Structural Design of Benzoxazine-derived Nanoporous Carbon Electrodes for Energy Storage Devices

Thanyalak Chaisuwan[1,2*], Wilawan Sukponchaikul[1], Peeranat Jitwatcharakul[1], Stephan T. Dubas[1,2] and Sujitra Wongkasemjit[1,2]

[1]The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330

[2]Center for Petroleum, Petrochemicals, and Advanced Materials, Chulalongkorn University, Bangkok 10330

Phone +66 2218 4185, Fax +66 2215 4459, [*]E-Mail: thanyalak.c@chula.ac.th

Abstract

In electrochemical energy storage devices, choosing the appropriate electrode materials could increase the efficiency significantly. In this study, polybenzoxazines were chosen as precursors to prepare 3D – interconnected nanoporous carbon. By varying different types of precursors and synthesis parameters, nanoporous carbon with different microstructures can be obtained. In case of using phenol and 4,4′-methylenedianiline based polybenzoxazine as a carbon precursor, it was found that polybenzoxazine with surfactant added and CO_2 activation exhibited remarkable improvement in textural properties with the surface area of 494 m^2/g and the total pore volume of 0.81 cm^2/g. The relationship between the specific capacitance and pore structure of the carbon electrodes was investigated. The electrochemical measurement in 1.0 M H_2SO_4 electrolyte showed that surfactant and CO_2 activation leaded to better capacitive performances with the specific capacitance of 275.16 F/g at a scan rate of 1 mV/s. The presence of micropores are essential for electrolyte ions adsorption, while the mesopores help to decrease the diffusive resistance of carbon electrodes and facilitate the electrolye ions transportation.

Keywords: energy storage, electrode materials, nanoporous carbon, polybenzoxazine