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Martin Z. Bazant* (bazant@stanford.edu), 488 Escondido Mall, Bldg. 02-500, Rm. 500A, Stanford, CA 94305. *Intercalation dynamics in rechargeable batteries.*

In spite of extensive applied research, the performance of rechargeable batteries has improved only incrementally in recent decades. Power density must improve drastically for new applications such as electric vehicles, and this will require advances in our fundamental understanding of intercalation dynamics – how ions are cycled in and out of host particles in electrodes. The current model for phase separating compounds, such as LiFePO_4 , assumes that the new phase replaces a diffusive "shrinking core" of the other, but recent experiments show instead the phase interface spanning the particle along crystal axes of fast diffusion. Here, we present a general phase-field theory of intercalation dynamics with two key features: (i) strong bulk anisotropy and (ii) surface reactions driven by electrochemical potential differences, including entropic and gradient contributions. The theory reproduces shrinking-core dynamics in some limits, but in the relevant regime for lithium iron phosphate, also predicts nonlinear phase-transformation waves, consistent with experimental observations. (Received September 14, 2008)