ABSTRACT

The need for alternative energy source that is efficient and environmental friendly has driven research and development activities in fuel cell technology. The PEMFC, one of the fuel cell types, has been developed in large-scale operation by integrating with the hydrogen production. The investigation of process characterization for large-scale operation has become important topic, since a number of parameters influenced the power production. This work explores the possibility of using some engineering thermoplastics namely polystyrene (PS), polycarbonate (PC), Poly methylmethacrylate (PMMA), Polyvinyl chloride(PVC) to serve as suitable proton exchange membranes for fuel cell applications. Currently NAFION, which has a fluorinated alkyl backbone, is widely used in fuel cells. These engineering polymers were modified through a process called sulfonation, in which a sulfonic acid group (SO_3H) is introduced render them some electrical conductivity. Fourier Transform Infrared Spectroscopy (FT-IR) was performed to confirm sulfonation. Thermal analysis tests using Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) were run to determine the effects of sulfoantion on glass transition temperature and thermal stability of the modified polymers. The Ion Exchange Capacity (IEC) was also calculated using results from titration. Degree of substitution of sulfonic acid groups was calculated. Swelling properties were also tested using water. Scanning Electron Microscopy (SEM) was run to determine the structure of the polymeric membranes both before and after sulfonation. The results of these tests concluded that a sulfonated commercially available bisphenol polymer (polycarbonate) was the most viable substitute for NAFION, owing to its comparable Ion Exchange Capacity and Degree of substitution, low cost of production, good mechanical and thermal stability.