Electrodeposition of high capacity nanostructured battery electrodes for conventional and solid-state batteries

Paul V. Braun, University of Illinois Urbana-Champaign

Short summary

Conventional batteries contain electrodes consisting of a mixture of active material, binder, and conductive additives. Via electrodeposition, we have realized nearly dense crystallographically oriented nanostructured electrodes which provide near-theoretical capacities and attractive rate performances. We will discuss the electrodes and solid-state and conventional batteries built using electrodeposited electrodes.

Abstract

Conventional batteries contain composite electrodes consisting of a mixture of active material, binder, and conductive additives on a current collector. Such composite electrodes exhibit energy densities below the theoretical limit of an active material only electrode due to the volume and mass of the additives and are limited to planar form factors. Via electrodeposition, we have realized nearly dense crystallographically oriented cathodes within the families of $LiCoO_2$, $NaCoO_2$, $LiMn_2O_4$, and Al-doped $LiCoO_2$ and anodes in the families of silicon and tin which provide near-theoretical capacities and attractive rate performances. Unique aspects of electrodeposition include that the electrode can be formed on a wide range of size and shape of current collectors, including nanostructured current collectors, and the electrodeposition process provides control of the crystallographic orientation of the deposited film which is important to enable good rate performance. We will discuss the electrodes and solid-state and conventional batteries built using electrodeposited electrodes.