# Development of non-fluorinated membranes based on PBI for application in high temperature fuel cells (HT-PEM)

R.P. Silva, R.F.B de Souza, C.M.G. Santos, A. J. Silva e E. I. Santiago
Instituto de Pesquisas Energéticas e Nucleares – IPEN, Avenida Lineu Prestes, 2242, Cidade Universitária – São Paulo – Brasil

Most of Proton Exchange Membrane Fuel Cells (PEMFCs) use the Nafion as electrolyte, which has a limitation in the operating temperature. Usually, these cells operate up to 80°C since the proton conduction is dependent on water molecules carriers. The increase in the operating temperature of a PEMFC cell is desired due to the contribution of the temperature in the acceleration of the electrochemical reactions, which are thermoactivated processes. In the context of searching alternative polymeric electrolytes, PBI (polybenzimidazole) membranes have been considered a promising membrane for high temperature operating PEMFC (HT-PEMFC) due to the combination of satisfactory proton conduction in conditions of low relative humidity (RH) and excellent thermal stability. Pure PBI membranes were prepared by casting a solution of PBI / N, N'-dimethylacetamide (DMAc) and doped with phosphoric acid at different times (1, 3, 5, 7 10 and 15 days). Each membrane was evaluated in Fuel Cell tests, doping level and online Raman tests in order to determine effects of doping level, chemical degradation and fuel cell performance. The electrodes were optimized by studying different catalytic layer composition and the cell tested at different operational conditions.

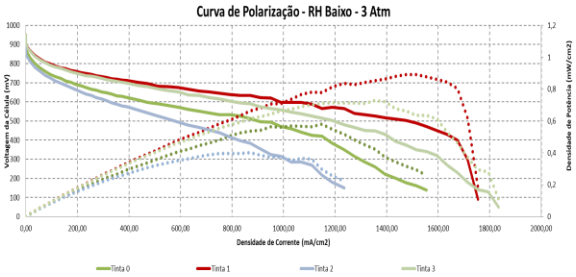


**Figure 1:** Polarization curves of different catalytic layer in the electrode.

Figure 1 presents HT-PEMFC polarization curves for membranes with different catalytic layers. The results show that factors, such as relative humidity (RH) and quantity of binder, strongly influence the performance of the system. Also, the methodology of preparation of the catalytic layer (brushing or spray), backpressure and relative humidity impacts the performance of HT-PEMFC. Raman tests showed some structures modifications in PBI chain due to phosphoric acid interaction.

**Acknowledgments:**
Shell e Fapesp

**References:**

KORDESCH et al., Fuel Cells and Their Application, 1996, 375.
MAURITZ et al., Chemistry Review, 2004, v. 104, 4535.
JIANG et al. Electrochimica Acta, 2008 v. 53, p. 4495. MATOS et al. Journal of Power Sources, 2014, v. 268, 706.

*e-mail: rodrigopires@usp.br