CHAPTER I
INTRODUCTION

The supercapacitor is an electrochemical energy–storage device that is invented to respond to the increasing demand for energy. It can be used as the energy–storage systems for electric vehicles, electronic devices, back-up sources, etc. Great attentions of this device over batteries, capacitors, and fuel cells have been focused on their high specific capacitance, high energy density, long life-cycle, low cost, and environmental friendliness (Katanyoota *et al.*, 2010).

Generally, the electrochemical supercapasitors can be classified into two types according to the charge/discharge mechanism; electrochemical double–layer capacitors (EDLCs) and pseudocapacitors. EDLCs store energy via electrostatic adsorption/desorption in which charge is divided at the interface of electrode and electrolyte; on the other hand, pseudocapacitors store energy by faradaic redox reactions through metal oxides which are formed on the electrode surface. These materials are also electroactive materials. Among many metal oxides, ruthenium oxide (RuO_2) is a promising material but its rarity and high cost are impractical for commercial scale (Hwang *et al.*, 2007). In fact, the metal oxides are not only the major material studied for capacitors, but carbon and conducting polymers were also investigated (Pekala *et al.*, 1992). Carbon aerogels have received great attention as the electrode materials due to their useful properties such as high porosity, high surface area, outstanding electrical conductivity, easily accessible (Wei *et al.*, 2005).

The polycondensation of resocinal and formaldehyde has been generally used for the carbon aerogels preparation because the physical properties of carbon aerogels can be easily controlled via modification of preparation conditions, for instance, concentrations, pHs, reaction times, and temperatures. However, carbon aerogels are generally obtained by supercritical drying which is inappropriate for commercialization due to high cost. Therefore, ambient drying process has been focused instead to obtain carbon aerogels (Lee *et al.*, 2010) and the carbon obtained via ambient drying is generally called "carbon xerogel". In this work, polybenzoxazine, a novel type of phenolic resin, was selected as a precursor for the preparation of carbon aerogels owing to its unique characteristics, e.g., excellent dimensional stability, low shrinkage upon polymerization and low water adsorption. Furthermore, the molecular design flexibility allows the tailoring of the cured materials properties in order to fit desired applications (Ghosh *et al.*, 2007).

The purposes of this work are to find out the optimum doping amount of metal oxide on the electrode surface and to evaluate the effect of metal oxide on the electrochemical properties.