Electrochemical characterization and electroanalytical applications of RGO-AuNPs Hybrids

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A novel synthetic route for the synthesis of gold nanoparticles (AuNPs) modified graphene electrodes has been developed: Reduced Graphene Oxide (RGO) sheets are functionalized with pyrene linkers acting as growing sites for gold nanoparticles (AuNPs) of different dimensions (approximatively 5, 10 and 20 nm). The Au surface is functionalized with oleylamine or 3,4-dimethylbenzenethiol as capping agents. The hybrid material is deposited onto Carbon Screen Printed Electrodes (C-SPEs) for a deep physico-chemical and electrochemical characterization, using Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS) measurements.

The role played by every single hybrid counterpart has been investigated, showing a synergistic effect, which is responsible of the enhancement of the system properties. The charge transfer from gold nanoparticles to graphene, assisted and stimulated by the pyrene linker, seems to be the key point to understand the peculiarities of this innovative material.

The as prepared RGO-AuNPs hybrids have been used in the electroanalytical detection of both inorganic and organic species (arsenic, H_2O_2, dopamine), showing promising results in terms of sensitivities and detection limits. In particular, regarding the detection of the neurotransmitter dopamine by means of Differential Pulse Voltammetry in Phosphate Buffer Solution, a LOD of (3.3 ± 0.2) ppb has been reached, comparable with other electroanalytical results in the literature and in accordance with the benchmark for this molecule [1]. For arsenic detection, the hybrid devices show increased performances in comparison with bare gold or gold NPs, also allowing speciation between arsenic (III) and (V), appropriately adjusting the experimental conditions. In the case of H_2O_2, the hybrid devices display high electrocatalytic activity and fast electron-transfer kinetics, representing an ideal platform for developing oxidoreductase-based electrochemical biosensors as well as for detecting H_2O_2 in real samples.

[1] J.A. Ribeiro, P.M.V. Fernandes, C.M. Pereira, F. Silva, *Talanta* **160** (2016) 653-679.

Acknowledgements The authors acknowledge the MIUR National Project PRIN 2012 (prot. 20128ZZS2H).