Classification of Spatio-temporal Patterns in Charging and Discharging of Li-ion Batteries

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Abstract

We classify the dynamic patterns that emerge in charging or discharging of Li-ion batteries, under galvanostatic conditions, using simulations of the two-phase 1D porous model. This work examines the effect of exchange current function, $R_0(X)$, which expresses the nature of kinetics and extends our previous study limited to $R_0=1$ for which the same pattern emerges, whether homogeneous or step-wise process made of multiple symmetry breaking events. With the commonly-used asymmetric $R_0(X)$ the emerging pattern may be one of the two above or fronts that follow single SB event and lithiation/delithiation behaviors are different. These effects are clear when parameters are uniform; non-uniformity leads to noise that mask the behavior. The full 4-variable model exhibits SB, even in absence of noise, since the liquid potential gradient () works like a perturbation. Similarity between noise and gradient effects allows us to derive approximations to full model behavior, and study various effects.

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