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Chemo-Mechanics of Advanced Rechargeable Battery Materials



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ABSTRACT:

There is currently a growing demand for low-cost, high-performance electrochemical energy storage solutions to consumer electronics, vehicle electrification and stationary power management. The successful development and deployment of such solutions necessitate a fundamental understanding of the mechanical characteristics of electrochemical materials, as well as the intricate coupling between the electro-chemo-mechanical processes in these materials. In this talk, I will present a combined experimental and computational investigation of the mechanics of solid electrode and electrolyte materials for their use in next-generation rechargeable batteries. The presentation will focus on: (i) study of deformation and failure processes in large-volume-change electrode materials using novel in situ and ex situ nanomechanical experiments; (ii) continuum and atomistic modeling for revealing the mechanistic origins of these phenomena; (iii) chemo-mechanical degradation in ionically conductive solid electrolytes; and (iv) outlook on multiphysics research in advanced rechargeable batteries.

BIOGRAPHY:

Dr. Shuman Xia is an Associate Professor in the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. He obtained his B.S. in Theoretical and Applied Mechanics with highest distinction from Beijing University in 2003, and then attended Brown University where he received a M.S. in Applied Mathematics and a Ph.D. in Engineering (Solid Mechanics) in 2008. He joined the faculty of Georgia Tech in 2011 after completing postdoctoral studies at the California Institute of Technology. His research interests include mechanics of energy storage materials, experimental nano- and micro-mechanics, fracture and failure of heterogeneous media, and mechanics of active materials. He is the recipient of the Orr Early Career Award from the Materials Division of the American Society of Mechanical Engineers (ASME), the James W. Dally Young Investigator Award from the Society for Experimental Mechanics (SEM), the Eshelby Mechanics Award for Young Faculty, and the NSF CAREER Award.