PROTON EXCHANGE MEMBRANE FUEL CELL (PEMFC)

[1]Linardi, M.; [1]Spinacé, E.V.; [2]Saliba-Silva, A.M.; [1]Silva, D.F.da; [3]Fungaro, D.A.; [3]Cunha, E.F.da; [3]Ayoub, J.M.S.; [1]Aricó, E.M.; [1]Oliveira Neto, A.; [1]Bueno, S.A.A.; [1]Frey, T.; [1]Franco, E.G.; [1]Baldo, W.R.; [1]Santoro, T.A.B.; [1]Negro, M.L.M.; [1]Vasconcellos, T.R.R.; [1]Silva, R.W.R.V.da; [1]Santos, A.R.dos

[1]Programa Célula a Combustível - IPEN/CNEN-SP; [2]Centro do Combustível Nuclear - IPEN/CNEN-SP; [3]Centro de Química e Meio Ambiente - IPEN/CNEN-SP

Keywords: fuel cell; membrane electrode assembly (MEA); platinum-based electrocatalysts; nanoparticle.

Objectives: The Proton Exchange Membrane Fuel Cell (PEMFC) Group aims the basic and technological developments of low power fuel cell for the direct oxidation of hydrogen, methanol and ethanol, concerning stationary applications (micropower), that means, distributed electric power generation. These includes: synthesis of components of PEMFC and its characterization; Membrane-electrode-Assembly production and optimization; unit cells tests in laboratory scale; development of low power fuel cell stacks; development of new methods for electrocatalyst production and characterization and, finally, education in related fields. Realizations in 2002/2004: Start of operation of a 4 unit PEM cells workstation. Determination of optimal operation parameters for 25 and 144 cm2 electrode area fuel cells, for hydrogen/oxygen feed gases. Development of electrocatalysts systems (Pt-based nanoparticles supported on high surface area carbon) by different methodologies: Bönneman´s method, in cooperation with the University of Darmstadt, Germany, alcohol-reduction process, spontaneous deposition, citric acid and molecular precursor methods(FIG.1).

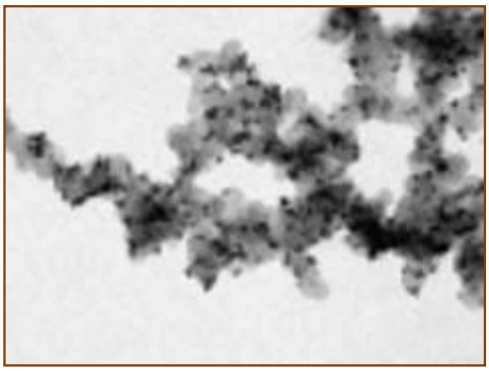

FIGURE 1 - Transmission electron micrograph of PtRu/C electrocatalyst prepared by alcohol-reduction process (Brazilian Patent INPI/RJ, PI0304121-2, 2003).

Chemical, electrochemical and morphological characterization of the produced new electrocatalysts for PEM fuel cell, in cooperation with the University of Darmstadt, Germany. Determination of the electroactivity of Pt-based electrocatalysts, prepared by different methodologies, in electrochemical cell with gas diffusion electrode for hydrogen/CO, methanol and ethanol oxidations, by the thin porous electrode technique (FIG.2).

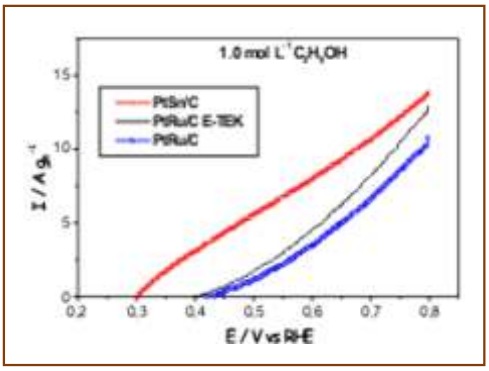

FIGURE 2 - Cyclic voltammetry of PtRu/C and PtSn/C electrocatalysts prepared by alcohol-reduction process and the commercial PtRu/C E-TEK electrocatalyst in 0.5 mol L-1 H2SO4 containing 1.0 mol L-1 of ethanol with a sweep rate of 10 mV s-1, considering only the anodic sweep.

Development of an optimized in-house membrane electrode assembly (MEA) (FIG.3) combining catalyst ink spraying and assembly hot pressing (Brazilian Patent INPI/RJ, PI0401474-0).

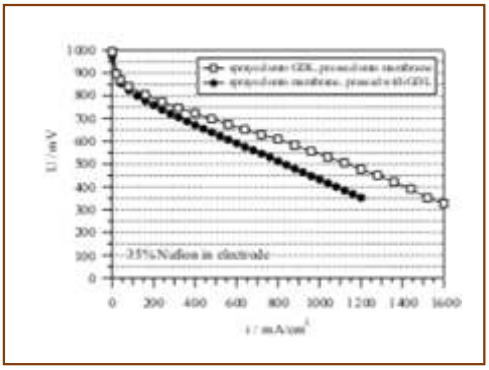

FIGURE 3 - Performance of single MEAs with carbon cloth as gas diffusion layers that were prepared by spraying either onto the membrane or onto the GDL. (anode: hydrogen, cathode: oxygen, Tcell = 65oC, Thum. = 80oC at anode, ambient pressure on anode and cathode).

Studies of MEA fabrication and PEMFC operational improvements by statistical experimental design. · Studies on the impacts of the introduction of fuel cells for distributed generation of electricity in Brazil.