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PREPARATION AND CHARACTERIZATION OF MATERIALS FOR LITHIUM
POLYMER BATTERIES

By

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PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

PREPARATION AND CHARACTERIZATION OF MATERIALS FOR LITHIUM POLYMER BATTERIES oleh **RAHIMAH BINTI OTHMAN**, no matrik **UK9958** telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Fizik sebagai memenuhi sebahagian daripada keperluan Ijazah Sarjana Muda Sains Gunaan (Fizik Elektronik dan Instrumentasi), Fakulti Sains dan Teknologi, Universiti Malaysia Terengganu.

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TABLE OF CONTENTS

	Pages
TITLE PAGE	i
APPROVAL FORM	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS/SYMBOLS	viii
ABSTRACT	xi
ABSTRAK	xii
CHAPTER 1: INTRODUCTION	
1.0 Introduction	1
1.2 Objectives	3
CHAPTER 2: LITERATURE REVIEW	
2.0 Introduction	4
2.1 Chitosan	4
2.2 Poly(vinyl alcohol)	6
2.3 Lithium triflate	7
2.4 Lithium polymer batteries	7
2.5 Polymer blending	8

CHAPTER 3: METHODOLOGY

3.0	Introduction	11
3.1	Sample preparation	11
3.2	Sample analysis	
3.2.1	Electrochemical Impedance Spectroscopy (EIS)	14
3.2.2	Fourier Transform Infrared (FTIR) Spectroscopy	16

CHAPTER 4: RESULTS AND DISCUSSION

4.0	Introduction	18
4.1	Room temperature study	18
4.2	Temperature studies	21
4.3	Fourier Transform Infrared (FTIR) analysis	26
4.3.1	Chitosan/PVA spectra	27
4.3.2	Chitosan-PVA- LiCF ₃ SO ₃ spectra	32

CHAPTER 5: CONCLUSION 37

REFERENCES 38

CURRICULUM VITAE 45

LIST OF TABLES

- Table 3.1 Composition of the chitosan/PVA blends with different percentages of LiCF_3SO_3 salt.
- Table 4.1 Vibrational modes and wavenumbers exhibited by chitosan
- Table 4.2 Vibrational modes and wavenumbers exhibited by PVA
- Table 4.3 Vibrational modes and wavenumbers exhibited by LiCF_3SO_3

LIST OF FIGURES

- Figure 2.1. Chemical structure of chitosan.
- Figure 2.2. Chemical Structure of PVA.
- Figure 2.3. Chemical structure of Lithium Triflate.
- Figure 2.4. Ionic blend of PVA and chitosan.
- Figure 3.1. The solution was stirred overnight by using magnetic stirrer.
- Figure 3.2. Thin film samples are prepared using solution casting technique where the solutions are casted into different plastic Petri dishes and left to form film at room temperature.
- Figure 3.3. Samples are left in the desiccators filed with silicon gel for continuous drying.
- Figure 3.4. Instrument: Digital mass balance used for measuring the mass of materials.
- Figure 3.5. Instrument: Distilled water
- Figure 3.6. Solid thin film sample are sandwiched between two blocking stainless steel electrodes (also called sample holder) for conductivity measurement.
- Figure 3.7. Samples are mounted in a conductivity holder under spring pressure.
- Figure 3.8. Temperature study was done by heating the samples manually in an oven at temperature 303-393 K.
- Figure 3.9. Vibrational spectroscopic studies were carried out using FTIR Spectrometer-Perkin Elmer System 2000.
- Figure 3.10. FTIR sample holder.
- Figure 3.11. FTIR Spectrometer-Perkin Elmer System 2000 and PC Data System in kalium bromide (KBr) pellet.
- Figure 4.1. Variation of conductivity as a function of LiCF_3SO_3 salt content.
- Figure 4.2. Dielectric constant for salted chitosan-PVA blend with LiCF_3SO_3 .
- Figure 4.3. Dielectric loss of salted chitosan-PVA blend at room temperature.

- Figure 4.4. Frequency dependence of real part of electrical modulus at room temperature.
- Figure 4.5. Imaginary part of modulus formalism versus frequency at different salt concentration.
- Figure 4.6. Typical variation of loss tangent at room temperature.
- Figure 4.7. Arrhenius plot of $\log \sigma$ versus $1000/T$ for chitosan-PVA blend film.
- Figure 4.8. Activation energy, E_a of polymer complexation.
- Figure 4.9. Variation of activation energy and room temperature conductivity as a function of salt concentration.
- Figure 4.10. Typical plot of the variation of real part of dielectric constant for chitosan-PVA blend in the temperature range 303K – 393K
- Figure 4.11. Typical plot of variation of imaginary part of dielectric loss for chitosan-PVA blend in the temperature range 303K – 393K
- Figure 4.12. Frequency dependence on real part of electrical modulus for 45 wt. % LiCF_3SO_3 in polymer blend.
- Figure 4.13. Frequency dependence on imaginary part of electrical modulus for 45 wt. % LiCF_3SO_3 in polymer blend.
- Figure 4.14. Temperature variation of loss tangent at the highest conductivity in chitosan/PVA- LiCF_3SO_3 system.
- Figure 4.15. The FTIR spectra of pure chitosan.
- Figure 4.16. The FTIR spectra of pure PVA.
- Figure 4.17. The FTIR spectra of chitosan: PVA (50:50) blend.
- Figure 4.18. FTIR spectra of (a) pure chitosan (b) chitosan-PVA blend film (c) pure PVA.
- Figure 4.19. Intermolecular Hydrogen bonding.
- Figure 4.20. Intramolecular Hydrogen bonding.
- Figure 4.21. The FTIR spectra of pure LiCF_3SO_3 .
- Figure 4.22. FTIR spectra of (a) chitosan/PVA blend (b) chitosan/PVA-45 wt.% LiCF_3SO_3 (c) pure LiCF_3SO_3 .
- Figure 4.23. FTIR spectra for chitosan/PVA blend vary with (a) 5 wt.%, (b) 10 wt.%, (c) 15 wt.%, (d) 20 wt.%, (e) 25 wt.%, (f) 30 wt.%, (g) 35 wt.%, (h) 40 wt.%, (i) 45 wt.% and (j) 50 wt.% LiCF_3SO_3 .

