5th School on X-Ray Spectroscopy Methods
Brazilian Synchrotron Light Laboratory (LNLS)
Campinas, São Paulo, Brazil August 22nd-23rd 2016

Electrocatalytic activity of supported platinum-on-carbide composites for the oxygen reduction and hydrogen evolution reactions

José Luiz Bott Neto[1], Edson Antonio Ticianelli[1]

[1]*São Carlos Institute of Chemistry, University of São Paulo, Physical Chemistry, Brazil*

The growing of the real demand for energy and the depletion of fossil fuel reserves have boosted research and development of new technologies for the production of clean fuel and sustainable sources. Fuel cells are electrochemical devices with large potential to be used in the production of electricity, which meet these requirements. However, there are still challenges that need to be overcome for the optimum practical utility of this technology. In the search for new and more active and stable catalytic materials, tungsten carbides catalysts have emerged as a promising choice for the production of hydrogen from water, as well as an alternative support to be applied in the fuel cell cathode (M-WC/C , M = Pt, Pd, PtNi , PtCo and other catalyst), replacing the carbon.

In this work, the effect of the preparation method of WC/C, W_2C/C, Pt-WC/C, and Pt-W_2C/C electrocatalysts in the catalytic activity for oxygen reduction (ORR) and hydrogen evolution (HER) reactions in acidic medium were investigated. WC/C and W_2C/C were synthesized in an inert atmosphere by a carburization method at 850°C, using WO_3 and WCl_6 precursors in excess of carbon powder (Vulcan XC-72), so to obtain 20, 30 and 40 wt.% of WC/C. In addition, the carbides were used as support for platinum nanoparticles, which were deposited on the substrate employing formic acid as reducing agent. X-Ray Diffraction, Energy Dispersive X-Ray Spectroscopy, Nitrogen adsorption measurement (BET method), Transmission Electron Microscopy, X-Ray Absorption Spectroscopy, and Cyclic Voltammetry were employed to physically/electrochemically characterize the synthesized catalysts. Finally, the electrocatalytic activity towards the ORR and HER were investigated in acidic medium using the Thin-Film Rotating Disk Electrode Technique.

Results show that the pure tungsten carbides (W_2C and WC) are active for the HER, but they present poor activity for the ORR, with W_2C being more active for the HER than WC. On the other hand, materials containing platinum, particularly Pt-WC/C, resulted more active for the HER and also for the ORR, as compared to a standard 20 wt.% Pt on carbon (Pt/C) catalyst.

Keywords: Fuel Cells, Carbides, Electrocatalysis, Oxygen Reduction Reaction, Hydrogen Evolution Reaction.