Università degli Studi di Napoli Federico II

PhD in Biotechnology - 38th cycle

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Development of electrochemical biosensors for the detection of environmental DNA with high sensitivity

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Environmental DNA (eDNA) can be defined as the mixture of complex DNA that all living organisms release into the environment they reside in. These DNA fragments are typically found at ultra-low concentrations. eDNA has often proved to be more sensitive in detecting organismal presence with respect to conventional surveys. [1] Thus, its detection and quantification play an important role in the biomonitoring of rare or hard-to-detect organisms. To date, eDNA qualitative analyses are normally performed following well-known protocols. These consist of a Polymerase Chain Reaction (PCR) coupled with gel electrophoresis, real-time PCR, and high-throughput sequencing. However, as far as these techniques can be reliable and performing, too much work is needed concerning coupling the versatile eDNA-based sampling method with simple, selective, and compact analytical tools in order to achieve a significant cost reduction, scalability, as well as rapid and low-cost analyses. In this scenario, the hyphenation of PCR with electrochemical DNA biosensors and bioassays can offer a simple, compact, rapid, cost-effective, instrumental alternative.[2] Thus, the aim of this PhD project is the development of an electrochemical biosensor for the detection of eDNA. This goal will be achieved by functionalizing the screen-printed electrode (SPE) with a single-strand DNA (ssDNA) probe against the specific target and performing impedance spectroscopy measurements. As further, new 2D materials (the MXenes) will be employed to increase the conductivity of the SPEs and as consequence to improve the sensitivity.

References

[1] A. N. Curtis et al., “High stream flows dilute environmental DNA (eDNA) concentrations and reduce detectability,” Divers. Distrib., vol. 27, no. 10, pp. 1918–1931, 2021, doi: 10.1111/ddi.13196.

[2] F. Bettazzi et al., “A simple and selective electrochemical magneto-assay for sea lice eDNA detection developed with a Quality by Design approach,” Sci. Total Environ., vol. 791, p. 148111, 2021, doi: 10.1016/j.scitotenv.2021.148111.