CONTEMPORARY METALLIC MATERIALS

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Chapter 010

Synthesis and Characterization of Lithium Manganese Copper Oxides for Use in Lithium Rechargeable Cells

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Abstract: Lithium manganese copper oxides are synthesized using the sol-gel method. Thermal studies are performed on the precursor material to investigate the behaviour of the material when subjected to heat. From the thermmogravimetric traces, a suitable annealing temperature is identified and the precursors are heated at this temperature for 24 hours. X-Ray diffraction (XRD) studies are performed on the annealed samples and the XRD's are compared to that of the spinel $LiMn_2O_4$. Cyclic voltammetry (CV) experiments are done using the final cathode active material to study the redox potential of the materials.

Introduction

Present commercial lithium-ion cells employ toxic materials such as cobalt and nickel in their cathode materials [1, 2]. Cobalt is also an expensive metal and not abundant in nature [3-5]. Therefore, it is logical to seek other less toxic and more environmentally friendlier materials.

Manganese is a relatively cheap metal and abundant in nature [6-9]. It is also very well known in the battery industry [8, 9]. It is used in the manufacture of dry cells. The layered lithium manganese oxide and the spinel lithium manganese oxide have been quite extensively studied over the past 20 years. Layered lithium manganese oxide is a 3 V cathode material while the spinel is a 4 V cathode material [10]. However, the spinel lithium manganese oxide suffers from capacity fading [11-13]. One way of solving this problem is to introduce some other cation in the spinel matrix.

In this work, copper is introduced into the spinel structure and the material is characterized using the thermogravimetric analysis (TGA), X-Ray Diffraction (XRD) spectroscopy and Fourier Transform Infrared Spectroscopy (FTIR). Electrochemical studies are then made using cyclic valtammetry.

Experimental

$LiMn_{(2-x)}Cu_xO_4$ where x = 0.6, 0.8 and 1.0 are synthesized using the sol-gel method. Lithium acetate, manganese acetate and copper acetate are added together and stired with a magnetic stirrer in ethanol (absolute). Once the acetates have dissolved, a gelling agent is slowly added