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An Investigation of Lithium Transport through V_2O_5 Xerogel Film Electrode by Analyses of Ac-impedance Spectra and Current Transient

교류 임피던스 스펙트라 및 전류추이곡선 해석을 통한 V_2O_5 제로겔 박막 전극 내로의 리튬 이동에 관한 연구

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Lithium transport through amorphous vanadium pentoxide xerogel film electrode was investigated by using ac-impedance spectroscopy and potentiostatic current transient technique. The Nyquist plot of ac-impedance spectra exhibited a depressed arc associated with lithium absorption at the electrode/electrolyte interface in the high frequency range, and a straight line due to lithium diffusion in the low frequency range. Especially, the slope of the straight line was determined to be even lower than 45°. Such anomalous behaviour of diffusion impedance was analysed on the basis of modified transmission-line model in which the intercalation capacitances show a frequency dispersion due to the structural disorder. From the analysis of the anodic current transient it was found that when the potential step is taken so large that the lithium extraction potential exceeds the transition potential, the 'real potentiostatic' boundary condition is established at the electrode surface.

However, the anodic current transient measured under the 'real potentiostatic' boundary condition did not follow the Cottrell behaviour with the slope of -0.5, but simply showed a linear relationship between the logarithm of current and the logarithm of time with the slope negatively deviating from -0.5. Furthermore, both the current transient and impedance spectra were found to be highly dependent in shape and value on the drying temperature. Based upon the results numerically calculated in consideration of the structural disorder, consequently, these anomalous behaviours of current transient and diffusion impedance were discussed in terms of lithium transport through the disordered oxide lattice induced by the water molecules incorporated into the xerogel film electrode.

Reference

1. S.-I. Pyun and J.-S. Bae, J. Power Sources, 68 (1997) 669.