

A Study on Ionic Diffusion Towards Self-Affine Fractal
Electrodes by Cyclic Voltammetry and Atomic Force Microscopy
순환 포텐셜 전류법과 원자간력 현미경을 이용한 자기 유연 프랙탈
전극으로의 이온 확산에 대한 연구

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Ionic diffusion towards self-affine fractal electrodes was investigated using both cyclic voltammetry (CV) and atomic force microscopy (AFM). For this purpose, three kinds of self-affine fractal electrodes were first prepared by DC sputtering of Pt on the such substrate materials with different roughnesses as polished Al_2O_3 , etched Ni, and unpolished Al_2O_3 . And then, surface morphology of the electrodes was examined by using AFM and cyclic voltammograms were obtained from the electrodes in a 30 wt % glycerol + 70 wt % (0.01 M $\text{K}_4[\text{Fe}(\text{CN})_6]$ + 0.5 M Na_2SO_4) solution at various scan rates. Finally, fractal dimensions of the electrodes were determined from image analyses of AFM images and the power relation between peak current and scan rate in CV. All the fractal dimensions determined by CV were much smaller than the self-affine fractal dimensions determined by perimeter-area method. This means the self-affine fractal dimension is not always a sufficient condition required for describing the ionic diffusion toward the self-affine fractal electrode. Assuming the morphology of the self-affine fractal electrode can have a self-similar scaling property, apparent self-similar fractal dimensions of the self-affine fractal electrodes were determined by triangulation method and these values agreed well with the fractal dimensions determined by CV. From these results, it is concluded that the ionic diffusion towards the self-affine fractal electrode should be described by the apparent self-similar fractal dimension rather than the self-affine fractal dimension.

Reference

1. H.-C. Shin, S.-I. Pyun and J.-Y. Go, J. Electroanal. Chem., 531 (2002) 101.