Influence of Side Groups on the Properties of Aromatic Polymer Electrolyte Membranes for HT-PEMFCs

C. Morfopoulou[1,2], A. K. Andreopoulou[1,2], I. Kalamaras[1,2], M. K. Daletou[1,2], K. D. Papadimitriou[1,2], S. G. Neophytides[1,2,3], J. K. Kallitsis[1,2,3].

1) Department of Chemistry, University of Patras, GR-26500 Rio-Patras, Greece
2) Institute of Chemical Engineering Sciences, FORTH/ICE-HT, Post Office Box 1414, GR-26504 Rio-Patras, Greece
3) Advent Technologies SA, Patras Science Park, GR-26504 Rio-Patras, Greece

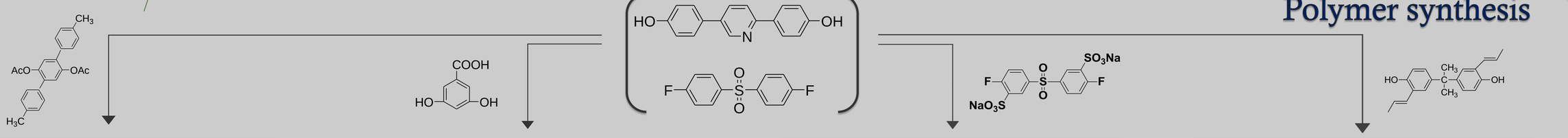
Introduction

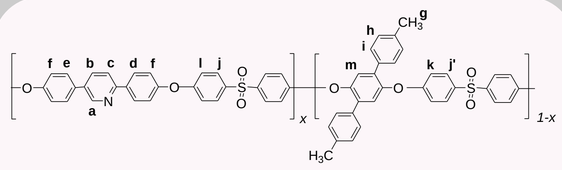
Fuel cell (FC) technologies have received much attention in recent years owing to their high efficiencies and low emissions. Proton Exchange Membrane Fuel Cells (PEMFC)s are the most attractive type of FC for many applications since they present mechanical simplicity, quick start-up, high efficiency, modularity and versatility. Till today, materials based on Polybenzimidazole (PBI) are the most prevalent polymer electrolytes for HT-PEMFCs. However, and in order to improve the properties of HT PEMs many efforts have been made. Our approach focuses on the development and optimization of pyridine based aromatic polyethers.(1a-d)

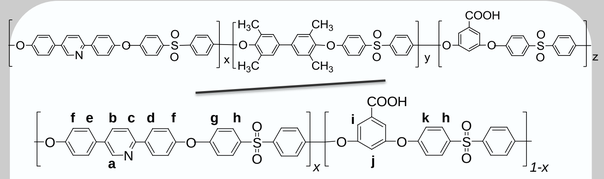
Following this concept we have prepared fully aromatic polyethers bearing main chain pyridine units with either non polar or polar moieties, such as p-tolyl, carboxylic(2) sulfonic(3) groups and double bonds(4). A vast library of polymeric materials is demonstrated, whose properties depend on the chemical and topological architecture of the backbone and the pendant groups(5). The membranes showed excellent mechanical and oxidative stability, as well as high doping levels. Furthermore, membranes obtained after polymer synthesis were fabricated and tested in 5x5 cm^2 single cells. The influence of the different parameters (e.g polymer structure, phosphoric acid doping level, electrode used) on the final single cell performance was studied and confirmed that these materials could be promising candidates for use as electrolytes in HT-PEMFCs.

