Preparation and characterization of MnO_2/carbon nanowalls deposited on stainless steel substrate as electrodes for microbial fuel cells

Miguel Fernández Martín [1,2], Joan Martí-González [1,2] , Fernando Pantoja-Suárez [1,2,3], Islam Alshaikh [1,2], Roger Amade [1,2], José Luis Andujar[1,2], Esther Pascual[1,2] and Enric Bertran-Serra[1,2]

[1] ENPHOCAMAT (FEMAN) Group, Dep. Applied Physics, Universitat de Barcelona, C/ Martí i Franquès, 1, 08028, Barcelona, España

[2] Institute of Nanoscience and Nanotechnology (IN2UB), Universitat de Barcelona

[3] Departamento de Materiales, Facultad de Ingeniería Mecánica, Escuela Politécnica Nacional, Ladrón de Guevara, E11 253, Quito, Ecuador, Address, City, Country

miguelfernandezmartin1@gmail.com

Abstract

Microbial fuel cells (MFCs) are bioelectrochemical systems that can produce bioelectricity from organic matter. Wastewater from urban, domestic or industrial origin can be used as a fuel to produce electricity. In addition, the amount of pollutants and contaminants decreases during the production of bioelectricity [1,2]. Thus, such bioelectrochemical systems produce renewable energy and, simultaneously, can be used as a novel technology for wastewater treatment. However, the efficiencies obtained are still too low and the output voltage of the MFCs need to be increased. In addition, the overall cost of the cell has to be reduced in order to promote this technology into the market. Here, we have studied the growth of graphene nanowalls on stainless-steel substrate 304 (SS), which can be used as electrodes in air-cathode MFCs. Growth parameters have been optimized to obtain vertically aligned and dense carbon nanostructures on both SS foil and mesh. MFCs with different electrodes have been prepared to study the effect of different parameters and to determine whether the presence of carbon nanostructures results in an increase of the electrochemical efficiency. An oxygen plasma treatment has been performed to study its effect on the properties of the electrodes. MnO_2 catalyst has been electrochemically deposited to catalyze the oxygen reduction reaction (ORR) that takes place on the cathode.

References

[1] R. Amade, H. A. Moreno, S. Hussain, M. Vila-Costa and E. Bertran, Applied Physics Letters, 109 (2016) 163904(1-4)

[2] R. Amade, M. Vila-Costa, S. Hussain, E. O. Casamayor and E. Bertran, Journal of Materials Science, 50 (2015) 1214-1220