## MAR12-2011-020156

Abstract for an Invited Paper for the MAR12 Meeting of the American Physical Society

Understanding the Degradation of Silicon Electrodes for Lithium-Ion Batteries Using Acoustic Emission and Fracture Mechanics<sup>1</sup> CLAUS DANIEL, Oak Ridge National Laboratory and University of Tennessee

Silicon is a promising anode material for lithium-ion battery application due to its high specific capacity, low cost, and abundance. However, when silicon is lithiated at room temperature, it can undergo a volume expansion in excess of 280%, which leads to an extensive fracturing. This is thought to be a primary cause of the rapid decay in cell capacity routinely observed. We have developed a special cell design which allows us to monitor acoustic emissions stemming from mechanical events in the cell and allow for detailed structural analysis using X-ray diffraction with an internal standard. The combined result from acoustic emissions and X-ray diffraction allow for a first of its kind detailed look at how silicon anodes degrade and together with presented theories of fracture mechanics enable a material engineering approach to optimize its long term behavior. In collaboration with Kevin Rhodes and Sergiy Kalnaus.

Parts of this research were performed at the High Temperature Materials Laboratory, a national user facility sponsored by the same office.

<sup>1</sup>This research at Oak Ridge National Laboratory, managed by U.T. Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00OR22725 was sponsored by the Vehicle Technologies program for the Office of Energy Efficiency and Renewable Energy.