22k Reducing the Order of Current-Potential Distribution Models

Venkat Subramanian and Vinten Diwakar

Recently, volume-averaging and Liapunov-Schmidt theory have been used to reduce the order of governing equations for transport in reactors.1 This technique reduces the order of original equation (from 2D to 1D) and predicts the expected behavior under a wide range of conditions and has been shown to be useful for bifurcation analysis. In this paper, we show the utility of the same approach for modeling current-potential distributions in electrochemical systems. For illustration, modeling of through-hole deposition is considered. Compared to models for chemical reactors, for electrodeposition, additional challenges arise because of the need to solve multiple dependent variables in multiple domains. Both secondary and tertiary distributions are predicted by simplifying the original set of equations (2D in multiple domains) to one-dimensional equations in multiple domains. The results predicted are in reasonable accuracy compared to the rigorous 2D models, which are difficult to simulate for high values of Peclet numbers.2

References: 1. Chakraborty. S and V. Balakotaiah, "Two-Mode Models for describing Mixing Effects for Homogeneous Reactors", AIChE J., 48, 11, 2571-2586 (2002). 2. V. R. Subramanian, “Reducing the Order of Current-Potential Distribution Models – Use of Volume Averaging”, to be submitted to the AIChE journal.