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Solid polymer electrolyte for lithium rechargeable batteries / Sit
Norbaizura Abdul Malik.

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SOLID POLYMER ELECTROLYTE FOR LITHIUM RECHARGEABLE BATTERIES

By

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the requirement for the degree of
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SITI NORBAIZURA BINTI ABDUL MALIK

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LIST OF ABBREVIATIONS/SYMBOLS

CA	Citric acid
DMP	Dimethyl phthalate
EIS	Electrochemical impedance spectroscopy
EO	Ethylene oxide
FTIR	Fourier transforms infrared
KBr	Kalium bromide
$LiBF_4$	Lithium tetrafluoroborate
$LiCF_3SO_3$	Lithium trifluoremethane sulfonate
$LiClO_4$	Lithium perchlorate
$LiN(CF_3SO_2)_2$	Lithium bis(trifluoromethanesulfonimide)
LiOAc	Lithium acetate
$LiPF_6$	Lithium hexafluorophosphate
LiTFSI	Lithium trifluoromethanesulfoimide
MW	Molecular weight
PEO	Poly(ethylene oxide)
PMMA	Poly(methyl methacrylate)
PPO	Polypropylene oxide
PVC	Polyvinyl chloride
PVP	Polyvinyl pyridine
TCNQ	Tetracyanoquinodimethane
A	Area of the cross-section of the film
C_o	Geometrical capacitance
E_a	Activation energy
eV	Electron volt
K_B	Boltzmann constant
M_I	Imaginary electrical modulus
M_R	Real electrical modulus
R_b	Bulk impedance
R^2	Regression value
S cm^{-1}	Siemens per centimeter
T	Absolute temperature

T_g	Glass-transition temperature
t	Thickness of the film
wt.%	Weight percent
Z_I	Imaginary impedance
Z_R	Real impedance
σ	Conductivity
σ_o	Pre-exponential factor
δ_s	Symmetric deformation
ε_o	The permittivity of the space area
ε_I	Dielectric loss
ε_R	Dielectric constant
ω	Angular frequency
υ_{as}	Asymmetric vibration

ABSTRACT

Solid polymer electrolytes composed of chitosan and PEO as the host polymer and $LiCF_3SO_3$ as the doping salt were prepared by the solution cast technique. These complexes with different amounts of salts were investigated as possible ionic conducting polymers by using the electrochemical impedance spectroscopy (EIS). At room temperature, the highest ionic conductivity of the complexes was observed at 5.74×10^{-6} S cm^{-1} for the film containing chitosan (0.35 g)-PEO (0.35 g) and 30 wt.% of $LiCF_3SO_3$. Conductivity for all samples was also studied as a function of temperature in range 303-393 K. Dielectric data were analyzed using complex permittivity, ε^* and complex electrical modulus, M^* for the sample with the highest ionic conductivity at room temperature. The temperature dependent conductivity data obeys the Arrhenius plot. The film exhibiting the highest ionic conductivity has the lowest activation energy 0.19 eV. Further, the interaction of the polymer chains with the different salt concentration is substantiated by Fourier transform infrared (FTIR) spectroscopy. From the infrared spectra of chitosan-PEO blends and chitosan-PEO with different salt concentration show that the complexation are miscible.

ABSTRAK

Elektrolit polimer pepejal menggunakan kitosan dan PEO sebagai hos polimer dan $LiCF_3SO_3$ sebagai pengedopan garam telah disediakan daripada teknik 'solution casting'. Kompleks-kompleks ini disediakan dengan amaun garam yang berbeza-beza telah dianalisis sebagai polimer pengaliran ion dengan menggunakan spektroskopi impedan elektrokimia (EIS). Pada suhu bilik, konduktiviti yang paling tinggi telah dikenalpasti pada 5.74×10^{-6} S cm^{-1} bagi filem yang mengandungi kitosan (0.35 g)-PEO (0.35 g) dan 30 wt.% $LiCF_3SO_3$. Konduktiviti bagi semua sampel juga turut dikaji sebagai satu fungsi suhu dalam julat 303-393 K. Data dielectric dianalisis dengan menggunakan kompleks ketelusan, ε^* dan modulus elektrik, M^* untuk sampel yang mempunyai konduktiviti yang paling tinggi pada suhu bilik. Suhu yang bergantung dengan konduktiviti adalah mematuhi plot Arrhenius. Filem yang mempunyai ionik konduktiviti yang paling tinggi memberikan nilai tenaga pengaktifan yang paling rendah iaitu 0.19 eV. Seterusnya, interaksi antara rantai-rantai polimer dengan kepekatan garam yang berbeza-beza dianalisis oleh spektroskopi Fourier transform inframerah (FTIR). Daripada spektrum inframerah, adunan kitosan-PEO dan kitosan-PEO dengan kepekatan garam yang berbeza-beza menunjukkan bahawa kompleks ini adalah boleh bercampur.