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Theoretical Analysis of the Effect of the Surface Roughness on Lithium Transport through Fractal Li1-δCoO$_2$ Film Electrode

프랙탈 Li1-δCoO$_2$ 박막 전극내 리튬 이동에 미치는 표면 거칠기의 영향에 대한 이론적 해석

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The effect of the surface roughness on cell-impedance-controlled lithium transport through fractal $Li_{1-\delta}CoO_2$ film electrode was theoretically studied by the numerical analysis of the generalised diffusion equation (GDE). For this purpose, the numerical solution to the GDE was obtained using the finite difference method, and then the potentiostatic current transient and the linear sweep voltammogram (LSV) were theoretically calculated as a function of the fractal dimension under both the cell-impedance-controlled constraint at the electrode/electrolyte interface and the impermeable constraint at the electrode/current collector interface. From the change of shape and value in the theoretical current transient, it was noted that the initial current level increased and the characteristic time necessary until lithium reaches the impermeable boundary decreased with increasing fractal dimension. This result indicates that cell-impedance-controlled lithium transport is enhanced by the surface roughness of the electrode, which is consistent with the effect of the surface roughness on diffusion-controlled lithium transport. For the sake of clarity, the effect of the surface roughness on cell-impedance-controlled lithium transport was discussed in detail by comparison of the relationship between the peak current and the potential scan rate obtained from the theoretical LSV with the generalised Randles-Sevcik relation derived from the analytical solution to the GDE under the diffusion-controlled constraint.

References

1. H.-C. Shin and S.-I. Pyun, in Modern Aspects of Electrochemistry, C.G. Vayenas *et al.* Eds., Kluwer Academic/Plenum Publishers, New York, No. 36 (2003) 255.
2. Y. Dassas and P. Duby, J. Electrochem. Soc., 142 (1995) 4175.