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CHAPTER I
INTRODUCTION

Nowadays, fuel cell is very interesting as power sources for electric vehicles, stationary applications, and portable electronics. Among the several kinds, proton exchange membrane fuel cell (PEMFC) is the most popular choice because of its potential high efficiency, low operating temperature and usage safety. An important part of PEMFC is the polymer membrane which works as an efficient polymer electrolyte, *i.e.*, conduct by protons whereas hindering electronic transport and penetration of fuel [Navarra et al., 2003., Moszczynski et al., 2007].

Generally, perfluorinated membrane, Nafion, is used in practical cells, showing good ionic conductivity and chemical stability. Despite these good qualities, perfluorinated membranes still have few disadvantages, such as high cost, unstable mechanical properties at temperatures above 100 °C, and conductive only when soaked in water, which limits fuel cell operating temperatures to 80 °C. The operation of fuel cells at higher temperature own many advantages such as lower heat exchangers, and easier to integrate with reformers. Consequently, the development of membranes which are mechanically and chemically stable at higher temperatures (above 100 °C) is very interesting for studying fuel cells [Martinelli et al., 2005., Jalani et al., 2005].

Polymer matrix composite providing various advantages such as low cost, lightweight, and easier to manufacture than other materials, is one of the choices to improve high-temperature performance. The membrane is made with organic polymers containing ceramic fillers. Inorganic materials can have high proton conductivity with hydrophilicity, good chemical and thermal stability, high porosity, and high specific surface areas. Organic materials can make membranes elastic and have good mechanical properties with hydrophobicity. Thus, the composite film is applicable at higher temperature and moderate water vapor pressures [Navarra et al., 2004., Zhu Bin et al., 2006., Kuanchaitrakul et al., 2008].

In this study, inorganic particles, including titanium dioxide and antimony-modified titanium dioxide particle, were prepared by the sol-gel method. These inorganic particles are the porous materials which have high surface area and high proton conductivity. The ceramic powder was characterized using XRD, SEM, and EDX. The surface area and pore size distribution were also measured using Nitrogen sorption. Later, various inorganic powders were mixed together with polymer, PVDF and PVDF/PAN blend. The solution was then casted on glass substrate and dried by heating. Following this method, the composite films of 10%, 20%, 30%, 40%, and 50% by weight ceramic were fabricated. The dispersion of ceramic particles was observed by using SEM and EDX-mapping. Various inorganic/organic composite membranes were tested in order to evaluate the potential use as electrolyte in PEMFCs at high temperature by using TGA, Impedance spectroscopy and Water uptake. Lloyd Universal Testing machine were carried out to measure the mechanical properties of the thin films [Kuanchaitrakul et al., 2008., Sodsong et al., 2009].