

SEMINAR

Friday 21st June 10:00 am

Scuola di Ingegneria UniPi, Aula Pacinotti

Control of Battery Phase Transformations by Electro-autocatalysis

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The rapid, stable cycling of rechargeable batteries requires well-controlled phase transformations of the redox active materials in each electrode, between the charged and discharged states. In Li-ion batteries, common intercalation materials, such as graphite and iron phosphate, undergo phase separation (into Li-rich and Li-poor phases), which limits the power density and causes degradation, and unusual high-rate “phases” have also been reported in solid-solution NMC layered oxides. A general stability theory will be presented for single particles and populations in porous electrodes, based on electrochemical non-equilibrium thermodynamics, which accurately predicts the driven phase behaviour revealed by X-ray imaging. Interfacial stability is strongly influenced by the asymmetric dependence of the exchange current on concentration (“electro-autocatalysis”).

Bio

Prof. Martin Z. Bazant is E. G. Roos Professor Chair and Executive Officer of Chemical Engineering and Mathematics at the Massachusetts Institute of Technology. He received his B.S. in Mathematics and Physics in 1992 from the University of Arizona, his M.S. in Mathematics in 1993 from the same university and a Ph.D. in Physics at Harvard University in 1997. He joined MIT in 2000 as Assistant Professor and was then promoted Associate Professor in Mathematics in 2003 and in Chemical Engineering in 2009 and eventually Full Professor in 2012. He held visiting professorship positions at Stanford University, Ecole Supérieure de Physique et Chimie Industrielles in Paris and at the University of Minnesota. His main research interests include the mathematical modelling of electrochemical energy systems, with special focus on Li-ion batteries, electrodeposition and electrodialysis, by developing new theoretical branches of nonlinear electrokinetics and non-equilibrium thermodynamics. He has published more than 200 papers in international peer-reviewed journals (h-index > 60) and his scientific achievements have been recognised by prestigious awards among which the Andreas Acrivos Award for Professional Progress in Chemical Engineering, the Alexander Kuznetsov Prize in Theoretical Electrochemistry and the Brilliant Ten by Popular Science Magazine. He is Fellow of the American Physical Society, Fellow of the Royal Society of Chemistry, Fellow of the International Society of Electrochemistry and serves as Section Editor for Current Opinion in Colloid and Interface Science, Associate Editor of the SIAM Journal of Applied Mathematics and of Scientific Reports (Nature Publishing Group).