CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

The results of this work show that pure TiO_2 and Sb doped TiO_2 nanoparticles which were prepared using the sol-gel process present anatase phase with mesoporosity. As it can be seen from XRD, the structure of all Sb doped TiO_2 samples was not significantly changed or distorted from anatase structure of pure TiO_2. Sb dopant was incorporated into the TiO_2 crystal according to EDX analysis. The specific surface areas of Sb doped TiO_2 are higher than that of pure TiO_2. From SEM/EDX analysis, all of the samples are spherical morphology and Sb dopant show good distribution in TiO_2. The PVDF composite films of 10% by weight of ceramic were prepared by solvent casting using DMF as a solvent. From TGA results, it can conclude that the composite film possess higher residue than pure PVDF film. The PVDF/Sb-TiO_2 composite films have higher percentage of water uptake and proton conductivity than PVDF-TiO_2 composite and pure PVDF film. The amounts of Sb do not significantly effect to the results. So, the suitable amount of Sb in TiO_2 is 5 mol%. PVDF/5 mol% Sb-TiO_2 composite film was prepared by solvent casting containing 10%, 20%, 30%, 40%, and 50% by weight ceramic. TGA thermograms indicated that higher residue was obtained at the higher ceramic contents. With increasing the amounts of ceramic, the percentage of water uptake and proton conductivity were higher. However, more agglomeration of ceramic powder were found in composites at higher 5 mol% Sb-TiO_2 contents which made them opaque, stiff and easy to break. The composite films between PVDF blended with PAN and 5 mol% Sb-TiO_2 ceramic were fabricated. PAN is the amorphous polymer and has high glass transition temperature. So, it can make the blend films quite brittle and stiff. By blending with PAN, the percentage of water uptake and proton conductivity were higher. The temperature dependence of proton conductivity of the composite films shows that the membranes have the highest proton conductivity (~10^{-1} S/cm) at 90 °C. The proton conductivity decreases strongly at temperatures higher than 100 °C due to the drying of membranes.

Recommendations

1. The films fabricated by solution-casting were not strong and difficult to control the thickness. So, the films should be prepared by other methods such as compression moulding.
2. The samples should be tested in a single fuel cell to evaluate the performance and the efficiency of membranes.
3. The samples should be tested for the gas permeability to evaluate the efficiency of membranes.