Texas Tech Department of Chemical Engineering
Seminar Series

Electrokinetics, transport and geometric stability of reactive metal electrodes in high-energy batteries

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Abstract

Electrodeposition is an electrochemical process that is widely used for creating metal, colloid, and polymer coatings on conductive substrates. The process also plays an important role in electrochemical storage technologies based on rechargeable batteries, where it must be carefully managed to facilitate stable and safe operations at low operating temperatures, high rates, and over many cycles of charge and discharge. A successful electrodeposition process requires fast interfacial transport of charged species (e.g. ions, particles, & polymers) and reversible redox reactions at liquid-solid interfaces. This talk considers the stability of electrodeposition of reactive metals on planar electrodes in liquid and semisolid structured electrolytes in which neither of these requirements are met in state-of-the-art rechargeable battery chemistries. Rechargeable batteries based on alkali metals, including lithium and sodium, have nonetheless been argued to offer potential for tranformational improvements in electrochemical storage technology over today's lithium ion batteries. As a result, they are under active investigation worldwide for high-energy, portable energy storage solutions in multiple fields. Beginning with analyses of electrokinetics in solid and viscoelastic liquid electrolytes, the talk will evaluate the stability limits of electrodeposition of metals in general. With an emphasis on understanding the role of electrolyte and electrode-electrolyte interphase design for enabling stable electrodeposition, the talk will explore materials design strategies for minimal electrolytes and electrochemical interphases that stabilize deposition of reactive metals.

Bio

Lynden Archer is the James A Friend Family Distinguished Professor of Chemical and Biomolecular Engineering and Director of the Cornell Energy Systems Institute. His research focuses on transport properties of polymer/particle hybrids, and their applications for electrochemical energy storage. Archer received his Ph.D. in chemical engineering from Stanford University in 1993 and was a Postdoctoral Member of the Technical Staff at AT&T Bell Laboratories in 1994. He is an elected member of the National Academy of Engineering (NAE) and fellow of the American Physical Society (APS). His research contributions have also been recognized with various awards, including the AICHE Nanoscale Science and Engineering Forum award, the National Science Foundation award for Special Creativity, a NSF Distinguished Lectureship in Mathematical & Physical Sciences, the American Institute of Chemical Engineer's MAC Centeniell Engineer award, and the Thompson-Reuters World's Most Influential Scientific Minds in Materials Science for 2014 & 2015. At Cornell, he has been recognized with the James & Mary Tien Excellence in Teaching Award and thrice with the Merrill Presidential award as the most influential member of the Cornell faculty selected by a Merrill Presidential Scholar awardee. He previously served as Director of the School of Chemical and Bimolecular Engineering from January 1, 2010 to June 30, 2016.

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