

TITLE: TiO₂ Nanotubes based composite Polymer Electrolytes for Fuel Cells.

AUTHORS: Kerrilee Stewart

SUPERVISORS: Dr. H. Missan



The Polymer electrolyte Membrane (proton exchange membrane) fuel cell (PEMFC) is one of the most promising approaches to fuel cell technology as they can be used in transport, stationary and portable applications. The function of the electrolyte membrane in the PEMFC was investigated and the desired properties for the electrolyte membrane were determined. The problems associated with the presently used membranes such as Nafion[®], Aciplex[®] and Dow[®] were indentified and were found to include low operational temperature, low performance, high manufacturing cost and the environmental impact of their life cycle. In order to optimize use of the PEMFC in the future new electrolytes must then be developed. Composites are used in electrolytes to improve its properties such as operational temperature, mechanical, thermal and chemical strength. In this project composite polymer electrolyte membranes were synthesized using ionic liquids in-situ with polymer matrix and then by reinforcing them with various functionalized and non-functionalized TiO₂ nanotubes. TiO₂ nanotubes were successfully made using hydrothermal method. The effect of the starting particle size of TiO₂ and reaction time was also studied. Nanotubes were the also functionalized with an acid group. The TiO₂ nanotubes were then analyzed using TEM, XRD, and NMR to determine their morphology and structure, ionic properties, and sizes inclusive of length and diameter.