

**UNIVERSITI TEKNOLOGI MARA**

**DEVELOPMENT AND  
CHARACTERIZATION OF LITHIUM  
ION SOLID COMPOSITE  
ELECTROLYTES PREPARED BY  
SOL GEL**

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## ABSTRACT

Solid Composite Electrolytes (SCE) was developed, with  $\text{LiClO}_4$  and  $\text{LiNO}_3$  as the host material in composition with metal oxide,  $\text{SiO}_2$  to enhance the conductivity and the lithium transference number. SCE were sintered at  $200\text{ }^\circ\text{C}$  by using simple sol-gel method to remove the excess water with help of acetic acid as a binder between the interphase of host matrices and the metal oxide. SCE was then tested by using X-Ray Diffractogram (XRD), Field Emission Scanning Electron Microscope (FESEM) and Electrical Impedance Spectroscopy (EIS) to observe the physical properties of SCE in room temperature and also in high temperature. The highest conductivity of SCE is by using  $\text{LiNO}_3$  as host matrix and  $\text{SiO}_2$  as metal oxide which is  $9.74 \times 10^{-4}\text{ S/cm}$  at room temperature with lower activation energy at higher temperature. Compared to  $\text{LiClO}_4\text{-SiO}_2$ , the conductivity of SCE is seemed too low compare with  $\text{LiNO}_3\text{-SiO}_2$  but higher in lithium ion number which is 0.58. Existence of new lattice in XRD diffractogram caused the decrease in ion mobile and caused the ion mobile is anion. The enhancement of conductivity of the SCEs is depended on the amorphous phase of the samples that will create the ion pathways and increase the lithium ion number.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND STUDY

Ionic conduction in solids has been known since the 1830's when Faraday observed ionic conduction in nonmetallic solids of silver sulfide, ( $\text{Ag}_2\text{S}$ ) and lead fluoride, ( $\text{PbF}_2$ ) (Chadwick, 1999). It was not until the late 1960, when very few devices based on ion-conducting materials were available. Majority of them were liquid-aqueous electrolytes based devices. These devices suffered from a lot of problems although the ionic conducting ability is high. The problems suffered are limited temperature range of operation, device failure due to electrode corrosion by electrolytic solution, bulky in size and less rugged. (Chadra et al, 1980)

In order to solve these problems, scientists came out with new ideas of transforming liquid-aqueous electrolytes to solid electrolytes. The search for solid electrolytes exhibiting ionic conductivity as liquid-aqueous electrolytes have continued rigorously. Recently, research and development in this area have assumed significant importance to meet the increase in demand for cost effective and environmentally friendly alternative energy sources.

The ideal electrolytes for any solid state application such as batteries must have high ionic conductivity, stable mechanical properties and high window stability (Agrawal et al, 1999). In the effort of developing such solid electrolytes, various type of ion conduction system has been studied. These electrolytes are commonly known as superionic solids. This includes polymer electrolyte, amorphous-glassy electrolytes, framework crystalline materials and solid composite electrolytes (SCE). Composite electrolytes have received extensive attention after Liang (1973) reported enhancement in ionic conductivity by dispersion of ultrafine particle alumina by using Lithium iodide (LiI).