

THE UNIVERSITY OF CHICAGO
LIBRARY

UNIVERSITY OF CHICAGO

UNIVERSITY OF CHICAGO

**FTIR, CONDUCTIVITY AND IONIC TRANSPORT STUDY OF CHITOSAN
DOPED ADIPIC ACID SOLID POLYMER ELECTROLYTE AS PROTON
CONDUCTOR FOR BATTERY APPLICATION**

By
Muhammad Shahazmi Bin Mohd Zambri

A thesis submitted in partial fulfillment of
the requirements for the award of the degree of Bachelor of
Applied Science (Physics Electronics and Instrumentation)

**DEPARTMENT OF PHYSICAL SCIENCES
FACULTY OF SCIENCE AND TECHNOLOGY
UNIVERSITI MALAYSIA TERENGGANU
2008**



JABATAN SAINS FIZIK
 FAKULTI SAINS DAN TEKNOLOGI
 UNIVERSITI MALAYSIA TERENGGANU

PENGAKUAN DAN PENGESAHAN LAPORAN PITA I DAN II

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:.....FTIR,.....
 ..CONDUCTIVITY AND IONIC TRANSPORT STUDY OF CHITOSAN DOPED.....
 ..ADIPIC ACID SOLID POLYMER ELECTROLYTE AS PROTON CONDUCTOR.....
 ..FOR BATTERY APPLICATION.....
 oleh: MUHAMMAD SHAHAZMI B. MOHD ZAMRI.....,no. matrik: ..UK 12534.....

telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini
 dikemukakan kepada Jabatan Sains Fizik sebagai memenuhi sebahagian daripada
 keperluan memperoleh Ijazah S.M.S.G. (FIZIK ELEKTRONIK & INSTRUMENTASI).....,
 Fakulti Sains dan Teknologi, UMT.

Disahkan oleh:

Penyelia Utama
 Nama: DR. MOHD IKMAR NIZAM BIN MUHAMAD ISA
 Pensyarah
 Cop Rasmi: Jabatan Sains Fizik
 Fakulti Sains dan Teknologi
 Universiti Malaysia Terengganu
 21030 Kuala Terengganu

Tarikh: 5/5/08

Penyelia Bersama (jika ada)
 Nama:
 Cop Rasmi


Tarikh:

Ketua Jabatan Sains Fizik
 Nama: **PROF. DR. SENIN BIN HASSAN**
 Head
 Cop Rasmi: Department of Physical Sciences
 Faculty of Science and Technology
 University Malaysia Terengganu
 21030 Kuala Terengganu

Tarikh: 5 Mei 2008

DECLARATION

I hereby declare that this theses entitled **FTIR, CONDUCTIVITY AND IONIC TRANSPORT STUDY OF CHITOSAN DOPED ADIPIC ACID SOLID POLYMER ELECTROLYTE AS PROTON CONDUCTOR FOR BATTERY APPLICATION** is the result of my own research except as cited in the references.

Signature:..........
Name: Muhammad Shahazmi Mohd Zambri
Matrix No: UK 12534
Date:.....5. Mei. 2008.....

ACKNOWLEDGEMENT

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

First of all, I am very grateful and thankful to ALLAH The All Mighty for giving me a good health, chance and strength to complete this research work. It took me a very strong determination to finish this thesis and as in returned I gained a lot of knowledge which are very precious.

I am deeply grateful to my charismatic supervisor **Dr. Mohd Ikmar Nizam Mohamad Isa** whose help, stimulating suggestions and encouragement helped me in all the time of research and writing of this thesis. Thank you for being such understanding, encouraging and broadminded during this period time.

I would like to express my thankfulness to all those who gave me the possibility to complete this thesis. I want to thank all the staffs in the Department of Physical Sciences for giving me permission to commence this thesis, to do the necessary research work and to use the departmental instruments. My sincere gratitude to master students, **Kartini** and **Nik Aziz**, for helping us during all the period time.

