Carbon Coatings on a Copper Antimonide Anode for Enhanced Performance and Lifetime in Rechargeable Metal-Ion Batteries

Chandra, Jay

The research project focused on the coating of a copper antimonide (Cu2Sb) anode material, characterizing the coating, and determining effects it had on the cycling of a battery. The carbon coating was expected to increase the lifetime of the battery due to maintaining electrical contact throughout the anode, physically reducing the negative effects of the breaking apart of the Cu2Sb anode material, and improving surface electrolyte interface (SEI) formation. It was advantageous to focus on a Cu2Sb anode material since copper antimonide batteries are generally safer than traditional anodes and have the potential for use in sodium ion batteries. The Cu2Sb was synthesized using electrodeposition from an aqueous solution. The carbon coating was formed using chemical vapor deposition (CVD) through the decomposition of acetylene. Battery half cells were made using the anode material, they were repeatedly cycled (charged and discharged), and voltage and current data was collected. The CVD procedure was developed to reproducibly form a consistent, thin carbon coating on the Cu2Sb. Raman spectroscopy showed it was an amorphous graphitic carbon coating. Early cycling data displayed a distinct difference between coated and non-coated anodes. Initially, the carbon coating favorably altered the electrochemical interactions between the anode material and the electrolyte. To make definitive conclusions about the effect of the carbon coating on the lifetime performance of a battery, extended cycling experiments must be run for a few months. This would allow for the determination of the anode lifetime, which could truly reveal the possible advantages of the carbon coating.

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Fourth Award of $500

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