Characterization of Proton Conducting Membranes Based on PVDF and PVDF-PAN blends

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Proton conducting polymers have attracted much attention for application in Polymer Electrolyte Fuel Cells (PEFC). The conducting membranes play the dual role of electrolyte and separator in these cells. Due to this role, the polymer electrolyte has to fulfill several specifications, e.g. high proton conductivity, mechanical strength, easy water uptake from the electrodes phases, good adhesion to the porous gas diffusion electrodes, chemical and electrochemical stability under prevailing conditions. Depending on fuel mode (pure H_2 or liquid methanol) the membrane properties have to be adjusted to the different operation conditions.

Different types of proton polymer conductors have been developed and in this report we present the characteristics of a proton gel system based on poly-vinylidenefluoride (PVdF)-ceramic filler (SiO_2) matrix [1]. Water can easily diffuse through PVdF due to the inherent hydrophobicity of the polymer's backbone, resulting in the absence of strongly hydrogen-bonded water in the membrane. Proton conductivity in the PVdF-SiO_2 membranes is high and slightly increases as the amount of ceramic filler increases (Fig1) [1]. In order to increase hydrophilic properties, gel electrolyte-type membranes have been also prepared by blending high molecular weight PVdF-HFP copolymer with poly-acrylonitrile (PAN) component. Due to the wide range of available compositions, it is possible to modulate the mechanical features of the PVdF with the proton affinity of PAN [2]. Highly conductive proton polymer electrolytes have been obtained by soaking PVdF-PAN porous membranes in acidic aqueous solutions. The PVdF-PAN blended membranes have a high conductivity (σ= 0.1 Scm^{-1}) and good thermal properties (Fig.2).

In this presentation we report the electrochemical characteristics of the two membranes and discuss the possibility of their application as polymer electrolytes in fuel cells.

Acknowledgments
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References

[1] S. Panero, F. Ciuffa, A. D’Epifanio, B. Scrosati, Electrochimica Acta, in press.
[2] D. Satolli, M.A. Navarra, S. Panero, B. Scrosati, D. Ostrovskii, P. Jacobsson, I. Albinsson, B. E. Mellander, Journal of Electrochemical Society, in press.

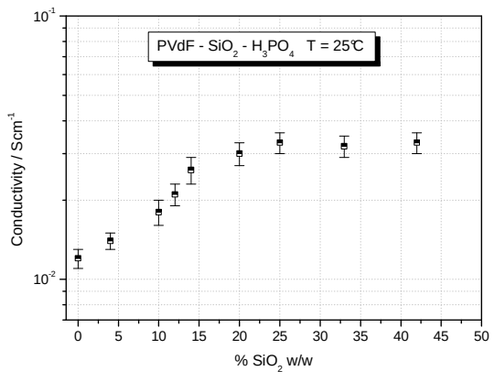

Fig.1: Conductivity of PVDF-SiO_2-H_3PO_4 based membranes at different SiO_2 content.

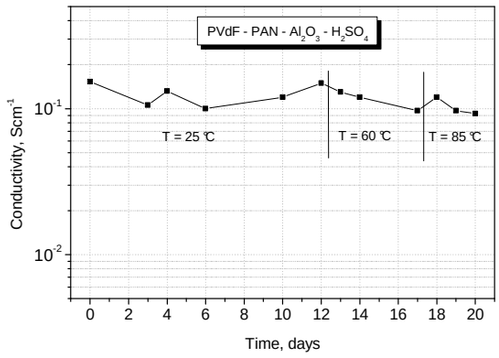

Fig.2: Conductivity of PVDF-PAN-Al_2O_3 based membrane at different temperature