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The Effect of Microcrystallite Structure on Electrochemical Characteristics of Mesoporous Carbon Electrodes for Electric Double-Layer Capacitors

미세결정질구조가 전기적 이중층 커패시터용 메조다공성 탄소전극의 전기화학 특성에 미치는 영향에 관한 연구

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The effect of microcrystallite structure on electrochemical characteristics of mesoporous carbon electrodes was investigated by using X-ray diffractometry, nitrogen gas adsorption method, ac-impedance spectroscopy, potentiostatic current transient technique and cyclic voltammetry. For this purpose, the microcrystallite structure was controlled by using different carbonaceous precursors and varying synthetic process of the carbon electrodes. In order to characterise the microcrystallite structure, the sizes of the microcrystallite in the *a*- and *c*- axis direction, L_a and L_c were quantitatively estimated from the X-ray diffraction patterns using Scherrer's equation. From the analysis of the impedance spectra, it was found that the value of constant phase element exponent α decreased with increasing L_c/L_a due to the dominant contribution of the surface inhomogeneity to the capacitance dispersion on the carbon electrodes. Moreover, the value of the specific double-layer capacitance determined at the lowest frequency in the impedance spectra increased with increasing L_c/L_a. From the results of cathodic current transients and cyclic voltammograms, it is suggested that the ion penetration into the pores during double-layer charging/discharging is closely related to the microcrystallite structure. The kinetics of double layer charging/discharging was discussed for the carbon electrodes with different microcrystallite structures in terms of the RC time constant distribution.

Reference

1. S.-B. Lee, S.-I. Pyun, Electrochim. acta, 48 (2002) 419.