SOL-GEL SYNTHESIS OF ION EXCHANGE MEMBRANES AS ELECTROLYTE FOR FUEL CELLS

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ABSTRACT

This study concerns the preparation of ion exchanging inorganic membranes for utilization as electrolytes in fuel cells. The use of perfluorocarbon sulfonate (PFSA) membranes are limited by the range of temperatures in which they can be effectively employed as well as their high cost at present, and are therefore not yet viable for use in polymer electrolyte fuel cells. In this study we attempted the sol-gel synthesis of a novel organically modified silica coating in order to prepare a material which has the same solid acid catalyst properties of Nafion but, due to increased surface area, better catalyst utilization and higher activity. Because of mild synthesis conditions it will also offer a more cost effective production.

The following alkoxysilanes were used to incorporate an acid functionality into the gel: 2-cyanoethyltriethoxysilane ($N\equiv C\text{-}CH_2CH_2Si(OC_2H_5)_{3)}$; 2-(carbomethoxy)ethyltrichlorosilane ($CH_3\text{-}OCCH_2CH_2SiCl_3$); 2-(carbomethoxy)ethylmethyldichlorosilane ($CH_3OCCH_2CH_2SiCl_2CH_3$);

6-azidosulfonylhexyltriethoxysilane ($N_3SO_2(CH_2)_6\text{-}Si(\text{-}OC_2H_5)_3$).

The best results were obtained by the condensation reaction between TEOS, methyltriethosysilane(MTES), and 6-azidosulfonylhexyltriethoxysilane.

These prepared gels were characterised with the aid of BET surface area analysis, hydrophobicity determination, IR spectroscopy, solid state ^{29}Si and ^{13}C nmr, atomic force microscopy (AFM), elemental dispersive x-ray analysis (EDAX), thermal gravimetrical analysis (TGA) and impedance measurements.

Thermal stability of the network has been measured up to 180ºC. The final coating presents a good ion exchangeability. Taking these results into account one may conclude that this membrane looks very promising, for utilization as a solid polymer electrolyte.