To my groups; **Nor Azwa**, **Mohd Fatihah** and **Santana D.C.Jani**, thank you very much for all the help and friendship given to me. We shared all the memories and experienced together during this wonderful journey in UMT. Inshaallah all the hard works will be paid.

Also not to forget, very special gratitude to my parent; **Mohd Zambri Hussain** and **Som Husin**, my bothers and sisters-in-law; **Kaiszer**, **Iqmal**, **Reezal**, **Zamil**, **Kak Manisah**, **Kak Lin** and **Kak Norli**. Without their prays and support, I would not be able to gain knowledge and success now. Thank you for all the moral and continuous support throughout my education.

MUHAMMAD SHAHAZMI MOHD ZAMBRI
April 2008

ABSTRACT

Film of adipic acid doped chitosan based polymer electrolyte was prepared by the technique of solution casting. The samples were characterized by using Fourier Transform Infrared Spectroscopy (FTIR), Electrochemical Impedance Spectroscopy (EIS) with temperature ranging 298 and 353 K and transference number measurement. The highest conductivity at room temperature achieved is $1.4 \times 10^{-9} \text{ S cm}^{-1}$ for sample containing 35 wt. % of AA. FTIR showed that complexation has occurred. FTIR exhibited shifts in amine and carbonyl bands at 1560 cm^{-1} and 1650 cm^{-1} . Peak at 1689 cm^{-1} has shifted to 1680 cm^{-1} indicates the deprotonation of COO^- in adipic acid and proved that the electrolyte is a proton conductor. The temperature dependence of chitosan doped adipic acid shows Arrhenius behaviour with the highest conductivity gives the lowest activation energy. The Rice and Roth model was applied in calculating the ionic mobility, μ and diffusion coefficient, D . The highest values of ionic mobility, μ and diffusion coefficient, D are $2.55 \times 10^{-13} \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and $6.56 \times 10^{-15} \text{ cm}^2 \text{ s}^{-1}$ respectively for sample with highest conductivity i.e. sample S6. The transference number measurements were conducted to correlate the diffusion phenomena to the conductivity behaviour of CA-AA polymer electrolyte. It has shown that the values of μ_+ is higher than μ_- and D_+ is higher than D_- and it proved that the samples are more cationic than anionic conductor.

ABSTRAK

Filem kitosan polimer dicampurkan dengan asid adipik telah disediakan dengan menggunakan teknik sebaran larutan. Pencirian sampel dijalankan dengan menggunakan FTIR, EIS dengan suhu di antara 298 – 353 K dan pengukuran nombor pemindahan (transference number measurement). Kekonduksian yang tertinggi yang dicapai di dalam suhu bilik ialah $1.4 \times 10^{-9} \text{ S cm}^{-1}$ untuk sampel yang mengandungi 35 wt. % asid adipik. Hasil daripada analisis FTIR menunjukkan berlakunya anjakan pada jalur amida dan karbonil pada 1560 cm^{-1} dan 1650 cm^{-1} . Puncak pada 1689 cm^{-1} teranjak ke 1680 cm^{-1} menunjukkan diprotonasi COO^- di dalam asid adipik dan membuktikan bahawa elektrolit adalah suatu konduktor proton. Data kekonduksian melawan suhu mematuhi sifat Arrhenius dengan menunjukkan bahawa kekonduksian menaik, tenaga pengaktifan menurun. Model Rice dan Roth telah digunakan untuk mengira ionik mobiliti dan angkali resapan. Nilai tertinggi ionik mobiliti dan angkali resapan yang diperolehi ialah $2.55 \times 10^{-13} \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ dan $6.56 \times 10^{-15} \text{ cm}^2 \text{ s}^{-1}$ masing-masing untuk sampel S6 iaitu sampel yang mempunyai kekonduksian tertinggi. Pengukuran nombor pemindahan telah dijalankan dan ia menunjukkan bahawa nilai μ_+ adalah lebih tinggi daripada μ_- dan nilai D_+ adalah lebih tinggi daripada D_- . Ini telah terbukti bahawa sampel ini adalah konduktor kationik.