

Understanding the Mechanical Degradation of High Energy Density Electrode Materials for Next Generation Lithium Ion Batteries

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Abstract

Diffusion induced stress is believed to be one of the major driving forces responsible for the mechanical degradation especially for electrode materials with high capacity in lithium ion batteries. On the other hand, due to the coupling effect, stress can also affect the diffusion and therefore change the cycling efficiency, which is not fully understood. In this talk, we will first introduce how to in situ characterize diffusion induced stress, combining the in-situ optical observation of crack generation and propagation in a Si thin film electrode. We will then discuss different approaches to tailor the nanostructure for mitigating mechanical degradation of the Si electrode to improve its capacity retention and cyclic life, including patterning Si to accommodate stress relaxation and applying surface coatings to modify the stress gradient and provide an energy barrier for crack nucleation.

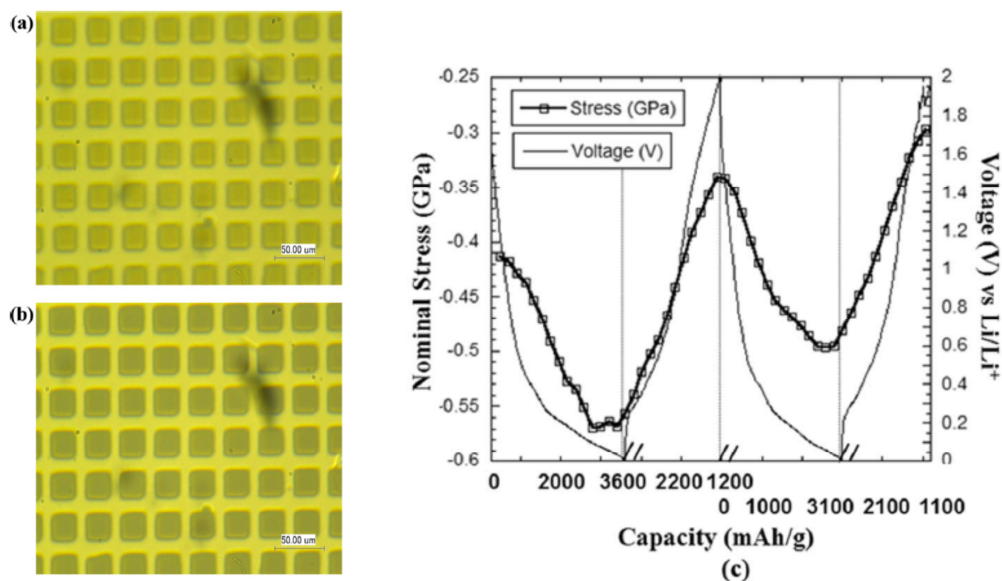


Figure 1. In-situ optical images show Si patterns before lithiation (a) and after lithiation (b); in-situ electrochemical stress sensor shows the stress evolution during the cycling (c).