IONIC CONDUCTIVITY OF $LiMn_{2-x}Fe_xO_4$ MATERIALS

BADRULAMIN ABDULLAH

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ABSTRACT

IONIC CONDUCTIVITY OF $LiMn_{2-x}Fe_xO_4$ MATERIALS

$LiMn_{2-x}Fe_xO_4$ materials with different stoichiometric value (x = 0.1, 0.2, 0.3) powders were synthesized via a Self-propagating combustion, (SPC) method by using nitrates of the metal or transition metal as a precursor. The thermal analysis was performed by using Setsys Evolution 1750 (TGA-DSC 1500) in order to determine the annealing temperature. The powders then annealed at the temperature 800°C for 30 hours to remove all of the moisture. The crystal structure and purity also ionic conductivity, σ of the materials were then investigated and characterized by X-ray diffraction (XRD) and a.c. impedance using Electrochemical Impedance Spectroscopy, (EIS) respectively. XRD results indicate that pure single phase of cubic crystal structure had been obtained for the materials. EIS results then indicate that the ionic conductivity, σ of the materials increasing with the increasing of temperature by following the Arrhenius law. At temperature 373K, $LiMn_{1.7}Fe_{0.3}O_4$ has the highest ionic conductivity, σ with 3.81×10^{-4} $S.cm^{-1}$. Overall, it had been noticed that by insertion of Fe atom, the ionic conductivity, σ of $LiMn_2O_4$ was increased by the degree of 2 which is from 10^{-6} $S.cm^{-1}$ to 10^{-4} $S.cm^{-1}$.

CHAPTER 1

INTRODUCTION

1.1 Background

This research will focus on cathode materials that build up the lithium-ion battery. A lithium-ion battery is a family of rechargeable battery types in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. There are two types of batteries which are primary (disposable) and secondary (rechargeable) batteries. Lithium-ion battery consists of three parts of electrochemistry which takes place in cathode (+), anode (-) and the electrolyte. Lithium can migrate into which and from which material called anode and cathode. Lithium moves into the electrode during insertion process while the vice versa of the process which is extraction, lithium moves back out. During the discharging process of lithium-based cell, the lithium is extracted from the anode and inserted into the cathode. The vice versa of this process then occurs for charging process. Lithium-ion batteries possess a series of advantages such as single high voltage, large specific capacity, long cycling life and no memory effect which makes them have good application prospects in the fields of portable electrical apparatus, tools and automobiles. To understand more regarding the material that builds up the cathode it is essential to refer to the material science.