

**ELECTRICAL, OPTICAL AND IONIC TRANSPORT
STUDY OF METHYCELLULOSE-NIAC POLYMER
ELECTROLYTE**

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**MASTER OF SCIENCE
UNIVERSITI MALAYSIA TERENGGANU
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Electrical, optical and ionic transport study of
methycellulose-NH₄F polymer electrolyte / Nik Aziz Nik Ali.

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**ELECTRICAL, OPTICAL AND IONIC TRANSPORT STUDY OF
METHYLCELLULOSE-NH₄F POLYMER ELECTROLYTE**

DEDICATION

NIK AZIZ BIN NIK ALI

I would like to thank my parents,
my wife and my source of support.
Without their love, understanding, support and most of
all love, the completion of this work
would not have been possible.

**Thesis Submitted in Fulfillment of the Requirement
for the Degree of Master of Science in the
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July 2010

This thesis is presented to the Senate of Universiti Malaysia Terengganu
in fulfillment of the requirements for the degree of Master of Science

**ELECTRICAL CONDUCTIVITY AND THERMOELECTRICITY OF
COPPER-CHLORIDE IN POLYMER ELECTROLYTE**

BY MR AZZU BIN NIK ALI

July 2010

Chairperson : Mohd Hanafi Bin Mohamad Isa, PhD

DEDICATION

*I dedicate this thesis to my parents.
Without their patience,
understanding, support and most of
all love, the completion of this work
would not have been possible.*

highest room temperature ionic conductivity in the magnetooptical
bismuth electrolyte at 0.02 S cm⁻¹ for frequency 10 Hz to 10 kHz.
The conductivity temperature dependence did follow the Arrhenius behavior
with the highest conductivity presenting the lowest activation energy. The
dielectric behavior of the samples show strong dependence on frequency
and temperature and found to be a non-Debye type.

In addition the estimation of FeO^{+} from IR with the oxygen
atom from TC was obtained at 4.64cm⁻¹ which shifted to 1.65cm⁻¹
while the CO-C peak at 1086cm⁻¹ is gradually shifted to 1030cm⁻¹ with the
increase of FeO^{+} . These data prove the formation of iron hydroxide

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu
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**ELECTRICAL, OPTICAL AND IONIC TRANSPORT STUDY OF
METHYLCELLULOSE-NH₄F POLYMER ELECTROLYTE**

NIK AZIZ BIN NIK ALI

July 2010

Chairperson: **Mohd Ikmar Nizam Bin Mohamad Isa, Ph.D.**

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Faculty : **Science and Technology**

In this work the development of biopolymer electrolytes were prepared by incorporating ammonium fluoride in methylcellulose by solution cast technique. Composition of NH₄F was varied from 8 wt.% to 25 wt.%. The highest room temperature ionic conductivity of the methylcellulose biopolymer electrolytes is 6.40×10^{-7} Scm⁻¹ for sample with 18 wt.% NH₄F. The conductivity-temperature dependents plot shows the Arrhenius behavior with the highest conductivity possessing the lowest activation energy. The dielectric behaviors of the samples show strong dependences on frequency and temperature and found to be a non-Debye type.

In FTIR studies, the coordination of NH₄⁺ from NH₄F with the oxygen in ether group from MC was observed at 1464cm⁻¹ which shifted to 1458cm⁻¹ while the C-O-C peak at 1066cm⁻¹ is gradually shifted to 1064cm⁻¹ with the addition of NH₄F. These peaks prove the protonation of NH₄F. XRD studies

show that complexation occurred in the amorphous complexes films. From transference number measurements, it was found that the value of cationic mobility (μ_+) is higher than the value of anionic mobility (μ_-) and the value of cationic diffusion coefficient (D_+) was higher than anionic diffusion coefficient (D_-).

From the results obtained in this work, it shows that the MC based biopolymer doped NH₄F is a proton conducting electrolytes.

Hasil penelitian ini menunjukkan biopolymer doped NH₄F dengan molekul berat rata-rata 1000000 g/mol yang merupakan kompleks ionik antara ion NH₄⁺ dan F⁻ memiliki sifat-sifat elektrolytik. Kompleks NH₄F diperoleh dari 8 wt% NH₄F sehingga 25 wt%. Kompleks NH₄F memiliki konduktivitas ionic pada suhu 25°C sebesar 6.40 x 10⁻³ S/cm² untuk komposisi 15 wt% NH₄F. Graf konduktivitas berperkembang secara eksponensial menunjukkan bahwa pola pola beraturan. Amperometri dapat menggunakan teknologi ini untuk mendekati nilai tetraga pengukuran temparatur berperkembang. Selain itu, teknologi ini dapat memungkinkan karya berorientasi ilmiah dalam mendekati nilai tetraga pengukuran temparatur berperkembang.

Dalam ketika TGA, identifikasi senyawa ion NH₄⁺ dari NH₄F dengan ekstraksi dalam konsentrasi air dan HCl yang dijumpai pada perjana gelombang "fiklon" dan ikon pada hasil analisis perjana gelombang TGA dan konsentrasi air dan C=O-C pada 10.60 m⁻¹ telah berkontribusi bersama pada

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Sarjana Sains.

KAJIAN ELEKTRIKAL, OPTIKAL DAN PERGERAKAN ION METILSELULOSA-NH₄F POLIMER ELEKTROLIT

NIK AZIZ BIN NIK ALI

July 2010

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Fakulti : Sains dan Teknologi

Dalam kajian ini pembangunan biopolimer elektrolit telah disediakan dengan mencampurkan garam amonia florida ke dalam metilselulosa dengan teknik tuangan larutan. Komposisi NH₄F disediakan dari 8 wt.% sehingga 25 wt.%. Nilai tertinggi bagi konduktiviti ionik metilselulosa pada suhu bilik ialah 6.40×10^{-7} Scm⁻¹ untuk sampel 18 wt.% NH₄F. Graf konduktiviti bergantung kepada suhu menunjukkan sampel adalah bersifat Arrhenius dimana nilai konduktiviti tertinggi menghasilkan nilai tenaga pengaktifan terendah. Sifat-sifat dielektrik bagi sampel menunjukkan ianya bergantung kepada frekuensi dan suhu dan menunjukkan ianya bukan bersifat Debye.

Dalam kajian FTIR, interaksi antara ion NH₄⁺ dari NH₄F dengan oksigen dalam kumpulan eter dari MC tulen dijumpai pada panjang gelombang 1464cm⁻¹ yang mana telah beralih kepada panjang gelombang 1458cm⁻¹, sementara puncak C-O-C pada 1066cm⁻¹ telah beransur-ansur beralih pada

panjang gelombang 1064cm^{-1} dengan penambahan NH_4F . Puncak-puncak tersebut membuktikan pemprotonan NH_4F . Kajian XRD menunjukkan berlakunya interaksi di dalam filem amorfus komplek. Dalam kajian pengukuran nombor pemindahan, didapati nilai kation bagi ionik mobiliti (μ_+) lebih tinggi berbanding nilai mobiliti anionik (μ_-) dan nilai pekali resapan kationik (D_+) lebih tinggi dari nilai pekali resapan anionik (D_-).

Berdasarkan keputusan yang diperolehi dalam kajian ini, ianya jelas menunjukkan MC berasaskan biopolimer dicampurkan dengan NH_4F adalah elektrolit bersifat pengkonduksi proton.