

**ELECTRICAL, OPTICAL AND IONIC TRANSPORT  
STUDY OF METHYCELLULOSE-NH<sub>4</sub>F POLYMER  
ELECTROLYTE**

**NIK AZIZ BIN NIK ALI**

**MASTER OF SCIENCE  
UNIVERSITI MALAYSIA TERENGGANU  
2010**



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METHYLCELLULOSE-NH<sub>4</sub>F POLYMER ELECTROLYTE**

**DEDICATION**

*I dedicate this thesis to my parents.*

**NIK AZIZ BIN NIK ALI**

*With their guidance,  
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  
Faculty of Science and Technology  
Universiti Malaysia Terengganu**

**July 2010**

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

ELECTRICAL, OPTICAL AND IONIC TRANSPORT STUDY OF  
PENTYLCELLULOSE-PMMA POLYMER ELECTROLYTE

NIK AZIZ BIN NIK ALI

July 2022

Chairperson: Prof. Dr. Mohd. Yusoff Bin Mohamed, Dr. Ph.D.

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**ELECTRICAL, OPTICAL AND IONIC TRANSPORT STUDY OF  
METHYLCELLULOSE-NH<sub>4</sub>F POLYMER ELECTROLYTE**

**NIK AZIZ BIN NIK ALI**

**July 2010**

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

**Member : Mohd Zamri Bin Ibrahim, Ph.D.**

**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 NH<sub>4</sub>F was varied from 8 wt.% to 25 wt.%. The highest room temperature ionic conductivity of the methylcellulose biopolymer electrolytes is  $6.40 \times 10^{-7} \text{ Scm}^{-1}$  for sample with 18 wt.% NH<sub>4</sub>F. 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 NH<sub>4</sub><sup>+</sup> from NH<sub>4</sub>F with the oxygen in ether group from MC was observed at  $1464\text{cm}^{-1}$  which shifted to  $1458\text{cm}^{-1}$  while the C-O-C peak at  $1066\text{cm}^{-1}$  is gradually shifted to  $1064\text{cm}^{-1}$  with the addition of NH<sub>4</sub>F. These peaks prove the protonation of NH<sub>4</sub>F. XRD studies

show that complexation occurred in the amorphous complexes films. From transference number measurements, it was found that the value of cationic mobility ( $\mu_+$ ) is higher than the value of anionic mobility ( $\mu_-$ ) 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  $\text{NH}_4\text{F}$  is a proton conducting electrolytes.

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

**KAJIAN ELEKTRIKAL, OPTIKAL DAN PERGERAKAN ION  
METILSELULOSA-NH<sub>4</sub>F POLIMER ELEKTROLIT**

**NIK AZIZ BIN NIK ALI**

**July 2010**

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

**Ahli : Mohd Zamri Bin Ibrahim, Ph.D.**

**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 NH<sub>4</sub>F disediakan dari 8 wt.% sehingga 25 wt.%. Nilai tertinggi bagi konduktiviti ionik metilselulosa pada suhu bilik ialah  $6.40 \times 10^{-07} \text{ Scm}^{-1}$  untuk sampel 18 wt.% NH<sub>4</sub>F. 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 NH<sub>4</sub><sup>+</sup> dari NH<sub>4</sub>F dengan oksigen dalam kumpulan eter dari MC tulen dijumpai pada panjang gelombang  $1464\text{cm}^{-1}$  yang mana telah beralih kepada panjang gelombang  $1458\text{cm}^{-1}$ , sementara puncak C-O-C pada  $1066\text{cm}^{-1}$  telah beransur-ansur beralih pada

panjang gelombang  $1064\text{cm}^{-1}$  dengan penambahan  $\text{NH}_4\text{F}$ . Puncak-puncak tersebut membuktikan pemprotonan  $\text{NH}_4\text{F}$ . Kajian XRD menunjukkan berlakunya interaksi di dalam filem amorfus kompleks. Dalam kajian pengukuran nombor pemindahan, didapati nilai kation bagi ionik mobiliti ( $\mu_+$ ) lebih tinggi berbanding nilai mobiliti anionik ( $\mu_-$ ) 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  $\text{NH}_4\text{F}$  adalah elektrolit bersifat pengkonduksi proton.