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Effects of Assembling and Operating Conditions on the Performance and CO Tolerance of PEMFCs with Different Membranes

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The proton exchange membrane fuel cell (PEMFC) is a well-established alternative for electric energy generation, particularly when using hydrogen as fuel. However, when this gas is generated by reform of fossil or even renewable fuels, it contains CO and this contaminant poisons the Pt anode catalyst in the membrane&electrodes assembly (MEA) of the PEMFC, severely decreasing the system efficiency [1], thus reducing its applicability. A possible option to diminish this poisoning effect may involve the use of other membranes to prepare the MEAs, simply because it allows high PEMFC operating temperatures, as are the cases of the Acquivion membranes [2]. Also, several works had been devoted to the investigation of CO tolerant catalysts in PEMFCs, particularly when Nafion® membranes are considered [3]. Among a series of multi-metallic dispersed catalysts, it has been shown that a material formed by Pt-Mo nanoparticles supported on carbon (PtMo/C) significantly enhances CO tolerance properties of the PEMFC anode. However, a decay of the catalyst performance caused dissolution of Mo and its migration/diffusion toward the cathode during the cell operation have been observed, indicating that the nature of the of ionomer membrane separating the electrodes may play a role regarding this phenomenon [3].

This work discusses the CO tolerance of proton exchange membrane fuel cells with membrane&electrodes assemblies (MEA) prepared under different hot-pressing conditions and formed by Nafion (DuPont, 212), Aquivion® (Solvey, E87, E98), and Fumapem (Fumatec) membranes of different thicknesses. Pt/C and PtMo/C electrodes containing different molecular weight ionomers in several proportions in the catalyst layer were employed. Studies have been made in single cells fed with H_2, H_2/CO-100 ppm, and O_2 gases saturated with water, by polarization measurements mainly conducted at 85° and 105 °C. Results have shown that better PEMFC performances are achieved when: (i) the MEA hot-pressing step is made at 200 ^oC (200 ^oC for Aquicvion nsand 145 ^oC for the others; (ii) the fuel cell working temperature is increased, particularly when fed with CO-containing H_2; (iii) the MEAs containing ionomer loads in the range of 28 to 35 wt.%, respect to the total mass of the electrode's catalyst layers; (iv) the MEA containing thinner membranes. Similar cell performances are observed for electrodes with different molecular weight, except for the systems operating at a higher temperature (125 ^oC). Finally, the CO tolerance of PtMo/C anode was found to be superior to that of Pt/C.

References

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