

**THE EFFECT OF FILLER FROM RICE HUSK ASH ON MG30-
MAGNESIUM TRIFLATE POLYMER ELECTROLYTES**

NURUL AZMEERA AZNY BINTI ABD AZIZ

**Final Year Project Report Submitted in
Partial Fulfilment of The Requirements for the
Degree of Bachelor of Science (Hons.) Physics
in the Faculty of Applied Sciences
Universiti Teknologi MARA**

JULY 2025

This Final Year Project Report **“The Effect of Filler from Rice Husk Ash on MG30-Magnesium Triflate Polymer Electrolytes”** was submitted by Nurul Azmeera Azny Binti Abd Aziz in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Physics In the Faculty of Applied Science, and was approved by:

Dr. Khuzaimah Nazir
Supervisor
B.Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
Perlis Branch, Arau Campus,
02600, Arau, Perlis

Dr. Nabilah Akemal Muhd Zailani
Co Supervisor
B.Sc. (Hons.) Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
Perlis Branch, Arau Campus,
02600, Arau, Perlis

Dr. Siti Zulaikha Mohd Yusof
Project Coordinator
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
Perlis Branch, Arau Campus,
02600, Arau, Perlis

Dr. Rosyaini Afindi Zaman
Programme Coordinator
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
Perlis Branch, Arau Campus,
02600, Arau, Perlis

Date: 25 JULY 2025

ABSTRACT

THE EFFECT OF FILLER FROM RICE HUSK ASH ON MG30-MAGNESIUM TRIFLATE POLYMER ELECTROLYTES

Over the years, researchers worldwide have focused on polymer electrolytes (PEs) for electrochemical devices. This study focuses on exploring the effect of adding rice husk ash (RHA) as a filler with 30% poly (methyl methacrylate) grafted natural rubber (MG30)-magnesium triflate ($\text{Mg}(\text{OTf})_2$) based composite polymer electrolytes (CPEs). Rice husk ash (RHA) was selected as the filler because it is a low-cost, renewable material with potential to improve the properties of polymer electrolytes (PEs). The composite polymer electrolytes (CPEs) were prepared using the solution casting method, where MG30 mixed with magnesium triflate, ($\text{Mg}(\text{OTf})_2$) salt and different concentration of RHA. The aim was to evaluate the structural and mechanical effects of RHA on polymer matrix at different concentrations (2-10 wt.%). The films were analyzed using Fourier transform infrared spectroscopy (FTIR), optical microscopy (OM) and tensile test. FTIR analysis revealed clear interactions between the polymer matrix, magnesium triflate salt, and RHA, indicating successful incorporation and strong molecular interactions. OM shows a relatively smooth and homogeneous surface morphology for the 6 wt.% RHA sample, indicating uniform filler dispersion and minimal agglomeration. This homogeneous distribution contributes to improved ion transport pathways and consistent mechanical properties. Tensile testing verified that 6 wt.% RHA offered the best possible compromise between flexibility and mechanical strength. It showed excellent mechanical reinforcement without sacrificing flexibility, achieving a high tensile stress of 0.7 MPa and an exceptional elongation at break of almost 374%. In conclusion, the results indicate that 6 wt.% RHA provides the optimal performance to enhance the mechanical and structural properties of the polymer electrolyte. This finding suggests that using agricultural waste like RHA as a filler can help improve polymer electrolytes (PEs) in a more environmentally friendly way. Overall, this research offers a sustainable approach to enhance the performance of composite polymer electrolytes (CPEs) for potential applications in energy storage devices.

TABLES OF CONTENTS

ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
ABSTRAK	v
TABLES OF CONTENTS	vi
LIST OF TABLES	vii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	x

CHAPTER 1 INTRODUCTION

1.1	Research Background	1
1.2	Problem Statement	4
1.3	Research Questions	5
1.4	Objectives	5
1.5	Significant of Study	5
1.6	Expected output/Outcomes/Implication	6

CHAPTER 2 LITERATURE REVIEW

2.1	Introduction to Polymer Electrolytes	7
	2.1.1 Solid Polymer Electrolytes	8
	2.1.2 Gel Polymer Electrolytes	9
	2.1.3 Composite Polymer Electrolytes	10
2.2	Polymer host	11
	2.2.1 30% poly (methyl methacrylate) grafted natural rubber (MG30)	11
2.3	Magnesium Triflate as a Complex Salt	12
2.4	Silica from RHA as a filler	13
2.5	Structural Properties of CPEs based RHA	15
2.6	Mechanical properties of CPEs based RHA	17

CHAPTER 3 RESEARCH METHODOLOGY

3.1	Introduction	20
3.2	Materials	20

3.3	Preparation of Polymer Electrolytes	22
3.3.1	Preparation of rice husk ash (RHA) silica	22
3.3.2	Preparation of solid polymer electrolytes (SPEs)	23
3.3.3	Preparation of Composite Polymer Electrolytes (CPEs)	23
3.4	Sample Characterization	24
3.4.1	Fourier Transform Infrared Spectroscopy (FTIR)	24
3.4.2	Optical Microscopy (OM)	26
3.4.3	Tensile	27
3.5	Experimental Designs / Flow chart	29
CHAPTER 4 RESULT AND DISCUSSION		33
4.1	Fourier transform infrared spectroscopy (FTIR)	33
4.1.1	Introduction	33
4.1.2	Structural studies on RHA	34
4.1.3	Structural studies on MG30 with Mg(OTf) ₂ -SPEs	36
4.1.4	Structural studies on CPEs thin film	38
4.2	Optical microscopy (OM)	40
4.2.1	Introduction	40
4.2.2	OM studies on CPEs thin film	40
4.3	Tensile	44
4.3.1	Introduction	44
4.3.2	Mechanical Strength on CPEs	44
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS		47
5.1	Introduction	47
5.2	Conclusion	48
5.3	Recommendation	49
REFERENCES		50
APPENDICES		53
CURRICULUM VITAE		62