DESIGNING POLYMER ELECTROLYTES AS MEMBRANES FOR HIGH TEMPERATURE FUEL CELLS

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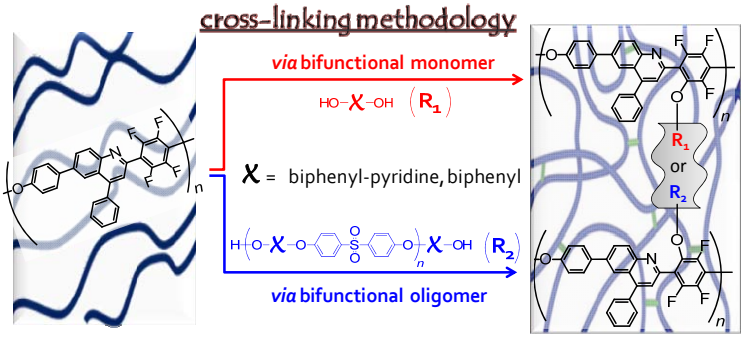
Polymer electrolyte Fuel Cells are devices that transform the chemical energy of hydrogen into electricity and heat with high efficiency and zero emissions. Polymer membranes are of critical importance for the fuel cell device operation and depending on the type of the polymer electrolyte used, low (60-90°C) and high (160-200°C) temperature operation is enabled. The advantages and disadvantages of each of the above technologies will be discussed in this presentation. High Temperature operation is mostly based on acid doped basic polymers like polybenzimidiazole resulting in the ability to use reformate hydrogen as fuel feed, while the Fuel Cell system based on that is drastically simplified compared to the low temperature operation. In the course of our work to develop high temperature polymer electrolytes an alternative approach was followed by using polymers bearing basic groups like pyridine as main chain functionalities providing the interactive sites for the strong acids complexation.

This approach gave us the advantage of developing a large number of copolymers by combining the necessary units in order to assure solubility and high molecular weight copolymers resulting in high quality membranes. Additionally we developed a number of functionalized copolymers bearing side groups having carboxy or double bond units and thus we were able to further stabilize the doped membranes by crosslinking enabling the increase of the operation temperatures even up to 210°C.



In a most recent attempt quinoline based homopolymers and crosslinked structures were developed, as shown in the Scheme above, resulting in high quality membranes with high acid uptake and controllable swelling only along their z-axis in order to prevent failure from expansion-contraction of the doped membranes during operation.

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