UNIVERSITI PUTRA MALAYSIA

PREPARATION AND CHARACTERIZATION OF CROSS-LINKED NATURAL RUBBER/MULTI-WALLED CARBON NANOTUBE/CLAY NANOCOMPOSITES

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FS 2011 31
PREPARATION AND CHARACTERIZATION OF CROSS-LINKED
NATURAL RUBBER/MULTI-WALLED CARBON NANOTUBE/CLAY
NANOCOMPOSITES

By

MOHAMMADREZA GHORBANI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
In Fulfillment of the Requirements for the Degree of Master of Science

April 2011
DEDICATION

I would like to dedicate this work to the love of my life, Elham, who has always been next to me on this long journey; to my brother, Ahmad, who has been always so proud and supportive of his younger brother.
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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Chairman: Prof. Dato’ Wan Md Zin bin Wan Yunus, PhD

Faculty: Science

Polymer composites have a wide range of applications in electronics, transportation, construction and consuming products. In recent years, polymer/clay nanocomposites have been extensively studied due to improved properties of the material produced. In addition, polymer/nanotube nanocomposites have been given a special attention because of the unique properties of carbon nanotubes. One of the problems of using these fillers separately is the existence of their agglomerations. It was suggested to overcome this problem and also to obtain new properties of the products by using of two fillers.

In this study, nanocomposites of natural rubber (NR)/Octadecylamine modified montmorillonite(ODA-MMT), NR/multi-walled carbon nanotube(MWNT) and NR/MWNT/ODA-MMT, crosslinked by Luperox 231xl-40, were prepared by using melt blending method and characterized. The NR/ODA-MMT nanocomposites
produced were of intercalation and exfoliation types as proved by XRD and TEM analyses. The presence of the ODA-MMT in the composites improved their tensile strength of around 40%, storage modulus and thermal stability. Similar effects (of around 30% increases in tensile strength) were observed when the ODA-MMT was replaced with 3.00 phr MWNT which was dispersed as single and agglomerated fibers, in the composites.

When both a mixture of MWNT and ODA-MMT were used in the nanocomposites, the dispersion of the MWNT in the matrix improved, although some of the fibers were still in the agglomerated form. Addition of 3.00 phr of the MWNT increases 9% of the tensile strength higher compared to that of the NR/ODA-MMT nanocomposite but decreases the thermal stability. However, when the MWNT was chemically treated and used in the nanocomposites, both storage modulus and thermal stability were enhanced, despite insignificant effect on the tensile strength.
Abstrak tesis yang dibentangkan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan ijazah Master Sains

PENYEDIAAN DAN PENCIRIAN NANOKOMPOSIT GETAH ASLI BERANGKAI SILANG/KARBON NANOTIUB/TANAH LIAT

Oleh

MOHAMMADREZA GHORBANI

April 2011

Pengerusi: Prof. Dato’ Wan Md Zin bin Wan Yunus, PhD

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Dalam penyelidikan ini tiga komposit iaitu komposit getah asli/tanah liat, getah asli/karbon nanotiub dan getah asli/karbon nanotiub/tanah liat, yang telah dirangkaisilangkan dengan Luperox 231xl-40, telah disediakan dengan menggunakan

Apabila kedua-dua karbon nanotiub dan tanah liat digunakan secara serentak dalam komposit, sebaran karbon nanotiub menjadi lebih baik walaupun gumpalannya masih lagi ujud. Penambahan 3% karbon nanotiub meninggikan sedikit kekuatan regangan tetapi merendahkan kestabilan terma. Walau bagaimana pun, apabila karbon nanotiub yang dirawatkan secara kimia digunakan, sungguh pun tidak memberi kesan kepada kekuatan regangan, tetapi telah meningkatkan modulus setoran dan kestabilan terma komposit yang dihasilkan.
ACKNOWLEDGEMENT

I would like to thank my advisor, Professor Dato Dr. Wan Md Zin Wan Yunus for patient guidance and constant encouragement through my study and research at UPM. From him I learned a lot of experimental and theoretical chemistry, technical writing, and the meaning of hard work. I would like to thank the Department of Chemistry that allowed me to conduct research and enjoy decent conditions in Malaysia. I am grateful to associate Professor Dr. Mansor Ahmad for serving on my thesis committee, and also Dr. Nor Azowa Ibrahim.

