164e The Development and Application of Symbolic Solutions for Ac Impedance Response of Electrochemical Power Sources

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AC impedance is a powerful non-destructive technique and has been used to analyze electrochemical power sources by various researchers. Recently, electrochemical models based on transport phenomena, material/energy balance, and porous electrode theory have been used to simulate AC impedance of secondary batteries and fuel cells.

A closed form solution for AC impedance as a function of all the system parameters will pave way for better understanding, design, parameter estimation and optimization of electrochemical power sources. Though all the governing equations are linear, researchers have typically used only a numerical solution, as there is a need to solve coupled partial differential equations in multiple domains simultaneously. We discuss various methods to obtain the AC impedance response as a function of the system parameters. Our approach involves a combination of matrix methods, approximate solutions and numeric symbolic solution[1,2. In addition, we will show the use of the novel symbolic solutions in predicting the transport and kinetic parameters of electrochemical power sources.

The advantages and disadvantages of the proposed method in simulating the AC impedance response of electrochemical power sources will also be discussed.

References:

1. V. R. Subramanian and R. E. White, “Symbolic solutions for boundary value problems using Maple,” Comp. Chem. Engng., 24(11), 2405-2416 (2000).

2. S. Devan, V. R. Subramanian and R. E. White, "Analytical Solution for the Impedance of a Porous Electrode,” J. Electrochem. Soc., 151(6), A905-A913 (2004).