CARBON BLACK-MOLYBDENUM DISULFIDE NANOHYBRIDS AS ELECTROCHEMICAL TRANSDUCERS

Daniel Rojas[1,2], Flavio della Pelle[2], Michele Del Carlo[2], Dario Compagnone[2], Alberto Escarpa[1,3]

[1]Department of Analytical Chemistry, Physical Chemistry and Chemical Engineering, Faculty of Sciences University of Alcalá, E-28871 Alcalá de Henares, Madrid, Spain.

[2]Faculty of Bioscience and Technology for Food, Agriculture and Environment University of Teramo 64023, Teramo (Italy).

[3]Chemical Research Institute "Andres M. del Rio", University of Alcala, E-28871, Madrid, Spain

jdrojastizon@unite.it

Transition metal dichalcogenides (TMDs) are compounds with a general structure MX_2 where M is a transition metal and X is a chalcogen. These materials possess a layered structure with an X-M-X structure where the atoms form covalent bounds, whereas each layer is linked by Van der Waals bonds. These materials could be easily processed to form 2D nanomaterials using liquid phase exfoliation (LPE) in appropriate solvents. These nanomaterials show unique electrical, optical, mechanical and catalytic properties along with large surface area. In the last years, an intense research about these materials has been carried out being widely employed in energy conversion and storage. However, its properties have not yet been widely and deeply studied for (bio)sensing purposes. In this work a new hybrid nanomaterial is used in a screen-printed electrode (SPE) for sensing the ortho-diphenols oleuropein (OLEU) and hydroxytyrosol (HYT) in extra virgin olive oil (EVOO) and related samples and catechins (CAT) in cocoa samples. The hybrid material consists of carbon black (CB) and molybdenum disulfide (MoS2). In comparison with individual nanomaterials, CB-MoS2 exhibits improved charge-transfer ability, low charge-transfer resistance, high electrical conductivity and enhanced electrocatalysis. The sensor is also characterized by high sensitivity that avoids the use of adsorptive voltammetry and reduces analysis time, as well as high anti-fouling ability (RSD_{OLEU}<8%, n=10). OLEU can be detected in the 0.3 to 30 µM concentration range with 0.1 µM LOD while HYT in the 2 -100 µM range with 1 µM LOD. For the case of CAT, can be detected between 0.12 and 25 µM and LOD ≤ 0.17 µM. A comparison of the data obtained by this sensor and by HPLC-UV in the EVOO and related samples exhibited high correlation (r = 0.995). In the case of cocoa powder samples, were compared with classical methods for polyphenols evaluation as Folin- Ciocalteu (F.C.), ABTS and an AuNPs based assay. The results were significantly correlated with classical methods (r= 0.95–0.97). Noteworthy, after the measurements of 59 cocoa samples the electrode was still active (recovery signal 99 %). These data revealed the reliability of CB-MoS_2 nanohybrids for analysis of complex EVOO and related samples and cocoa powder samples.

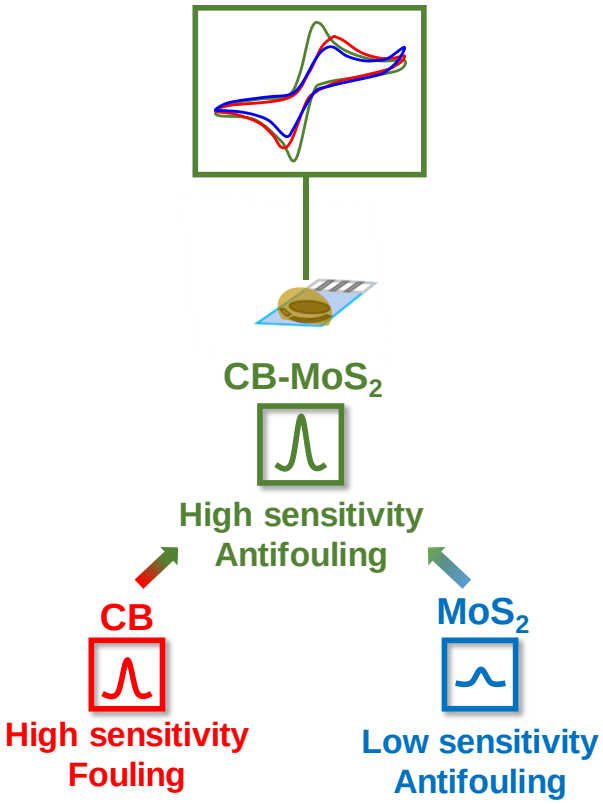

Figure 1: Schematic representation of the electroanalytical properties CB-MoS_2 nanohybrids

References:

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