Two-Dimensional Materials (2D) from Synthesis to High-Performance Electrochemical Sensors

Khouloud abid [a,b]
Antonino Foti [b], Ramzi Maalej [c], Pietro Giuseppe Gucciardi [b], Giovanni Neri [a]
[a] *Department of Engineering, University of Messina, C.da Di Dio, I-98166 Messina, Italy*
[b] *CNR IPCF Istituto per i Processi Chimico-Fisici, viale F. Stagno D'Alcontres 37, I-98156 Messina*
[c] *Laboratory of Dielectric and Photonic Materials, Faculty of Sciences of Sfax, Sfax University, Sfax 3018, Tunisia*
abid@ipcf.cnr.it

Abstract
Electrochemical sensors have gained crucial progress owing to the fast evolution of two-dimensional (2D) materials technology. Among them, graphene and its derivatives, transition metal dichalcogenides, and metal oxides are among the most used. To synthesize these materials chemical vapor deposition, mechanical exfoliation, liquid phase exfoliation (LPE), and liquid cascade centrifugation (LCC) are widely used. 2D materials possess unique features like high surface area, excellent conductivity, and tunable electronic structures, which contribute to their remarkable performance in electrochemical sensing. In this communication, we show how 2D materials solutions produced by LPE and LCC can be used to modify commercial screen-printed carbon electrodes (SPCEs) with the aim to improve their sensing performances, boosting the 3S parameters (sensitivity, selectivity, stability) for the detection of biomolecules and environmental pollutants. We report two examples: a SPCE modified with a hybrid-based molybdenum selenide ($MoSe_2$) nanosheets for the determination of dopamine (DA), and a novel SPCE platform modified with a GO:WS_2 nanocomposite for the determination of Thiram fungicide. In the former case, we developed an AuNPs-$MoSe_2$(5 krpm)/SPCE sensor displaying a LOD of 0.21 µM for DA and sensitivity of 2.18 $\mu A \mu M^{-1}$ cm^{-2}, which is 8 times better than the unmodified SPCE [1]. In the latter case [2], GO:WS_2 with a 2:1 v/v ratio provides the best electrocatalytic activity toward Thiram oxidation, with a limit of detection of 0.02µM.
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References

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Figures

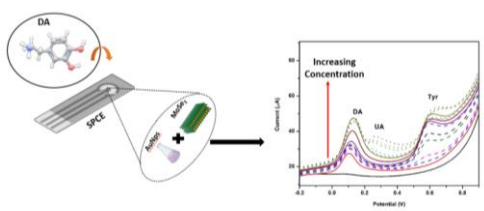

Figure 1: Modification of a SPCE and Linear Sweep Voltammetry curves for the determination of DA.