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다공성 $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ 전극으로의 전기화학적 리튬 인터칼레이션에 대한 연구

The Electrochemical Lithium Intercalation into Porous $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ Electrode

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The electrochemical lithium intercalation into porous $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ electrode was investigated in 1M $LiClO_4$ propylene carbonate solution by using galvanostatic charge-discharge experiment, electrochemical impedance spectroscopy(EIS) and potentiostatic current transient technique. $LiAl_{1/4}Ni_{3/4}O_2$ powder was prepared by heating a pressed mixture of $LiNO_3$, $Al(OH)_3$ and $NiCO_3$ in stoichiometric proportions at 750℃ for 24 h in air. From the XRD pattern of synthesized powder, the crystal structure of $LiAl_{1/4}Ni_{3/4}O_2$ was identified as a rhombohedral one with $R\bar{3}m$ space group. The galvanostatic charge-discharge curve for the porous $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ electrode showed no potential plateau, indicating the lithium-ion diffusion in a single phase of the electrode. The electrode underwent a capacity loss during the first charge-discharge cycle, but it displayed no capacity loss during the subsequent charge-discharge cycles. This means that the cation mixing mainly occurs during the first charge-discharge cycle. From the impedance spectra of $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ electrode, it was observed that contact resistance associated with the arc in the high frequency range decreased and absorption resistance associated with the arc in the middle frequency range increased as $(1-\delta)$ in $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ increased, which are presumably due to the cation mixing effect and reduction in the number of available intercalation sites, respectively. The typical current transients showed that the lithium transport through the oxide electrode is largely governed by the lithium ion diffusivity value. The electrochemical lithium intercalation into porous $Li_{1-\delta}Al_{1/4}Ni_{3/4}O_2$ electrode has been discussed in terms of cation mixing effect.

References

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