Project Title: Impedance Measurements of Gold-Coated Lithium Manganese Oxide

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Project Description:

The increasing demand for electric vehicles and portable electronics urgently calls for improvements in battery performance, for example, increases in energy capacity and cycle life. Lithium manganese oxides (LMO) are promising cathode materials for electric vehicles due to its low cost, thermal stability, abundance and lack of toxicity. However LMO suffers from significant capacity fade due to manganese dissolution, solution-electrode interface (SEI) instability and Jahn-Teller effect. Coating the surface of the LMO with an oxide or phosphate exhibits improved electrochemical properties such as lower capacity fade, higher rate capabilities and longer lives. Recently, Au coated LMO shows superior electrochemical performance, and reduction in manganese dissolution into the electrolyte. Although researchers reported improved electrochemical characteristics of LMO electrodes by the various coating techniques, the underlying mechanism of the coated electrodes has not been fully understood yet. Coating of the electrode might regulate the lithium diffusion into the bulk electrode and prevent contact between the electrode and electrolyte. Understanding the sources of resistance with the electrodes is a key factor to shed light on the mechanism. Electrochemical impedance spectroscopy is an effective technique to analyze the transport and kinetic properties of electrodes. Monitoring the changes in the transport and kinetic properties of gold-coated LMO during charging/discharging will provide vital information to find out the mechanism responsible for improving the battery performance.

An undergraduate student will be responsible for producing cathode materials, preparing coin-cell batteries and performing electrochemical experiments. Furthermore, the student will analyze electrochemical impedance spectroscopy results and calculate the kinetic and transport properties. Our group is also performing in-situ stress and strain measurements to understand the mechanical deformation in the cathode electrodes. The student will be able to participate in different projects and collaborate with various graduate students, scientist and professors from different universities and national labs.

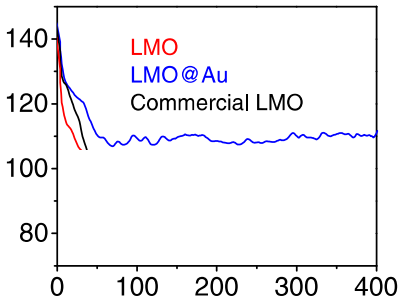

Figure 1: Discharge Capacity over 400 cycles for LMO, gold coated LMO(LMO@au) and commercial LMO at 1 C rate.
Reference is Gewirth et al, J. Electrochem. Soc., 162,2015

Student background

We are seeking an en enthusiastic individual, who is interested in *energy storage,* and *electrochemistry.* Experience in the laboratory is preferred, but not mandatory. The student should be capable of operating equipment for electrochemical testing, and possess strong communication skills. Primary duties include hands on work in the lab with fabrication and testing, as well as data processing. Woman and minorities in STEM are encouraged to apply.

Points of Contact:

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