

AEROSPACE & MECHANICAL ENGINEERING



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INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL
UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: Professor Robert M. McMeeking
Mechanical Engineering Department
University of California, Santa Barbara
Santa Barbara, California

TOPIC: MODELS FOR LITHIUM-ION BATTERY PERFORMANCE AND DAMAGE

DATE: Tuesday, May 1, 2012

TIME: 3:30 pm

PLACE: 138 DeBartolo Hall

ABSTRACT

Models are developed for the transport of Li ions in the electrolyte of lithium ion batteries, their diffusion through storage electrode particles, and their kinetics through the surface of the particles between the electrolyte and the particles. As a consequence of the Li ion intercalating in the storage particles, their lattice swells, leading to elastic stress when the concentration of Li ions in the particles is not uniform. The models of transport are based on standard concepts for multi-component diffusion in liquids and solids, but are not restricted to dilute solutions, or to small changes in the concentration of the diffusing species. In addition, phase changes are permitted during mass transport as the concentration of lithium varies from the almost depleted state of the storage particle to one where the material is saturated with its ions. The elastic swelling and shrinkage may involve very large dilatations. Thus, the models should be suitable for storage particles where the amount of Li can vary by large amounts depending on the state of charge, for staging as observed in the storage process in graphite, for the enormous swelling that takes place when silicon is used for storage, and for electrolytes in which the concentration of Li ions is high. The model is used to compute the processes of charging and discharging the battery to assess the parameters that influence the development of stress in the storage particles, and to deduce the likelihood of fracture of the storage particle material. The objective is to assess designs of porous electrode microstructures that permit rapid charging and discharging, but obviate the likelihood of fracture and other mechanical damage that limit the performance and reliability of the battery.

NOTE: *If you are interested in meeting individually with
Dr. McMeeking, please contact Nancy at 631-9024*