Integration of smart nanomaterials with advanced nanotechnology for development of nanosensors for water pollution detection

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Abstract

Disposable electrochemical sensors have received special attention in recent years due to the advantages they offer in qualitative and quantitative identification of target analytes. Moreover, they are finding important applications in environment monitoring due to their cost-effectiveness for continuous monitoring. The development of sustainable nanosensors for the detection of environmental pollutants (heavy metals, pesticides and antibiotics), has been a key focus of the SUSNANO project, a Horizon Europe Twinning initiative involving various partners. Over two years of implementation, the scientific research work has concentrated on the fabrication of nanosensors by integrating newly synthesized nanomaterials with advanced nanotechnology, facilitated by complementary collaboration among four partners.

Advanced materials such as graphene [1] and its derivatives (GA, GAN, GCN, GN3, GAFe, etc.), reduced graphene oxide (rGO), and composites of reduced graphene oxide with metal nanoparticles (gold, silver etc.), [2], have been studies and applied to develop nanosensors for environmental pollutant monitoring. Several printing techniques (screen printing, inject printing, laser scribing etc.) [3, 4, 5], have been employed to fabricate nanosensors, particularly for water monitoring in real-world scenarios in Albania (rivers, lakes)

The successful and comprehensive research conducted within the SUSNANO project has significantly enhanced the scientific and innovation capacity of the University of Tirana. This has resulted in two major achievements: first, the establishment of a fully equipped electrochemical laboratory for the production, testing, and application of electrochemical sensors, and second, the consolidation of a specialized research group dedicated to the fabrication of electrochemical sensors for research and application.

References

[1] V. Urbanová, A. Bakandritsos, P. Jakubec, T. Szambó, R. Zbořil, Biosensors and Bioelectronics. (2017), 532–537.
[2] J. Li, Z. Xu, M. Liu, P. Deng, S. Tang, J. Jiang, H. Feng, D. Qian, L. He, Biosensors and Bioelectronics, (2017), 210–216.
[3] C. Giacomelli, R. Álvarez-Diduk, A. Testolin, A. Merkoçi, 2D Mater, (2020), 2053-1583
[4] A. Scroccarello, R. Álvarez-Diduk, F. Della Pelle, C. de Carvalho Castro e Silva, A. Idili, C. Parolo, D. Compagnone, A. Merkoçi *ACS Sens.* (2023), 598−609
[5] M.-A. Nalepa, D. Panáček, I. Dědek, P. Jakubec, V. Kupka, V. Hrubý, M. Petr, M. Otyepka, Biosensors and Bioelectronics. (2024), 256. 116277.