LIST OF ABBREVIATIONS/SYMBOLS

A	the area of film-electrode contact
CF ₃ SO ₃ ⁻	trifluoromethanesulfonate
DMP	dimethyl phthalate
E_a	activation energy
EIS	Electrochemical Impedance Spectroscopy
FTIR	Fourier Transform Infrared Spectroscopy
Hz	hertz
IR	infrared
k	Boltzmann constant (1.38×10^{-23} J@K)
K	kelvin
Li	lithium
LiBF ₄	lithium tetrafluoroborate
LiCF ₃ SO ₃	Lithium Trifluoremethane Sulfuric Acid
LiClO ₄	lithium perchlorate
Li-ion	lithium ion
Li-Poly	lithium polymer battery
LiPo	lithium polymer battery
LiTf	lithium triflate
LPB	lithium polymer battery
MHz	mega hertz
M_r	real electrical modulus
M_i	imaginary electrical modulus
mm	millimeter
PAN	polyacrylonitrile
PC	personal computer
PEO	polyethylene oxide

PMMA	polymethyl methacrylate
PVA	Polyvinyl alcohol
PVC	poly(vinyl chloride)
PVdF	polyvinylidene fluoride
PVP	poly(vinylpyrrolidone)
R_b	bulk resistance of the film
R^2	regression value
SPE	solid polymer electrolytes
S/cm	siemen per centimeter
t	thickness of the film
$\tan \delta$	loss tangent
T	absolute temperature
T_m	melting point (for thermoplastics) temperature
T_g	glass transition temperature
TS	tensile strength
wt. %	weight percent
Z^*	complex impedance
Z_r	real impedance
Z_i	imaginary impedance
δ_s	symmetric stretching mode
ϵ_r	dielectric constant
ϵ_i	dielectric loss
σ_0	pre-exponential factor
ν_s	symmetric stretching vibration
ν_{as}	asymmetric stretching vibration
C_0	pre-exponential factor
ω	angular frequency ($2\pi f$)

ABSTRACT

Solid polymer electrolyte films containing chitosan-poly(vinyl alcohol) (PVA)-LiCF₃SO₃ were prepared by solution casting technique. Chitosan/PVA (50:50 w/w) solution was diluted in 100 ml 1% acetic acid solution and stirred using magnetic stirrer overnight at room temperature. Various amount of lithium triflate were added accordingly varies from 5 to 50 wt.%. Complexation of the prepared electrolytes is studied by using EIS and FTIR analysis. The structure of chitosan, PVA and lithium triflate and the miscibility of the blend films were investigated and proved from infrared spectroscopy. Ionic conductivities of the electrolyte have been determined by AC impedance studies in the temperature range of 300-393 K. Results show that the regressions values are obey the Arrhenius plot. Dielectric relaxation studies of the polymer electrolyte have been undertaken and the results were discussed. The highest ionic conductivity value (2.71027×10^{-5} S/cm) has been observed for chitosan (0.275g)-PVA (0.275g)-LiCF₃SO₃ (45 wt.%) system with the activation energy, E_a observed is 0.25 eV.

ABSTRAK

Polimer elektrolit filem jenis pepejal yang mengandungi chitosan-poly(vinyl alcohol) (PVA)-LiCF₃SO₃ disediakan dengan menggunakan teknik 'solution casting'. Larutan Chitosan/PVA (50:50 w/w) dilarutkan di dalam 100 ml 1% larutan asid asetik dan dikacau dengan menggunakan 'magnetic stirrer' semalaman pada suhu bilik. Lithium triflate ditambah secara selaras mengikut kuantiti berat yang berbeza daripada 5 ke 50 %. Struktur kompleks elektrolit dianalisis dengan menggunakan EIS dan FTIR. Struktur bagi chitosan, PVA dan lithium triflate serta misibiliti bagi campuran polymer dikenalpasti dan dibuktikan dengan menggunakan sinar inframerah spectrometer. Konduktiviti ion elektrolit dikenalpasti melalui ujikaji 'AC Impedance' pada suhu antara 300-393 K. Hasil menunjukkan nilai-nilai regresi mematuhi plot Arrhenius. Kajian dielektrik bagi elektrolit jenis polimer diperhatikan dan keputusannya dibincangkan dengan lebih lanjut. Nilai konduktiviti ion yang paling tinggi (2.71027×10^{-5} S/cm) dikenalpasti pada sistem chitosan (0.275g)-PVA (0.275g)- LiCF₃SO₃ (45 wt.%) dengan nilai tenaga pengaktifan, E_a yang diperoleh adalah 0.25 eV.