CHAPTER I
INTRODUCTION

Presently, the energy consumption sharply increases against limited supply, the alternative energy sources and storage technologies are attractive towards world's economy and industry. However, the renewable energy source without storage capability cannot fulfill the commercial requirement. Recently, the department of energy (United States of America) evaluated redox flow batteries as rechargeable energy storage implementations. Vanadium redox flow battery (VRFB) is one of most attractive choices due to a large charge/discharge cycle, rapid response, and reasonable capital cost (Weber *et al.*, 2011).

For VRFB, most researchers are directed towards producing the proton exchange membrane. The Nafion commercial membrane provides the high performance in the proton conductivity and stability of electrolyte. However, the Nafion membrane has high vanadium permeability that reduces the energy efficiency of the redox flow battery. The thermal stability is also a drawback of Nafion membrane because the proton conductivity diminishes with elevated temperature. Moreover, Nafion membrane is very expensive. Aromatic containing membranes have been utilized as a proton exchange membrane extensively due to their high proton conductivity and high mechanical property (Dupuis, 2011). The department of energy (United States of America) expects that the membranes should have proton conductivity of at least 0.1 Scm^{-1} at 80 °C (Park *et al.*, 2011).

The proton conductivity of an aromatic polymer is improved by a sulfonation process. The sulfonic groups are attracted on the polymer backbone or pendant group. The sulfonic attachment enhances proton transfer within the polymer matrix because it promotes the hydrophilic domains for proton transfer (Park *et al.*, 2011). However, a high water uptake of the polymer membrane leads to unpleasant mechanical properties (Macksasitorn *et al.*, 2012).

The objective of work was the preparation of aromatic containing proton exchange membrane which possesses the crucial properties composed of the proton conductivity, vanadium permeability, and mechanical properties. The two polymers: poly(ether ether ketone) and poly(phenylene ether ether sulfone) were sulfonated with

98% sulfuric acid. The effect of the degree of sulfonation on various membrane properties was investigated to determine the optimal membranes for VRFB application and to be compared with Nafion117.