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Electrochemical performance of hybrid electrodes based on graphene and CNW for fuel cells and supercapacitors applications

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Fuel cells and supercapacitor applications could much contribute to meeting the tremendous energy demand of modern society, as they represent appropriate alternatives for electricity generation and storage. In the present work, the performances of new WO3-decorated electrodes for supercapacitor applications were assessed. Tungsten oxide was electrochemically deposited on graphite supports (G), functionalized with either reduced graphene oxide (WO3/rGO/G) or carbon nanowalls (WO3/CNW/G). The electrochemical tests demonstrated that the presence of carbon nanowalls significantly enhances the capacitive performances of these new WO3-based electrodes (the capacitance of WO3/CNW/G, appraised from galvanostatic charge-discharge experiments, was ca. 351 mF/cm2 at an applied current density of 1 mA /cm2), whereas the presence of graphene leads to a less significant increase of capacitive performance (the capacitance of WO3/rGO/G was ca. 71 mF/cm2 at an applied current density of 1 mA /cm2). Based on these observations and on the SEM results (Fig.1), one may assert that the presence of CNW provides mainly better electrical conductivity and enhanced double layer capacitance of the electrode material, mainly due to the morphology adopted by CNW on graphite. Additionally, in view of fuel cells applications, the electrocatalytic activity towards methanol oxidation of these new Pt-decorated electrodes was herein assessed. Platinum nanoparticles were electrochemically deposited on a conductive substrate, functionalized either simply with graphene, (Pt/GR) or with graphene modified with boron-doped diamond powder (Pt/GR-BDDP). The electrochemical tests pointed out that the presence of boron-doped diamond powder (BDDP) into the graphene facilitates the overall methanol oxidation process and provides a better resistance to fouling via CO-poisoning of the electrocatalyst. Additional investigations revealed that the inclusion of BDDP allows a better exposure of the edge planes of the graphene platelets which enables a better accessibility of Pt particles to species from the solution.

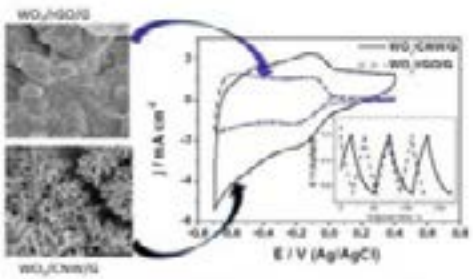

Figure 1: Electrochemical behavior and SEM micrographs of WO3/CNW/G and WO3/rGO/G

Recent Publications

1. Marcu M., Preda L., Vizireanu S., Bita B., Mihai M. A., Spataru T., Acsente T., Dinescu G., Spataru N. (2022) Enhancement of the capacitive features of WO3 supported on pristine and functionalized graphite by appropriate adjustment of the electrodeposition regime. Mater. Sci. Eng. B 277: 115585.
2. Zarshad N., Wu J., Ur Rahman A., Tariq M., Ali A., Ni H. (2020) MnO2 nanospheres electrode composed of low crystalline ultrathin nanosheets for high performance and high rate supercapacitors. Mater. Sci. Eng. B 259: 114610.
3. Spataru N., Calderon-Moreno J. M., Osiceanu P., Kondo T., Terashima C., Popa M., Radu M. M., Culita D., Preda L., Mihai M. A. , Spataru T. (2020) Conductive diamond powder inclusion in dropcasted graphene for enhanced effectiveness as electrocatalyst substrate. Chem. Eng. J. 402: 126258.
4. Guerra A. , Achour A. , Vizireanu S., Dinescu G., Messaci S., Hadjersi T. , Boukherroub R., Coffinier Y. , Pireaux J.-J. (2019) ZnO/Carbon nanowalls shell/core nanostructures as electrodes for Supercapacitors. Appl. Surf. Sci. 481: 926–932.
5. Ji X., Zhang X., Zhang X. (2015) Three-dimensional graphenebased nanomaterials as electrocatalysts for oxygen reduction reaction. J. Nanomater. 357196.

Biography

Loredana Preda is senior researcher at Romanian Academy, Institute of Physical Chemistry "Ilie Murgulescu", Romania. Her research interests lie in different fields of great importance for society like electrocatalysis, supercapacitors and photo-electrochemistry. She has expertise in fabrication of hybrid materials with outstanding features which find applications in different areas of great interest like supercapacitors and fuel cells. The characterization of these active materials (e.g. electrochemical characterization) as well as their performance assessment (e.g. their capacitive performance or their catalytic performance for ethanol/methanol oxidation) is her competence. Her research work is also related to improving bioactivity and biocompatibility of some new alloys (e.g. Ti-4Al-6V-SLM) for dental and orthopaedic applications.

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