Preparation and characterization of SPEEK/Silicotunstic acid/acid functionalized polysilsesquioxane hybrid composite membranes for PEM fuel cells

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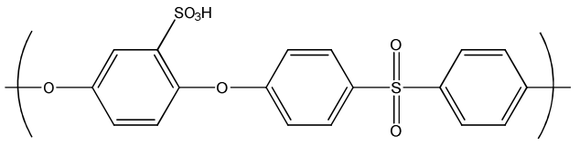
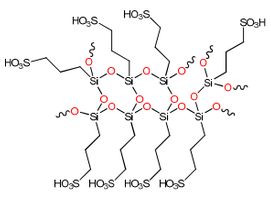
The polymer electrolyte membrane fuel cells (**PEMFC**) have received considerable attention as a future source of clean energy because of their high energy efficiency, low temperature operation, low emission pollutants. Nafion® produced by DuPont is widely acknowledged to be good electrolyte membranes owing to their high proton conductivity and excellent chemical/physical properties. However, high cost, loss of proton conductivity at high temperature, and low humidity, and relatively high gas permeability have limited PFSA membranes for further commercial application.



SPEEK



Sulfopropylated polysilsesquioxane

A typical Kegging Structure $[PW_{12}O_{40}]^{3-}$

Therefore, the development of an alternative non-perfluorinated polymeric materials have been extensively investigated in many research groups to get high proton conductivity and to apply for the condition at high temperatures with lower fuel crossover. More recently, trend is developing the hybrid organic/inorganic composite membranes fuel cell applications, because many of the inorganic materials enhance proton conductivity, water retention, and mechanical strength at high temperatures.

So in this work, a series of new **SPEEK**-based composite membranes have been prepared by the solvent casting method. It was found that the proton conductivities and water uptake measured as a function of humidity (30-95%RH) at 80 °C were improved. We found that addition of **STC** or **TPSA** to **SPEEK** membranes increased the proton conductivity at all the RH>40%.A significant increase in proton conductivity, decrease in water uptake had been reported depending on the %wt ratio of **STC** or **TPSA**. In the case of water uptake, the composite membrane with increase in content **STC** or **TPSA**, the water uptake of the composite membrane gradually decreased. Although further improvement of matrix phase and additives should be needed, heteropolyacid hybrid membrane with hydrocarbon-type polymer would be promising to improve their properties such as proton conductivity and mechanical property. [This work was supported by the Ministry of Economy, Trade and Industry (METI) and The New Energy and Industrial Technology Development Organization (NEDO), Japan]