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"Building bridges in Chemical Engineering"

BOOK OF ABSTRACTS

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New modified Nafion-biphosphonic acid composite membranes for enhanced proton conductivity and PEMFC performance

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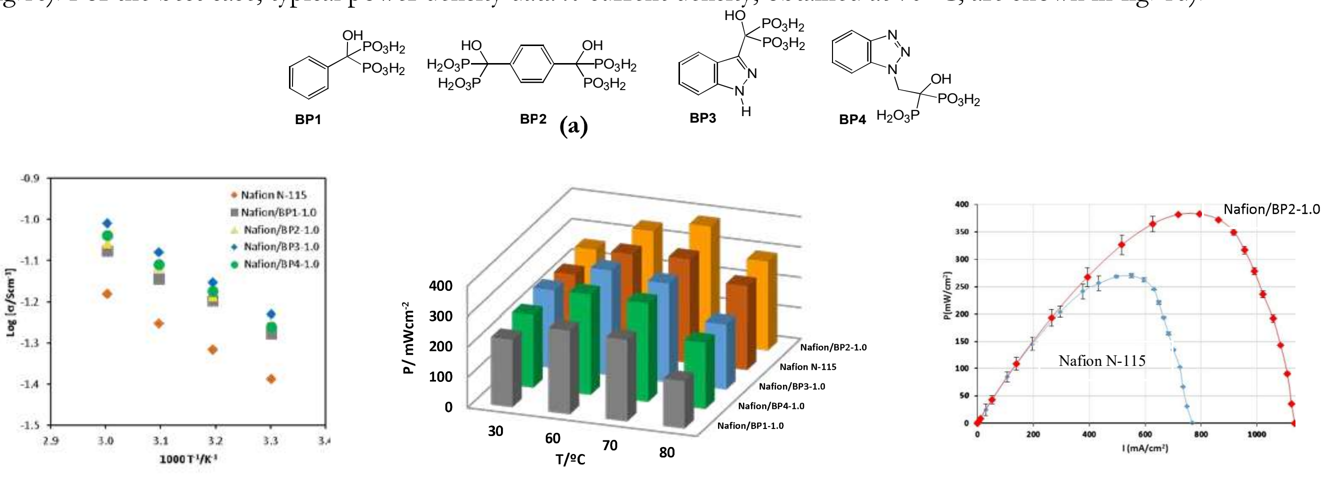
Abstract

The performance of PEM fuel cells critically depends on their proton exchange membrane structural and chemical stabilities as well as on their proton conductivity. Limitations of commercially available Nafion membranes to operating at temperatures above 80 ºC have fostered the interest in research and development of new membranes [1,2]. The aim of this work is the preparation of new modified Nafion composite membranes, with a bisphosphonic acid moiety, a promising proton carrier exhibiting good proton donating/accepting properties and thermal stability. Synthesis and characterization were undertaken of a series of bisphosphonic acid derivatives (fig.1a) and their incorporation into a Nafion matrix, by casting. The new membranes were characterized by ATR-FTIR and SEM along with their ion exchange capacity and water-uptake. The evaluation of their proton conductivity was carried out by electrochemical impedance spectroscopy, at various temperature and relative humidity (RH) conditions. The incorporation of BPs dopants enhances the proton conductivity, with all membranes exhibiting higher values than Nafion N-115, tested in the same experimental conditions, fig. 1b). Selected membranes were integrated into a fuel cell MEA, using a single cell assembly, with an active area of 2.5x2.5 cm^2 and a catalyst loading of 0.5 $mg_{Pt}cm^{-2}$. Performance was evaluated, using an air fed cathode, at temperatures from 30 ºC to 80 ºC. Membrane doped with BP2 showed the best performance, with higher power density outputs than Nafion N-115 shown at all temperatures, fig.1c). For the best case, typical power density data *vs* current density, obtained at 70 ºC, are shown in fig. 1d).



(b) (c) d)

Fig. 1. (a) Structure of selected prepared BPs; (b) Proton conductivity of Nafion membranes vs reciprocal temperature at 80% RH; (c) H_2/O_2 (Air) PEM fuel cell performance using Nafion N-115 and Nafion-doped membranes at different temperatures; (d) Power density curves of H_2/O_2 (Air) PEM fuel cell using Nafion N-115 and Nafion/BP2-1.0 membranes operated at 70 °C.

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