

리튬 이차전지용 전극재료인 다공성 $\text{Li}[\text{Ti}_{2-x}\text{Li}_x]\text{O}_4$ 에서의
리튬 이동에 대한 연구

**Analysis of Lithium Transport through Porous $\text{Li}[\text{Ti}_{2-x}\text{Li}_x]\text{O}_4$
as an Electrode Material for Rechargeable Lithium Battery**

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The lithium transport through porous $\text{Li}[\text{Ti}_{2-x}\text{Li}_x]\text{O}_4$ electrode was investigated in 1M LiClO_4 propylene carbonate solution by using potentiostatic current transient technique in combination with galvanostatic intermittent titration technique(GITT). Metallic oxide $\text{Li}[\text{Ti}_2]\text{O}_4$ and insulating oxide $\text{Li}[\text{Ti}_{5/3}\text{Li}_{1/3}]\text{O}_4$ are the end members of $\text{Li}[\text{Ti}_{2-x}\text{Li}_x]\text{O}_4$ solid solution series and electrochemical lithium intercalation into both oxides can reversibly occur. $\text{Li}[\text{Ti}_2]\text{O}_4$ and $\text{Li}[\text{Li}_{1/3}\text{Ti}_{5/3}]\text{O}_4$ powders were synthesized by solid state reaction at 850 °C for 24h in vacuum and at 800 °C for 24 h in air respectively, and then identified as the cubic spinel-framework structures with space group $\text{Fd}\bar{3}m$ by X-ray diffractometry. The charge-discharge curve of porous $\text{Li}_{1+\delta}[\text{Ti}_2]\text{O}_4$ electrode displayed a wide potential plateau near 1.34 $V_{\text{Li/Li}^+}$ and that of porous $\text{Li}_{1+\delta}[\text{Ti}_{5/3}\text{Li}_{1/3}]\text{O}_4$ electrode displayed wider potential plateau near 1.56 $V_{\text{Li/Li}^+}$. The occurrence of these potential plateaus are due to the coexistence of two pseudo-phases of a Li-diluted phase α and a Li-concentrated phase β . The measured current transients were analysed in terms of the α/β phase boundary movement based upon the concept of the quasi-equilibrium potential and the corresponding lithium stoichiometry established by the GITT. The scaling of the current and the time was performed with respect to the driving force for the phase boundary movement and the transferred charge by using the values of the quasi-equilibrium potential and the corresponding lithium stoichiometry. The scaled current transients agree satisfactorily with one another in their shape during the lithium intercalation as well as the deintercalation. In addition, the effects of substitution of lithium for titanium at octahedral sites in $\text{Li}[\text{Ti}_{2-x}\text{Li}_x]\text{O}_4$ on the lithium transport were discussed in terms of the difference of the crystal structure and electronic property.

References

1. T. Ohzuku, A. Ueda and N. Yamamoto, J. Electrochem. Soc., 142 (1995) 1431.
2. K.M. Colbow, J.R. Dahn and R.R. Haering, J. Power Sources, 26 (1989) 397.
3. Y.-M. Choi, S.-I. Pyun and S.-I. Moon, Solid State Ionics, 89 (1996) 43.
4. Y.-M. Choi, S.-I. Pyun and J.M. Paulsen, submitted to Electrochim. Acta for publication (1997).