PROPERTIES FOR THE THERMODYNAMIC CONTROL OF THE COMPLEXATION OF INORGANIC SALT TO THE MODIFIED NATURAL RUBBER

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BY:

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Contents

Letter of Offer (Research Grant)

Surat Kami : 600-RMI/ST/DANA 5/3/Dst (^at/2011)
Tarikh . *Q*\ Oktober 2011

PEMENANG
Anugerah Kuaiiti
Pertfana Menteri

Profesor Madya Dr Sim Lai Har
Fakulti Sains Gunaan
Universiti Teknologi MARA
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Y Brs. Profesor/Tuan/Puan

KELULUSAN PERMOHONAN DANA KECEMERLANGAN 10/2011

T . . p . .	Properties for the Thermodynamic Control of the Complexation of Inorganic Salt to the Modified Natural Rubber
Kod Projek	600-RMI/ST/DANA 5/3/Dst (t\3.6/2011)
Kategori Projek	Kategori G (2011)
Tempoh	01 Oktober 2011 - 30 September 2013 (24 bulan)
Jumlah Peruntukan	RM 10,000.00
Ketua Projek	Profesor Madya Dr Sim Lai Har

Dengan hormatnya perkara di atas adalah dirujuk.

2. Sukacita dimaktumkan pihak Universiti telah meluiuskan cadangan penyelidikan Y. Brs Profesor/tuan/puan untuk membiayai projek penyelidikan di bawah Dana Kecemerlangan UiTM.

3 Bagi pihak Universiti kami mengucapkan tahniah kepada Y Brs. Profesor/tuan/puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang

4 Peruntukan kewangan akan disalurkan melalus tiga (3) peringkat berdasarkan kepada laporan kemajuan serta kewangan yang mencapai perbelanjaan lebih kurang 50% dan peruntukan yang diterima

Peringkat Pertama		20%__
Peringkat Kedua	1	40%
^Peringkat Kettga	} _	40%

5 Untuk tujuan mengemaskini pihak Y. Brs Profesor/tuan/puan adalah diminta untuk melengkapkan semula kertas cadangan penyelidikan sekiranya perlu, mengisi borang setuiu terima projek penyelidikan dan menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek

Sekian, harap makfum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar /

PROFESOR DR ABU BAKAR ABDUL MAJEED
Penolong Naib Cahse/or (Penyelidikan)

Properties for the thermodynamic control of the complexation of inorganic salt to the modified natural rubber

Original Objectives as Proposed:

This project aims at investigating the epoxidation content dependencies on thermal behaviour and development of morphologies for undoped- and doped-polymer host. Besides, the solubility of Li-salt in the system and the conductivity of the systems as a function of the epoxidation content for polymer host will be studied. Mobility and the diffusion coefficient will be estimated from the power-law dependence of ionic conductivity on salt concentration. Interactions between ions and the polymer segments will be elucidated from spectroscopy analysis.

5. Report

5.1 Proposed Executive Summary

(Original proposal - 300 words) - 1 page only

Solid polymer electrolytes (SPE) are ion conducting, solvent-free films compose of alkali salts dissolved in a polymer matrix. Owing to its elastomeric characteristic and the presence of epoxy and unsaturated sites along the polymer backbone, epoxidized natural rubber (ENR) has been extensively researched as a polymer matrix for SPE. It is well documented that carrier density and mobility as well as the segmental motion of the polymer matrix play a crucial role in improving the electrical properties of a polymer-salt complexe. The conductivity of a SPE with ENR as the polymer host is controlled not only by the ion concentration and the molar mass of the polymer matrix, more so by the epoxidation level of ENR. Increasing the epoxidation level of ENR concomitantly elevates its glass transition temperature (T_g), thus, reduces the flexibility of the polymer host and the conductivity of the SPE.

This project aims at synthesizing ENR with an optimal epoxidation level that provides adequate coordinating sites for ion transport and simultaneously increasing the solubility of the salt in the polymer host by devising a new thermal procedure. Besides, the characteristic parameters such as the thermal and mechanical properties of each ENR synthesized will be thoroughly explored and correlated with the degree of epoxidation of the ENR. The success of this project will promote the use of a green polymer, the synthesized ENR, in the electrical industry.

The samples will be prepared using the solution cast technique. Differential scanning calorimetry and dynamic mechanical analysis will be applied to study the thermal and mechanical properties of the sample, respectively. Conductivity will be carried out using the Impedance spectroscope. At least one master thesis in UiTM will be produced. Oral presentations in local conferences and a minimum of one publication in international refereed journal (Scopus indexed) are expected.

5.2 Enhanced Executive Summary

(Abstract of the research) - 1 page only

Solid polymer electrolytes comprise of epoxidized natural rubber (ENR) and methyl-grafted natural rubber (MG) as polymer hosts added with $LiCI0_4$ were prepared by solution casting technique. Glass transition temperature (T_g) obtained by using differential scanning calorimetry (DSC) and the ionic conductivity evaluated from bulk resistance (R_b) determined using the impedance spectroscopy point towards the higher solubility of the lithium salt in MG rubber. Moreover, two 7_gs are observed for the MG-salt electrolyte system whereas only one 7_g is obtained for the ENR-salt system at all salt concentrations. The carboxyl group of the MG is found to have a better solvation capability than the oxirane group of ENR. Ionic conductivities *{a)* and dielectric constants (^) are observed to increase with ascending salt content. However, restricted segmental motion due to the higher degree of Li^+ ion coordination to the polar epoxy oxygen of the ENR-50 leads to lower ionic conductivity as compared to ENR-25 and dependency of *d* on salt concentration is more pronounced at low frequencies from 50 to approximately 1.0 x 10^4 Hz. A power law dependence of ionic conductivity on salt concentration is also observed in which the lower charge carrier mobility in ENR as compared to MG is in good agreement with its lower conductivity.

5.3 Introduction

1 to 2 pages only

Solid polymer electrolytes (SPE) are ion conducting, solvent-free polymer films usually compose of alkali salts dissolved in a polymer matrix. From the past two decades till now, development of SPE continues to attract great research interest in the hope of opening new prospects for improved electrical energy-storage and energy-generation devices. Battery technology has been focused on SPE because of