to observe the interaction and conduct electrochemical measurements [4]. The experimental method is illustrated in Figure 1.

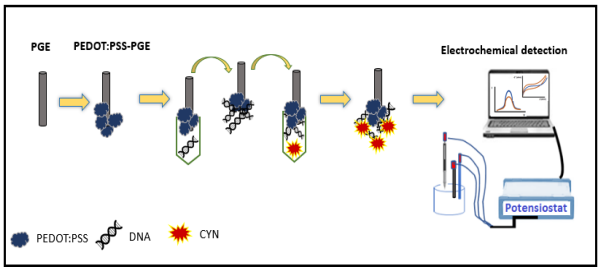

Figure 1. Schematic illustration of the interaction between CYN and DNA at PGE surface.

In conclusion, electrochemical examination of the interaction between CYN and DNA using PEDOT: PSS-modified pencil graphite electrodes was performed for the first time in the literature. This preliminary study of PEDOT: PSS-modified PGE has the potential to revolutionize the rapid and accurate detection of cyanobacterial toxins. These results suggest that this technology can be incorporated into future chip technologies, enabling ubiquitous and efficient toxicity monitoring. It has been demonstrated that a low-cost, disposable, and sensitive toxicity sensor could be developed for environmentally and food-safe sustainable agricultural practices.

References

[1] N. Sinan, E. Unur J. Electrochem. Sci. Technol., 11 (2020) 50-59.

[2] J. Kang, Z. Li, G. Wang, Bioelectrochemistry, 137 (2021) 107647.

[3] E. Kesici, A. Erdem International Journal of Biological Macromolecules, 139 (2019) 1117–1122.

[4] E. Eksin, M. Muti, A. Erdem Electroanalysis, 25, (2013) 2321-2329.

Ece Kesici Meço received her B.S. in Biochemistry and M.S. degree in Biotechnology from Ege University. She is currently a PhD candidate in the Biotechnology program under the supervision of Prof. Dr. Ece Unur Yilmaz. Her research is centred on the development of biosensor systems by using different materials (e.g, PEDOT:PSS, ionic liquid, carbon nanotubes etc.) designed for electrochemical sensing of nucleic acid (DNA, miRNA) hybridization, and the specific interactions between toxin and DNA, and also the development of integrated analytical systems for environmental monitoring, food safety, industry and biomedical monitoring.

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