

**Characterization of lithium intercalation oxides based on manganese
and copper**

BY

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DECLARATION

I hereby declares that the work reported in this dissertation is my own unless specified and duly acknowledged by quotation

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Abstract

In this study, several lithium intercalation compounds have been synthesized and characterized. Lithium manganese copper oxide cathode materials were prepared by sol gel method using tartaric acid as the gelating agent. Five types of cathode materials were synthesized. The sol gel technique has permitted the synthesis of manganese oxides that are capable of reversibly intercalating large amounts of lithium ions. To see the effect of adding copper to lithium manganese oxide several experiments were carried out. These include X-Ray diffraction to see whether the LiMn_2O_4 lattice has widened or collapsed. It was seen that LiMn_2O_4 and LiCu_2O_2 XRD patterns were obtained as reported in the literature. XRD of other three materials has no references so EDAX experiment was done to show the ratio of metals synthesized which were compared with the amount of the starting material. Particle Size Distribution experiment was done where the materials was ground to obtained a grain size at about $6\mu\text{m}$ and SEM results show the shape of the grain size which is important for a good performance of cathode materials. TGA studies of the precursors show evidence for phase formation of the compound for temperature range of 250°C to 500°C . FTIR spectrum for LiMn_2O_4 and $\text{LiMn}_{1.5}\text{Cu}_{0.5}\text{O}_3$ that were calcined at 800°C show no impurities in the compounds. The amount of copper was found to be the factor that, effect the purity of the other three compounds. Cyclic voltammetry results give a redox curves, implies that intercalation and de-intercalation of lithium are occurring.

Abstrak

Kajian ini telah dijalankan untuk mensintesis dan mengkaji beberapa bahan katod yang mengandungi lithium. Bahan katod lithium mangan kuprum oksida telah disintesis mengikut kaedah sol gel dengan menggunakan asid tartarik sebagai agen penggelat. Lima jenis bahan katod disintesis. Kaedah sol gel telah membolehkan sintesis bahan katod lithium mangan oksida yang mampu memberi satu tindak balas berbalik ion lithium dalam amaun yang tinggi. Bagi mengetahui pengaruh kuprum terhadap lithium mangan oksida beberapa eksperimen telah dijalankan. Ini termasuk eksperimen pembelauan sinar-x untuk melihat samada struktur LiMn_2O_4 membesar atau termusnah. Di dapati bahawa keputusan bagi pembelauan sinaran-x LiMn_2O_4 dan LiCu_2O_2 adalah seperti yang dilaporkan dalam jurnal. Bagi tiga bahan katod yang lain eksperimen EDAX dijalankan sebab tiada rujukan diperolehi. Kajian ini adalah untuk membuktikan bahawa nisbah bagi logam-logam yang digunakan untuk mensintesis bahan-bahan katod itu adalah sama seperti dalam keputusan EDAX. Eksperimen Taburan saiz zarah dibuat di mana bahan-bahan itu digiling untuk mendapatkan saiz lebih kurang $6\mu\text{m}$ dan di pastikan bagi eksperimen SEM menunjukkan bahan-bahan memperlihatkan zarah berbentuk bulat. Ciri-ciri ini penting untuk menghasilkan bahan katod berprestasi tinggi. Analisis termogravimetri menunjukkan kelima-lima bahan katod itu berpadu pada suhu dari 250°C hingga 500°C . Spektrum IR bagi LiMn_2O_4 dan $\text{LiMn}_{1.5}\text{Cu}_{0.5}\text{O}_3$ yang disintesis pada suhu 800°C menunjukkan tiada bendasing. Amaun kuprum yang digunakan menjadi penentu kepada kewujudan bendasing dalam tiga bahan katod yang lain. Keputusan voltammetri siklik menunjukkan bahawa terdapat tindak balas redoks yang membuktikan bahawa bahan katod yang disintesis dapat mengoksida dan menurun.

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