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Effect of Pore Size Distribution on the Kinetics of Double-Layer Charging/Discharging of Porous Activated Carbon Fiber Electrode

활성탄섬유의 기공크기분포가 이중층 충/방전의 속도론에 미치는 영향

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The effect of pore size distribution (PSD) on the kinetics of double-layer charging/discharging of an activated carbon-fiber cloth electrode was investigated in a 30wt.% H_2SO_4 solution using nitrogen gas adsorption, scanning electron microscopy (SEM), electrochemical impedance spectroscopy (EIS), and cyclic voltammetry. For this study, as-reactivated carbon-fiber cloth specimens with various PSDs were prepared by re-activation of the commercially as-activated carbon-fiber cloth at 1000 ℃ in an atmosphere of a CO_2/CO gas mixture for different activation times. From the results of nitrogen gas adsorption, it was found that the pore size of the carbon-fiber cloth specimen was non-uniformly distributed and the PSD changed with activation time. SEM micrographs revealed that the pore was cylindrical in shape irrespective of the pore size. In order to numerically analyze the electrochemical responses of the carbon electrode specimen with non-uniformly distributed pore size, we employed modified transmission line model in view of the PSD. The impedance spectra and cyclic voltammogram theoretically calculated were in good agreement in value and shape with those experimentally measured. The kinetics of double layer charging/discharging was discussed for the electrode specimen with different PSD in terms of the RC time constant distribution.

Reference

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