Measuring the Lithium Ion Diffusion Coefficient in Tin Thin Films: Comparisons Between Using Impedance Spectroscopy and Galvanostatic Intermittent Titration Technique

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Tin is a scientifically and practically interesting material for use in the anode of lithium-ion batteries. Its high specific capacity (994 mAh/g), due to the Li_xSn system's capability to be cycled between x=0 to 4.4[1], have led to many studies on tin, and its alloys with other elements such as silicon, nickel, and copper.

At the 223rd Electrochemical Society Meeting, we presented on using the Galvanostatic Intermittent Titration Technique (GITT) to extract the lithium ion diffusion coefficient in tin thin films. Thin films are chosen because its geometry simplifies data analysis, and they can be used in solid-state batteries. We showed that the single phase assumptions usually assumed for analysis of the GITT response cannot be used to explain the potential plateaus obtained during the current pulses. At these potentials, a moving boundary model needs to be used to fit to the measured potential response.

Another method commonly used to measure lithium ion diffusion coefficients is Electrochemical Impedance Spectroscopy (EIS)[2]. In this report, we'll discuss equivalent circuits that can be used to fit to the measured EIS results. The use of a phase transformation capacitance is shown to be important in obtaining a good fit. The relationship between the phase transformation capacitance and the moving boundary model will be discussed. The lithium ion diffusion coefficient in tin, as a function of potential, is extracted from the EIS data and compared to those obtained using GITT.

References

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2. A. V. Churikov, K. I. Pridatko, A. V. Ivanishchev, I. A. Ivanishcheva, I. M. Gamayunova, K. V. Zapsis, and V. O. Sycheva, *Russian Journal of Electrochemistry*, **44**, 550 (2008).