PREPARATION AND CHARACTERIZATION
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POLYMER ELECTROLYTE

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DEPARTMENT OF PHYSICAL SCIENCES
FACULTY OF SCIENCE AND TECHNOLOGY
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Preparation and characterization of starch-ammonium nitrate polymer electrolyte / Ahmad Zahin Ilman Othman.

PREPARATION AND CHARACTERIZATION OF STARCH-AMMONIUM NITRATE POLYMER ELECTROLYTE

By
AHMAD ZAHIN ILMAN BIN OTHMAN

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the requirements for the award of the degree of
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DEPARTMENT OF PHYSICAL SCIENCE
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Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk PREPARATION AND CHARACTERIZATION OF STARCH-AMMONIUM NITRATE POLYMER ELECTROLYTE oleh AHMAD ZAHIN ILMAN BIN OTHMAN, no. Matrik UK 15883 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Fizik sebagai memenuhi sebahagian daripada keperluan memperolehi Ijazah Sarjana Muda Sains Gunaan (Fizik Elektronik & Instrumentasi), Fakulti Sains dan Teknologi, UMT.

Disahkan oleh:

.....
Penyelia Utama
Nama: Dr. Mohd Ikmar Nizam bin Mohamad Isa
Cop Rasmi: DR. MOHD IKMAR NIZAM BIN MOHAMAD ISA
Pensyarah
Jabatan Sains Fizik
Fakulti Sains dan Teknologi
Universiti Malaysia Terengganu
21030 Kuala Terengganu

Tarikh: 20/4/10

.....
Ketua Jabatan Sains Fizik
Nama: Dr. Mohd Ikmar Nizam bin Mohamad Isa
Cop Rasmi:
Tarikh: 22/4/10

DR. MOHD IKMAR NIZAM BIN MOHAMAD ISA
Head
Department of Physical Sciences
Faculty of Science and Technology
University Malaysia Terengganu
21030 Kuala Terengganu

DECLARATION

I hereby declare that this thesis entitled Preparation and Characterization of Starch-Ammonium Nitrate Polymer Electrolyte is the result of my own research except as cited in the references.

Signature :
Name : Ahmad Zahin Ilman bin Othman
Matrix No. : UK 15883
Date : 22 April 2010

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PREPARATION AND CHARACTERIZATION OF STARCH-AMMONIUM NITRATE POLYMER ELECTROLYTE

ABSTRACT

A proton-conducting polymer electrolyte system based on starch doped ammonium nitrate (NH_4NO_3) has been prepared through solution casting method. The ionic conductivity for the starch- NH_4NO_3 was conducted over a wide range of frequency between 50Hz and 1MHz and at temperatures between 303K and 373K. Fourier Transform Infrared (FTIR) spectroscopy showed that the complexation has occurred. The sample containing 25wt% ammonium nitrate exhibit the highest conductivity at room temperature at 2.19×10^{-6} $S\cdot cm^{-1}$ for sample SAN25 studied using Electrochemical Impedance Spectroscopy (EIS). The conductivity by various temperatures obey Arrhenian rule and found to influence the proton conduction. Calculations using the Rice and Roth model provide number of mobile ions, η, diffusion coefficient, D and ionic mobility, μ. The transport parameter of the samples shows that the increase in conductivity is due to the increase in the mobility of ions, diffusion coefficient where the value of the cation diffusion coefficient, D_+ at 5.99×10^{-11} cm^2s^{-1} obtained is higher than the value of the cation diffusion coefficient, D_- at 1.70×10^{-12} cm^2s^{-1} and the value of the cation ionic mobility, μ_+ at 2.29×10^{-09} $cm^2V^{-1}s^{-1}$ is higher than the value of the anion ionic mobility, μ_- at 7.08×10^{-11} $cm^2V^{-1}s^{-1}$.The Transference Number Measurement was performed to correlate the diffusion phenomena to the conductivity, σ behaviour of starch-NH_4NO_3 polymer electrolyte. Therefore, this study had proven that the starch-ammonium nitrate polymer electrolyte is a proton conductor.

PENYEDIAAN DAN PENCIRIAN ELEKTROLIT POLIMER DARIPADA KANJI-AMMONIUM NITRATE

ABSTRAK

Satu sistem pengkonduktor proton elektrolit polimer berasaskan kanji-ammonium nitrate (NH_4NO_3) telah disediakan menggunakan teknik tebaran larutan. Kekonduksian ion bagi kanji-NH_4NO_3 telah dikaji dengan menggunakan frekuensi antara 50Hz dan 1MHz pada suhu diantara 303K dan 307K. FTIR spektroskopi menunjukkan bahawa tindak balas komplek telah berlaku. Sampel yang mengandungi 25wt% ammonium nitrate mencatatkan konduksi tertinggi pada suhu bilik iaitu pada 2.19×10^{-6} $S\cdot cm^{-1}$ yang dikaji menggunakan EIS. Kekonduksian melalui pelbagai suhu mematuhi peraturan Arrhenian dan mempengaruhi kekonduksian proton. Pengiraan menggunakan model Rice dan Roth memberikan bilangan gerakan ion, n, pekali difusi, D dan keboleh gerakan ion, μ. Parameter pergerakan bagi sampel menunjukkan bahawa peningkatan kekonduksian adalah disebabkan oleh peningkatan gerakan ion-ion, dimana nilai bagi pekali difusi kation, D_+ pada nilai 5.99×10^{-11} cm^2s^{-1} diperoleh adalah lebih tinggi berbanding pekali difusi kation, D_- pada nilai 1.70×10^{-11} cm^2s^{-1} dan keboleh gerakan kation, μ_+ pada nilai 2.29×10^{-09} $cm^2V^{-1}s^{-1}$ adalah lebih tinggi daripada keboleh gerakan anion, μ_- pada nilai 7.08×10^{-11} $cm^2V^{-1}s^{-1}$. Pengukuran bilangan perpindahan telah menunjukkan bahawa berlaku perkaitan dengan fenomena difusi bagi sifat konduktiviti kanji-NH_4NO_3 elektrolit polmer. Justeru, kajian telah membuktikan bahawa kanji-ammonium nitrate elektrolit polimer adalah pengkonduksi proton.