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New SPEEK doped membranes for ion exchange polymer electrolytes

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INTRODUCTION

A decarbonized society demands cleaner and sustainable energy sources, based on some well-established or emerging technologies with the potential of significant contribution to energy storage and conversion, such as batteries, fuel cells and CO_2 and water electrolysers. The performance of these electrochemical devices relies on key components such as their separators/ion-exchange membranes.[1,2] Nafion® is the most common commercial membrane but has some limitations including its operating temperature due to the dependence of conductivity on its water content. Our previous studies showed that the incorporation of bisphosphonic acid (BPs) dopants into Nafion membranes improve their properties.[1-3] Following these, in this study we prepared new membranes based on sulfonated poly(etheretherketone) (SPEEK) polymer, a reliable and effective alternative to Nafion, through the incorporation of the BPs dopants, to obtain low cost membranes with improved properties.

EXPERIMENTAL

BPs dopants were prepared in conditions already established within the group.[1,2] SPEEK polymer was prepared by sulfonation of PEEK with sulfuric acid and its degree of sulfonation was determined by NMR. Membranes were prepared by casting SPEEK/DMF solution with 1.0 or 2.0 wt% of BPs dopants. BPs and SPEEK were characterized by NMR, ATR-FTIR and the new SPEEK membranes were analyzed by ATR-FTIR spectroscopy. Evaluation of the proton conductivity of the new membranes was performed by electrochemical impedance spectroscopy (EIS) at 40 ºC and different relative humidity (RH) conditions, using a Frequency Response Analyzer coupled to an electrochemical interface (from Solartron) and a BekkTech conductivity cell.

RESULTS AND DISCUSSION

SPEEK membranes were prepared by sulfonation of PEEK starting material with a 63% sulfonation degree. The new SPEEK membranes prepared through the incorporation of **BP1** and **BP2** dopants (**Fig. 1**) were analyzed by ATR-FTIR. The evaluation of proton conductivity of the new doped membranes confirmed that the incorporation of BPs dopants modify the proton conduction depending on the RH conditions. At 80% RH, the new doped membranes showed similar proton conduction to SPEEK membrane but an increase of the proton conduction is observed in the doped membranes at a 100% RH compared to the pristine SPEEK. The membranes with different wt% of BPs dopants showed similar proton conduction.

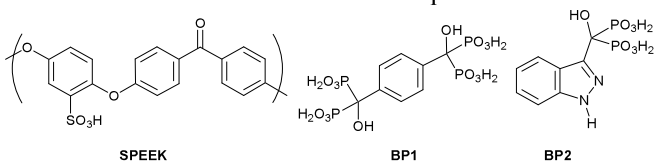

Fig. 1. Structures of BPs dopants and SPEEK polymer.

CONCLUSION

New modified SPEEK membranes were obtained by casting with **BP1** and **BP2** as dopants. The new modified SPEEK membranes showed higher proton conductivity than SPEEK pristine at 100% RH, with no relevant differences among membranes evaluated at the RH conditions or membranes with different BPs dopants.

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