Northwestern | McCORMICK SCHOOL OF ENGINEERING
Materials Science and Engineering

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Interfacial Stress, Strain and Stabilization in Li-ion Battery Electrodes

The high-rate exchange of lithium ions required for more power and faster charging of Li-ion batteries generates significant stresses and strains in the electrodes that ultimately lead to performance degradation. To date, electrochemically-induced stresses and strains in battery electrodes have only been studied individually and the relative contributions to battery performance/degradation have remained unknown. This seminar describes a new technique to probe the electro-chemo-mechanical response of electrodes by calculating the electrochemical stiffness via coordinated *in situ* stress and strain measurements in both graphite anodes and lithium manganese oxide ($LiMn_2O_4$) cathodes. Tracking changes in the electrochemical stiffness provides new insights into the effects of individual phase changes on the mechanical responses and kinetic limitations on lithium insertion and removal from the host electrode. Additionally, we investigate more deeply the mechanisms for strain generation in electrodes and the surprising effects of various interfacial coatings. The *in situ* strain measurements provide new insights into the electrochemical-induced volumetric changes in electrodes with progressing cycling and provide guidance for both passive and dynamic materials-based strategies to reduce strain and capacity fade, and potentially heal/stabilize electrode interfaces.

Nancy Sottos is the Donald B. Willet Professor of Engineering in the Department of Materials Science and Engineering and the Beckman Institute at the University of Illinois Urbana-Champaign. Sottos started her career at Illinois in 1991 after earning a Ph.D. from the University of Delaware. Her research interests include self-healing polymers and advanced composites, mechanochemically active polymers, tailored interfaces and novel materials for energy storage. Sottos' research and teaching awards include the ONR Young Investigator Award, Scientific American's SciAm 50 Award, the Hetényi Best Paper Award in Experimental Mechanics, the M.M. Frocht and B.J. Lazan Awards from the Society for Experimental Mechanics, the Daniel Drucker Eminent Faculty Award and an IChemE Global Research Award. She is a Fellow of the Society of Engineering Science and the Society for Experimental Mechanics.