สำนักงานวิทยทรัพยากร จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER I
INTRODUCTION

Currently, energy demand is increasing in our life; therefore, energy storage devices—batteries, capacitors and fuel cells—have been received great attention because they are good alternative power sources for electronic devices, electrical vehicles, digital telecommunication systems, and memory back-up systems, etc. Some problems found in these devices are low energy density, short life time and durability, high cost and toxic waste which limited their use.

Electrochemical supercapacitors are energy storage devices, which have a high specific capacitance and long life cycle. These devices can be categorized into two types according to their operation mechanisms: electrical double-layer capacitors (EDLCs) and pseudocapacitors. The former is based on charge separation at the electrode/electrolyte interface, whereas the latter is based on Faradaic redox reaction in the electrode surface formed with electroactive materials (Conway 1991). The materials studied for capacitors have been mainly of three types: carbon, metal oxide, and conducting polymers. Carbon aerogels are promising materials as electrodes for EDLCs due to their high performance and low cost (Pekala *et al.*, 1992).

Carbon aerogels normally are obtained via polycondensation of resorcinol and formaldehyde using acid or base as a catalyst (Fairén-Jiménez *et al.*, 2006). However, costly raw materials and tedious preparation time are the limitations for a commercial application. In this study, polybenzoxazine, a high-performance phenolic resin, is considered to be a precursor for carbon aerogel preparation because of its unique characteristics such as excellent dimensional stability and low water absorption. The molecular design flexibility allows the properties of the cured materials to be tailored for many applications (Ghosh *et al.*, 2007). Moreover, the facile synthesis approach adapted from the solventless method reported by Ishida et al. allows for scale-up production. Additionally, the surface characteristics of carbon aerogels—pore volume, pore size distribution and specific surface area—can be varied by changing concentration and type of precursors of benzoxazine and/or catalyst.

The purposes of this work are to fabricate the carbon aerogel electrodes for supercapacitors by using polybenzoxazine, a high-performance phenolic resin, as a precursor. The physical and electrochemical properties of the electrodes will be investigated. In order to compare the electrochemical properties, the activated carbon aerogel will also be studied.