A Mechanical Method of Determining Battery Aging and State of Health for Lithium-ion Pouch Cells

Abstract:

Monitoring state of health (SOH) over time is important in describing battery aging, yet a quick and accurate measurement of SOH is complicated and remains a challenge. In this presentation, we demonstrate a mechanical method of determining SOH by using stress measurements. By constraining lithium-ion pouch cells inside designed fixtures and monitoring stress and capacity over time, we obtain a linear relationship between peak stress and SOH. Such a linear relationship is due to growth of an irreversible film at the anode, which consumes active lithium and leads to capacity fade. After further investigation of the fundamentals behind such a linear relationship using batteries from different batches, we show that the linearity can be observed in all experiments but with different slopes, due to variations in both mechanical and electrochemical properties of battery components. The slopes of the linearity can also vary under various depth of discharge due to different average stress levels batteries experience. In sum, it is the combined effect from electrochemistry and mechanics that lead to the observed stress-SOH behaviors.