I thank, Lim Chee Siong for contributing his time, skill and smile to my experiments. I thank all laboratory assistants in Chemistry Department, particularly Mr Nazri. I thank all the staffs of FTIR, TGA, CHNS, and DMA units in Faculty of Science, and also all staff in Scanning Electron Microscopy Unit, Mr Raffie, and Transmission Electron Microscopy, Mr. Ho for their assistances. I also appreciate Dr. Jamaliah Sharif for her dedication in providing my samples in high resolution transmission electron microscopy (HRTEM) unit at Malaysia Nuclear Agency.
I certify that an Examination Committee has met on January 2011 to conduct the final examination of Mohammadreza Ghorbani on his Master of Science thesis entitled "Preparation and Characterization of Natural Rubber/Multi-walled Carbon nanotubes/Clay Nanocomposites" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of master of science. The members of the Supervisory Committee were as follows:

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Date:
DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

MOHAMMADREZA GHORBANI

Date: 22 April 2011
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>ii</td>
</tr>
<tr>
<td>Abstract</td>
<td>iii</td>
</tr>
<tr>
<td>strak</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>vi</td>
</tr>
<tr>
<td>DECLARATION</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xiv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xvi</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xxi</td>
</tr>
</tbody>
</table>

## INTRODUCTION

1.1 Objectives

## LITERATURE REVIEW

2.1 Natural Rubber

2.1.1 Applications of Natural Rubber

2.1.2 Standard Malaysian Rubber

2.1.3 Cross-Linking of Natural Rubber

2.1.4 Peroxide Cross-Linking

2.1.5 Mechanism of Cross-Linking Reaction

2.2 Structure and Properties of Layered Silicates Clay

2.3 Structure and Properties of Multi-Walled Carbon Nanotube

2.4 Polymer Nanocomposites

2.5 Natural Rubber/Clay Nanocomposites

2.6 Polymer/Carbon Nanotube Nanocomposites

2.7 Polymer/Multi-walledCarbon Nanotube/Clay Nanocomposites

## MATERIALS AND METHODS

3.1 Materials and Equipments

3.2 Preparation of Octadecylamine-Montmorillonite

3.3 Modification of Multi-Walled Carbon Nanotube

3.3.1 Acid Treatment

3.3.2 Potassium Dichromate Treatment
3.3.3 Potassium Permanganate Treatment 23
3.3.4 Preparation of ODA Modified MWNT 23

3.4 Preparation of NR Composites 24

3.5 Characterization of Clay and Composites 26
  3.5.1 X-Ray Diffraction Analysis 26
  3.5.2 Elemental Analysis 27
  3.5.3 Scanning Electron Microscopy 27
  3.5.4 Tensile Properties Measurement 28
  3.5.5 Gel Content Measurement 28
  3.5.6 Dynamic Mechanical Analysis 29
  3.5.7 Thermogravimetric Analysis 29

4 RESULTS AND DISCUSSION 30

4.1 PREPARATION AND CHARACTERIZATION ORGANOCLAY 30
  4.1.1 X-Ray Diffraction (XRD) Study of the Clay and Organoclay 30
  4.1.2 Thermal Stability of Na-MMT and ODA-MMT 31
  4.1.3 Elemental Analysis 34
  4.1.4 Fourier Transform Infrared (FTIR) Spectrophotometry of Na-MMT and ODA-MMT 34

4.2 Preparation and Characterization of the Cross-Linked NR/ODA-MMT Nanocomposites 36
  4.2.1 Preparation and Properties of the Cross-Linked NR 36
  4.2.2 X-Ray Diffraction Analysis 37
  4.2.3 Transmission Electron Microscopy 40
  4.2.4 Scanning Electron Microscopy 41
  4.2.5 Tensile Strength 42
  4.2.6 Elongation at Break 43
  4.2.7 Tensile Modulus 44
  4.2.8 Effect of ODA-MMT Content on Degree of the NR and NR/ODA-MMT Nanocomposite Cross-Linking 45
  4.2.9 Dynamic Mechanical Analysis 46
  4.2.10 Thermal Stabilities 50

4.3 Characterization of the Cross-Linked NR/MWNT Nanocomposites 52
  4.3.1 X-Ray Diffraction Analysis 53
  4.3.2 Transmission Electron Microscopy 54
4.3.3 Scanning Electron Microscopy 59
4.3.4 Tensile Strength 64
4.3.5 Elongation at Break 65
4.3.6 Tensile Modulus 66
4.3.7 Dynamic Mechanical Analysis 67
4.3.8 Thermal Stability 70

4.4 Preparation and Characterization of the Cross-Linked 74
4.4.1 X-Ray Diffraction Analysis 74
4.4.2 Transmission Electron Microscopy 76
4.4.3 Scanning Electron Microscopy 82
4.4.4 Tensile Strength 87
4.4.5 Elongation at Break 89
4.4.6 Tensile Modulus 90
4.4.7 The Effect of the MWNT Content on the Degree of the NR/ 91
4.4.8 Dynamic Mechanical Analysis 91
4.4.9 Thermal Stability 96

4.5 Preparation and Characterization of the Modified NR/MWNT/ 100
4.5.1 FTIR Analysis 101
4.5.2 X-Ray Diffraction Analysis 102
4.5.3 Transmission Electron Microscopy 103
4.5.4 Scanning Electron Microscopy 106
4.5.5 Tensile Strength 110
4.5.6 Elongation at Break 111
4.5.7 Tensile Modulus 112
4.5.8 Effect of Modified MWNT on the Cross-Linking Degree of NR/MWNT/ODA-MMT Nanocomposites 112
4.5.9 Dynamic Mechanical Analysis 113
4.5.10 Thermal Stability 115

5 CONCLUSION 119
REFERENCES 123
APPENDICES 129
BIODATA OF STUDENT 138