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Lithium Transport through a Hard Carbon Electrode : Analysis of Potentiostatic Current Transients based upon Modified McNabb-Foster Equation

경질 탄소 전극내로의 리튬 이동 : McNabb-Foster 변형식에 근거한 정전압 전류추이 곡선 해석

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Lithium transport through a hard carbon (Carbtoon-P) electrode was investigated in a 1 M $LiPF_6$ - ethylene carbonate (EC) / diethylene carbonate (DEC) (50:50 vol.%) electrolyte by the analysis of potentiostatic current transients based upon the modified McNabb-Foster equation. The electrode potential increased monotonously with decrease of lithium content. This means that there is no phase transformation throughout the whole lithium deintercalation. However, the anodic current transients showed inflection points, indicating several kinds of lithium intercalation sites in the hard carbon electrode are kinetically distinguishable. Moreover, the anodic current transients did not follow Cottrell behaviour, but Ohmic behaviour. In order to numerically analyse the abnormal behaviour in the anodic current transients, we employed the modified McNabb-Foster equation as a governing equation, and the 'cell-impedance-controlled' constraint as a boundary condition. The anodic current transients theoretically calculated were in good agreement with those current transients experimentally measured in value and shape. From the comparison between the anodic current transients calculated with different release rates and capture rates for lithium ions at various initial electrode potentials in the McNabb-Foster equation, lithium transport through the hard carbon electrode with several kinds of lithium intercalation sites was theoretically analysed.

References

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