Electrodes-membrane assemblies (MEA) based on sulfonated polyimides for fuel cell applications

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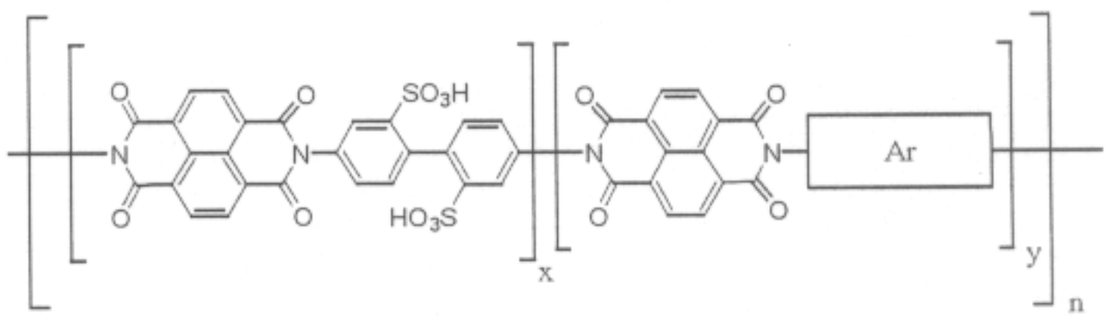
The state of the art in the field of fuel cell technology shows that Nafion® is a real reference for its use as polymeric proton conductive membrane. Indeed, this material is characterized by very high performances and durability. However, because of some limitations in terms of cost, high temperature conductivity, methanol permeability and recycling, an important research activity has been devoted to propose an alternative system and as a consequence, have led to the synthesis of a large array of sulfonated non fluorinated polymers. In this perspective, we are interested in developping proton exchange membranes based on sulfonated polyimides.

Sulfonated polyimides can be obtained either by sulfonation of a preformed polyimide or by polymerization of a sulfonated monomer. Whereas the first method gives a statistical distribution of sulfonic groups along the polymer blackbone, the second one allows in particular synthesis conditions the formation of block copolymers. As part of this study, we have chosen this approach to synthesize different sulfonated polyimides having various sulfonated sequence lenght and ionic exchange capacity as reported elsewhere. One relevant structure of sulfonated polyimide is shown in figure 1.

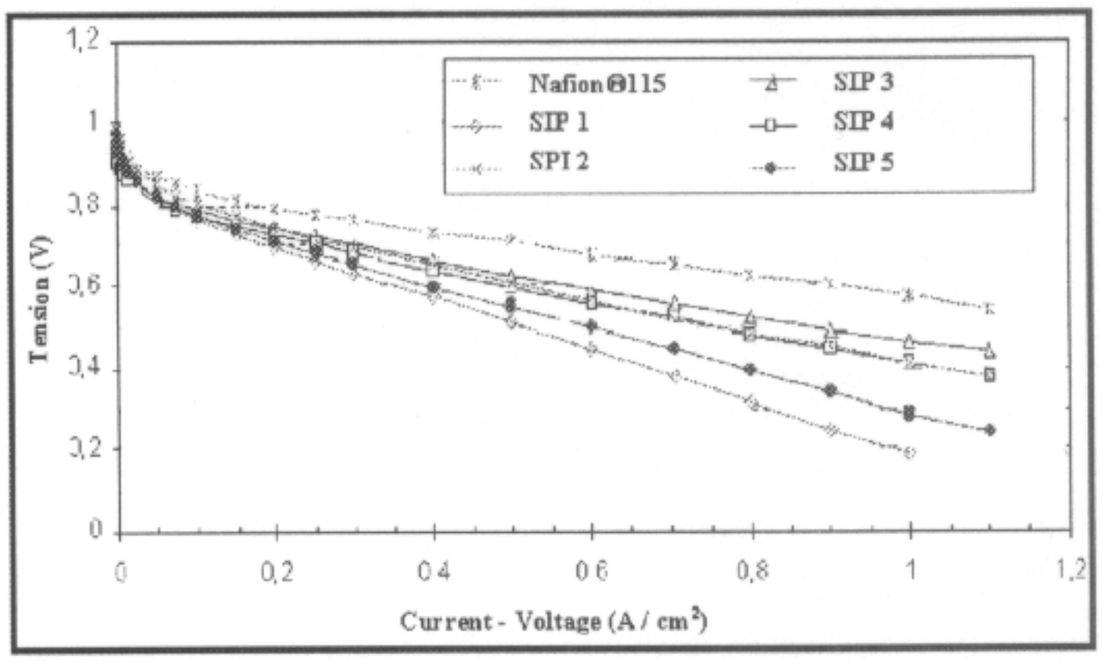
Figure 1 General chemical structure of sulfonated polyimide



Both dense and reinforced (organic and mineral tissues) sulfonated polyimide membranes were prepared using the casting solution process. SANS and LAXS analysis performed from SPI membranes revealed for the majority of SPI a phase –separated morphology related to the block copolymer structure.

Membrane performances have been checked from MEA obtained with E-Tek or SORAPEC electrodes. This EMAs were then evaluated for fuel cell performances in an home-made SORAPEC single-cell fuel cell with an active area of 25cm^2. The cell was operated on oxygen / hydrogen P = 4 bars, at 70°C. As an example, Fig 2 shows a current-voltage plot of some sulfonated polyimides.

Figure 2



In this presentation we will show how the fuel cell performances and long time stability depend on several parameters: chemical structure of the polymer, reinforcement, electrode impregnation conditions, cell geometry, etc..

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