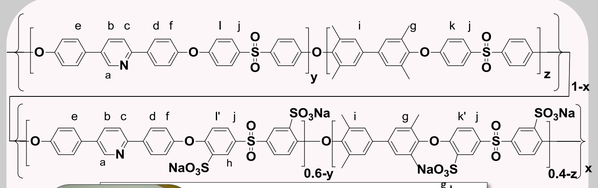
Results

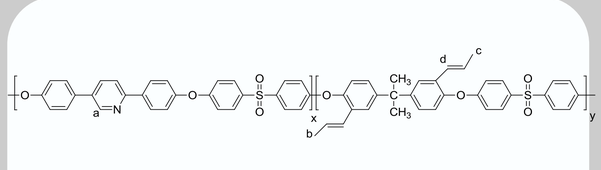
Polymer synthesis



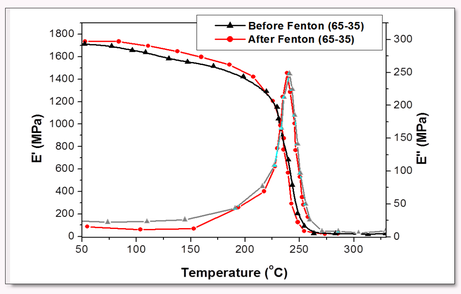


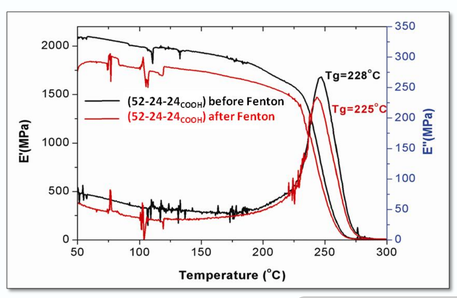


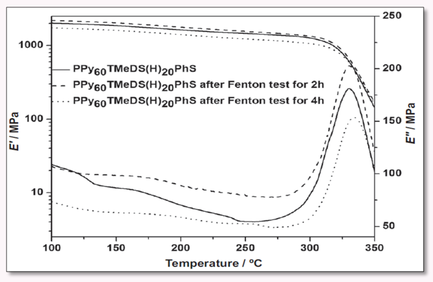


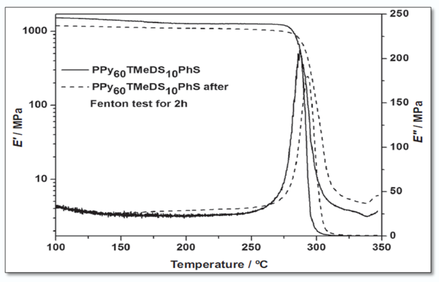


Mechanical and Oxidative Stability

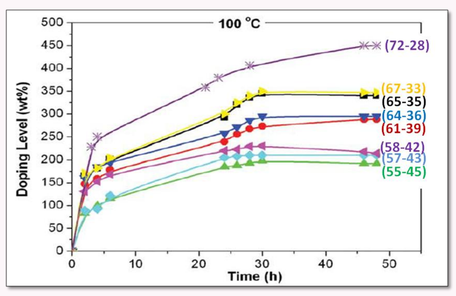


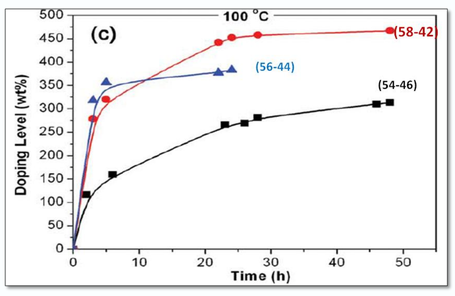


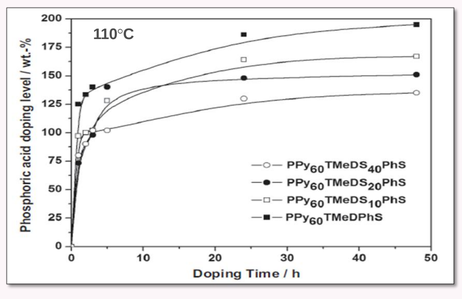


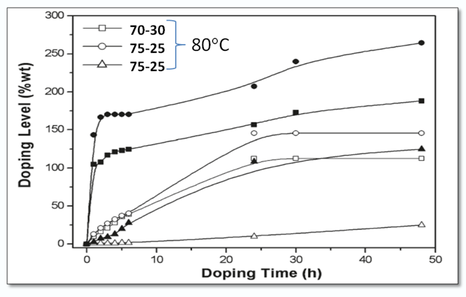


H_3PO_4 Doping Ability



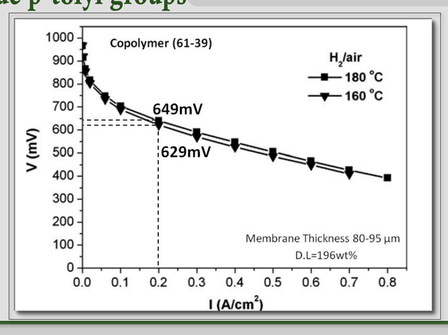




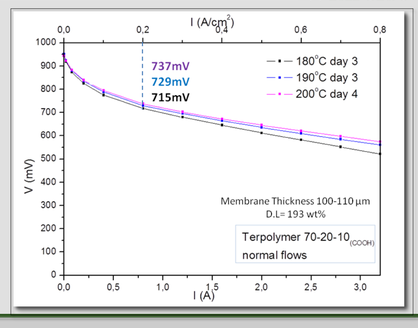


Electrochemical Characterization

With side p-tolyl groups



With side COOH groups



Conclusions

- Copolymers bearing main chain pyridine units and p-tolyl, carboxyl, sulfonic units and double bonds as side groups were synthesized with high molecular weight, excellent mechanical and thermal properties, increased H_3PO_4 acid uptake.
- Doping levels are strongly influenced by the pyridine units content and the polarity and bulkiness of the side groups.
- The MEAs' performance is drastically improved with increasing temperature.

Acknowledgement

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References

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