A PEM FUEL CELL DEVELOPED USING DIFFERENT GAS DIFFUSION ELECTRODES

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The gas diffusion layer facilitates the direct access and uniform spreading of the gases towards the reaction sites. More over it functions as a physical barrier and hence prevents the loss of the catalytic layer from the MEA. The gas diffusers must be porous, possessing high electrical conductivity, mechanically strong and resistant to acid media and humidity. Mostly used gas diffusers are made of carbon cloth and carbon paper.

The conversion efficiency of an MEA depends on many factors such as the kind and thickness of the gas diffuser material, the nafion to carbon ration in the catalysts and the MEA preparation method. In the present study a detailed analysis on the influence of the kind and combination of gas diffusers on the performance of the MEA was performed.

As gas diffusers carbon cloth and paper were used in different combinations. A nafion 115 (DuPont) membrane was used as the electrolyte and 0.4 mg/cm2 of 10 % Pt in Vulcan as the catalyst. The catalyst was mixed with liquid nafion and isopropanol and was deposited on the polymer membrane by the brushing method. The MEAs were fabricated by the hot-press method by applying a pressure of 100 Kg/cm2 at 100 oC for 5 minutes. To evaluate the MEAs, an FCT-2000 MFC fuel cell test station was utilized. The MEAs were loaded in a 5 cm2 fuel cell hardware for analysis and evaluation. The measurements were done at 25 oC and the gas flow rates were maintained at 100 and 80 cc/min for O_2 and H_2 respectively.

Figures 1 and 2 show the I-E characteristics for MEAs with different gas diffuser configurations. Figure 1 displays the case for two MEAs, one with carbon cloth (C) and the other with carbon paper (P) diffuser. It is evident from the figure that the one with cloth has better performance than the one with paper diffuser at higher current densities. Where as, the MEA with paper diffuser (P) is better at lower current densities. This may be attributed to the less ohmic loss for P at lower current densities compared to C, but, C has less duffusion loss at high current densities.

The combination of paper and cloth gave better results for the MEA. Figure 2 provides details of this study. A second layer of C or P gave better results only and when the first layer is C. This is clearly evident in figure 2. After the second layer, addition of subsequent layers did not make much difference in improving the performance of the MEA. The above results conclude the fact that it is always better to use a first layer of carbon cloth in the MEA. The better results obtained in the case of combination of C and P with always a first layer of C may be attributed to some factor, which reduces both ohmic loss as well as diffusion loss.

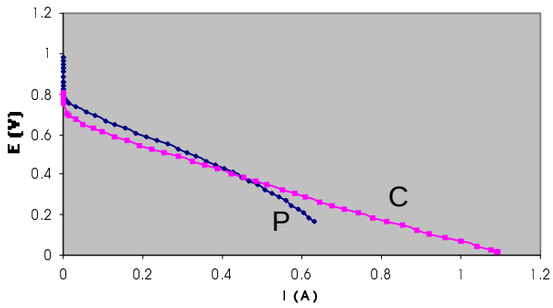

Figure 1: The i-E characteristics for MEAs with different kinds of gas diffusers

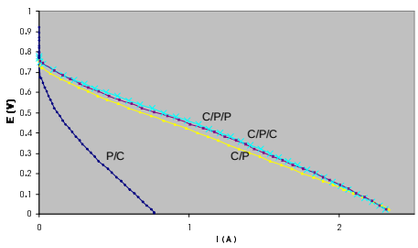

Figure 2: The i-E characteristics for MEAs with combinations of different types of gas diffusers