Metallic Lithium Electrodes: Electrochemistry in Shape-Changing Surfaces

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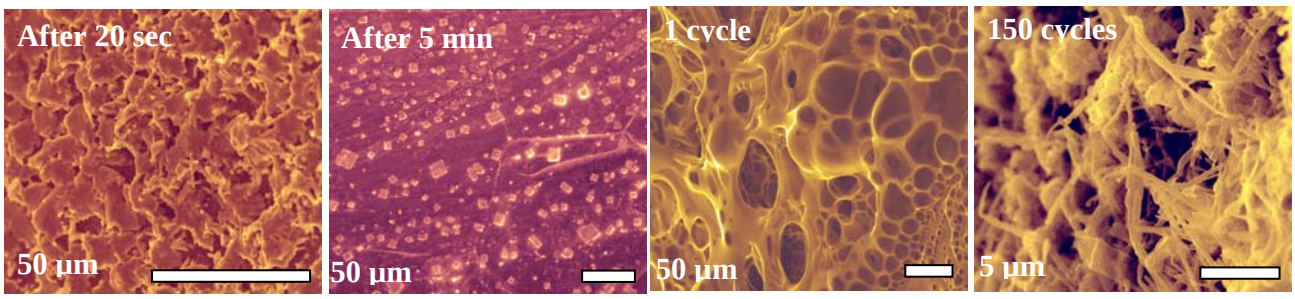
Abstract



Metallic lithium offers several advantages over the graphitic negative electrode materials currently in use for lithium batteries; including high energy density, large specific capacity and the possibility of using either charged or discharged positive electrode materials. However, problems with safety and efficiency during prolonged battery operation prevent metallic lithium from being used in advanced lithium batteries. Many of these problems are associated with changes in lithium metal surface morphology (i.e. shape) which lead to dendritic/mossy growth on repeated dissolution and plating of lithium. These high surface area structures are widely believed to be the cause of instability and safety issues for these batteries. Nonetheless, the vast majority of the studies previously done have focused primarily on the bulk properties of the electrodes rather than on understanding how the shape changes of the surface influence the observed electrochemical behavior. In my research I use Scanning Electrode Microscopy (SEM) in order to correlate systematic changes in surface morphology at different size scales (micron to nanoscale) to macroscopically measurable electrochemical properties. In this way a more definite solution to the instability and safety problems currently faced by metallic lithium electrodes may be addressed more effectively, and a practical solution that will allow their incorporation into rechargeable advanced batteries may be found.