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Faculty of Science

Chemistry Department



**Preparation and characterization of anodes by
electrodeposition for lithium ion batteries from
ionic liquids**

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Ph.D Thesis

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Preparation and characterization of anodes by electrodeposition for lithium ion batteries from ionic liquids

Sherief Al khey

Abstract

Lithium ion batteries have attracted considerable attention because of the high energy density, long cycle life, reasonable production cost and the ease of manufacturing. As the capacity of the current Li ion batteries is limited by the low theoretical capacity of the conventional graphite anode, the aim of the present thesis is the synthesis and characterization of high capacity anodes for lithium ion batteries as a possible replacement to the conventional graphite anode by electrodeposition from ionic liquids.

Ionic liquids have received significant attention as promising alternatives to conventional electrolytes in different electrochemical processes due to their unique physicochemical properties.

- The water absorption tendency of the ionic liquid electrolyte [Py_{1,4}]TfO / 0.1 M SnCl₂ under ambient atmosphere and its influence on the hydrolysis of Sn(II) species and on the electrodeposition of tin was studied. It was shown that the employed ionic liquid electrolyte strongly absorbs water under ambient conditions. The presence of water as well as the hydrolysis product affects the electrochemical behavior of the employed electrolyte and the morphology of tin electrodeposits.
- The electrodeposition of Sn, In and Sn-In alloys were investigated from two different ionic liquids 1-butyl-1-

methylpyrrolidinium trifluoromethylsulfonate ([Py_{1,4}]TfO) and 1-ethyl-3-methylimidazolium trifluoromethylsulfonate ([EMIm]TfO) at room temperature. The electrochemical behavior in the two ionic liquids was investigated by CV. The surface morphology of the electrodeposits depends on the deposition potential and the percentage of Sn in Sn-In alloy was found to be dependent on the applied potential.

- The electrochemical deposition of Sn, Sb and Sn-Sb films and nanowire arrays from the ionic liquid [Py_{1,4}]TfO via a template assisted electrodeposition process using track etched polycarbonate membranes were shown. High quality free standing Sn, Sb and Sn- Sb alloys nanowires arrays were prepared.
- The electrochemical behavior of In from two ionic liquids [EMIm]TfO and [EMeOIm]TfO was studied using cyclic voltammetry and potentiostatic. The surface morphology and composition of indium thin films was investigated using scanning electron microscopy (SEM) and energy dispersive x-ray (EDX). The insertion of methoxy group into the side chain of the imidazolium based cation has a strong effect on the electrodeposition pathway of In in comparison to [EMIm]TfO. In addition, In nanowire arrays were electrodeposited using template assisted electrodeposition method using track etched polycarbonate membrane (PC) from two ionic liquids.

- The performance of the electrochemically made films/
nanowire arrays as anodes for Li ion batteries was briefly
demonstrated.

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