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Quantitative Analysis of Lithium Transport through $Li_{1-\delta}CoO_2$ Thin Film Electrode

$Li_{1-\delta}CoO_2$ 박막형 전극을 통한 리튬 이동의 정량적 해석

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Quantitative analysis of lithium transport through $Li_{1-\delta}CoO_2$ thin film electrode prepared by Rf-magnetron sputtering was investigated in a 1M solution of $LiClO_4$ in propylene carbonate using galvanostatic intermittent titration technique (GITT), electrochemical impedance spectroscopy (EIS) and potentiostatic current transient technique. The experimental cathodic and anodic current transients did not follow Cottrell behaviour throughout the whole lithium intercalation/deintercalation time. In addition, the relation between initial current level and applied potential step remained ohmic. For quantitative analysis of the current transients, first, the electrode potential curve and the value of chemical diffusivity of lithium ion were determined by GITT and EIS, respectively. Next, the current transients were numerically simulated under the condition of the 'diffusion-controlled' lithium transport and the 'cell-impedance-controlled' lithium transport through the electrode subjected to the impermeable constraint to lithium. From the comparison of experimentally obtained current transients with those numerically simulated, it was suggested that lithium transport through $Li_{1-\delta}CoO_2$ electrode is mainly governed by 'cell-impedance'. Some discrepancies between experimental current transients and theoretical current transients were discussed in terms of electrochemical active area and the variation of chemical diffusivity and 'cell-impedance' with lithium stoichiometry.