CHAPTER I
INTRODUCTION

Perfluorosulfonic acid polymer e.g., Nafion®, is one of the most widely used polymer electrolyte membranes (PEMs) for using in polymer electrolyte membrane fuel cell (PEMFC), due to its function in transferring proton through water cluster under the process of forming and breaking of hydrogen bond (Agmon *et al.*, 1995). Eventhough Nafion® performs high proton conductivity, its performance in proton transferring decrease significantly at high temperature because of water evaporation (Kim *et al.*, 2006).

Because of the limitation of Nafion® for operating at high temperature, other alternative compounds and materials have been investigated. For example, Yi *et al.*, (2011) proposed the use of ionic liquid as medium in sulfonated poly (ether ether ketone) (SPEEK) membrane to maintain humidified state for proton transferring. However, it was found that the mechanical property of the membrane was relatively low because of the membrane swelling.

However, the development of PEM using water in transferring proton via hydrogen bond is still limited, this work focuses on the heterocyclic molecules in transferring proton via hydrogen bond. From our group research, we found that the key factors for enhancing proton transfer efficiency in PEMFC are the hydrogen bond network of proton conductive species groups and appropriate proton transfer channel of proton donor-acceptor. Jithunsa *et al.*, (2008) reported that the copolymer containing proton donor and proton acceptor in one polymer chain can enhance proton conductivity. Moreover, the order structure of heterocyclic molecule was also studied, to find that the packing structure resulted in hydrogen bond leading to proton conductive enhancement (Pangon *et al.*, 2011).

The present work aims to investigate how PEM can be prepared via a simple approach of layered-by-layered molecular assembly technique including its consequent proton conductive property. Here, acid-base polymer complex based on heterocycles of benzimidazole as proton donor and poly (acrylic acid) as proton acceptor, are proposed. The work covers molecular designs and syntheses, structural

characterization, membrane preparing condition via layered-by-layered process, and investigation of proton conductivity efficiency under water free condition.