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FIRST EXPERIENCES IN BUILDING AND TESTING A BRAZILIAN 500 W_e PEMFC STACK

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Keywords: fuel cell, PEMFC, electrocatalysis, hydrogen, stack

Abstract

This work describes the first experiences in building and testing a homemade stack at IPEN (*Nuclear and Energy Research Institute*). This stack combines all the technologies developed at IPEN´s Fuel Cell Laboratories, starting from choosing the materials and components until developing the new equipment to obtain a 500 W_e PEMFC stack.

The studies in fuel cells at IPEN have begun in 1999 with the development of new catalysts and methods to build MEAs and fuel cells [1, 2]. Today the emphases are the development of electrocatalyst systems for hydrogen and ethanol direct oxidation [3, 4], besides new polymers as electrolytes for high temperature fuel cells, manufacturing of high performance MEAs and CFD studies [5, 6, 7].

The 500 W_e PEMFC stack is composed by 10 MEAs that are 144 cm^2 in geometric area of electrodes and one of the first challenges to build the stack was the scale up of the desired components. MEAs that are 5 or 25 cm^2 were made either by manual painting or spraying and these methods were not appropriate to deposit the catalyst ink because the long time to get the MEA caused the clogging of the spraying and the formation of areas with different quantities of catalyst. To solve this problem, a sieve printing machine was acquired to build MEAs with larger areas [7]. But the catalytic ink used for the spray method was too liquid for this process. So, a catalytic paste was developed in order to deposit the catalyst over the carbon cloth or membrane.

The next step was to develop the bipolar plates. The carbon was chosen to be the best material for bipolar plates. It is a good electron conductor and inert for the gases. The fabrication problem concerning the flow channels is the fragility of the carbon and the time required to produce a large quantity of plates in an R&D laboratory. For this, a new composite material was developed, a mixture of carbon and polymers. This material has almost the same characteristic of carbon and a foil was built by pressing. Then the flow channels could be easily drilled.

The last challenge was the operation of the PEMFC stack. The existing expertise by operation of 25 cm^2 electrodes PEM single cells could not be adapted for a 144 cm^2 electrodes PEMFC stack. A careful study of the

operation parameters was carried out to obtain the optimized conditions to operate the new stack.

The PEMFC stack has reached 500 We at 5.92 V @ 85 A (590 mA cm^{-2} of current density) and the overall stack efficiency was approximately 40 % [8].

The most important contributions of this project were the aggregation of the all technologies developed at IPEN´s Fuel Cell Laboratories and the drag technology in terms of new materials and processes in a construction of the stack, creating a 100% Brazilian technology PEMFC prototype.

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