Effects of Concentration expansion co-efficient on diffusion induced stresses (DIS) for battery application

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1. INTRODUCTION & OBJECTIVE

Most lithium-ion battery electrodes experience large volume changes associated with Li concentration changes within the host particles during charging and discharging. Electrode failure, in the form of fracture or decrepitating, can occur as a result of repeated volume changes. It has been found many electrode materials, such as graphite, Si, and LiFePO4, change their elastic properties upon lithiation. Also it has been found that the diffusion induced stress depends upon a parameter called '**Concentration expansion Coefficient**'. However in previous DIS models the effect of **Concentration expansion Coefficient is** rarely studied. The value of concentration expansion is constant for a particular anode particle. Usually anode particle is made of either graphite or Si. For example, graphite, the most common negative electrode for Li ion batteries, expands 10% of its volume when Li intercalates between the graphite sheets. Compared to graphite, Si can store 10 times more Li, but is associated with massive volume expansion, on the order of 300%. The large volume expansion and the associated stress within electrodes can lead to fracture and failure of electrodes, causing capacity loss of batteries. Instead of using pure graphite or Si electrode composite electrode can be used to study the effect on the diffusion induced stresses.

2. RESULTS & HIGHLIGHTS OF IMPOINTANT POINTS

The effect of concentration dependent Young's Modulus on DIS is analyzed in this study. Also the effect of **Concentration expansion Coefficient (*α*)** on DIS is studied so that we can understand how the stresses vary for different values of **α.** After interpreting the results it can be judged whether composite electrode will be beneficial or not in terms of DIS and if yes what is the optimum value for α so that such composite anode can be produced in future for better performance of the battery cell and improve the overall battery pack life.

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