

**THERMAL DEGRADATION RATE OF ELECTRODE MATERIAL FOR THE
ALKALI METAL ENERGY CONVERTER**

By

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfilment of the Requirements for the Degree of Master of Science**

February 2005

Dedicated to

*My wife, Soon Lan and
my beloved children,
Jia Ning, Jia Yun
and Yang Jun*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in partial fulfillment of the requirement for the degree of Master of Science

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Alkali Metal Energy Converter, which is commonly referred to Alkali Metal Thermal To Electric Converter (AMTEC), was investigated for its use as a potential power supply unit in future space mission, for example, the Pluto Express Mission.

In this study, the degradation rate of different electrode materials used in AMTEC was examined under different hot side temperatures. The data were analyzed, using a Fortran command statements simulation program. Simulation studies carried out on Titanium Nitrate (TiN), Rhodium Tungsten (RhW) and Rh₂W electrodes for power output and conversion efficiency degradation over an operating period of 15 years, as recommended by space mission for Pluto. Simulations were also carried to test the performance of the electrodes for maximum power output and efficiency at both normal and maximum operating temperature at 1100 and 2000 Kelvin, respectively. The optimum power output

was in the range of 16W ~17W for the 3 types of electrode. The results obtained with these 3 new electrode materials agree with results of other researchers.

The solar thermal heat is proposed as the heat source of thermal energy input to the AMTEC as it is renewable and available for space applications.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**KADAR PENURUNAN TERMO GRED BAHAN ELEKTROD PENUKAR
TENAGA LOGAM ALKALI**

Oleh

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Penukar Tenaga Logam Alkali yang lebih biasa dirujuk sebagai Penukar Logam Alkali Termoelektrik (AMTEC) telah dikaji untuk potensi kegunaannya sebagai pembekal kuasa dalam misi angkasa lepas masa hadapan seperti misi Pluto Ekspres.

Dalam pengajian ini, kadar penurunan gred bahan-bahan elektrod AMTEC yang berlainan telah diperiksa di bawah masukan suhu yang berlainan. Data-data telah dianalisa dengan menggunakan program simulasi yang berasaskan bahasa Fortran. Simulasi telah dijalankan pada elektrod-elektrod yang bernama Titanium Nitrat (TiN), Rodium Tungsten (RhW) dan Rh₂W untuk kadar penurunan hasil kuasa dan kecekapan penukaran dalam jangka masa operasi selama 15 tahun yang mana telah dicadangkan oleh misi ke Pluto. Simulasi juga telah dijalankan untuk menguji prestasi elektrod-elektrod untuk hasil kuasa dan kecekapan yang maksimum di bawah kedua-dua suhu

operasi biasa dan maksimum iaitu 1100 dan 2000 Kelvin. Hasil kuasa maksimum adalah di antara 16W hingga 17W untuk ketiga-tiga jenis elektrod. Keputusan-keputusan yang diperolehi adalah bersetuju dengan keputusan-keputusan kerja-kerja penyelidikan sebelum ini.

Pemanasan suria termo telah dicadangkan sebagai punca masukan tenaga termo kepada AMTEC disebabkan sifatnya yang boleh diperbaharui dan boleh didapati untuk aplikasi angkasa lepas.

ACKNOWLEDGEMENTS

The author wants to take this opportunity to extend his sincere thanks to Assoc. Prof. Dr. Mohibullah for his support, guidance and valuable time spent in persuing this study. The author is also grateful to Prof. M.A.K. Lodhi from Texas Tech University, USA for his valuable guidance in the study of AMTEC while he was in the Department of Physics, UPM.

Thanks also to the thesis supervisory committee member, Assoc. Prof. Ir. Dr. Norman Mariun and Miss Nashiren Farzilah for their valuable comments and help needed from time to time on this thesis. Finally, the author would like to thank his wife and family for their love, patience, understanding and support during the course of this study.

I certify that an Examination Committee met on date of viva on _____ to conduct the final examination of Siew Choo Soon on his Master of Science thesis entitled “Thermal Degradation Rate of Electrode Material for the Alkali Metal Energy Converter” 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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DECLARATION

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

SIEW CHOO SOON

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TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	vii
APPROVAL	viii
DECLARATION	x
LIST OF TABLES	xiv
LIST OF FIGURES	xv
LIST OF ABBREVIATIONS	xvii

CHAPTER

1 INTRODUCTION

1.1	What is Alkali Metal Thermal to Electric Converter	1
1.2	Renewable Energy Facts and Figures	2
1.3	Problem Statements	6
1.4	Aim and Objectives	7
1.5	Importance of the Project	8

2 LITERATURE REVIEW

2.1	Energy Conversion	10
2.2	History of Alkali Metal Thermal to Electric Converter	11
2.3	Theory of Alkali Metal Thermal to Electric Converter	14
	2.3.1 Basic Concept	14
	2.3.2 Liquid-Anode AMTEC Cycle and Vapor-Fed AMTEC Cycle	15
2.4	Grain Growth Effect of Electrode	21
2.5	Time-Dependent Equation for Power Output	22
2.6	Advantages and Uses of AMTEC	26
	2.6.1 High Efficiency	26
	2.6.2 High Power Density	26
	2.6.3 Closed-Loop Design	27
	2.6.4 Absence of Moving Parts	27
	2.6.5 Reliability	27
	2.6.6 Maintenance-Free Operation	28
	2.6.7 Competitive Production Costs	28
	2.6.8 Working Temperatures	28
	2.6.9 Flexibility of Heat Source	29
	2.6.10 Modular Design	29
2.7	Earlier Research Work	30

2.8	Solar Heat to AMTEC	30
2.8.1	Parabolic Trough Systems	31
2.8.2	Parabolic Dish Systems	32
2.8.3	Power Tower Systems	34
2.9	Solar AMTEC	36
2.10	Summary	38
3 METHODOLOGY		
3.1	Performance Analysis of AMTEC	39
3.2	Simulation Program of AMTEC	40
3.3	Fixed Temperature Model Simulation	41
3.4	Solar Heat	41
3.5	Solar Parabolic Dish to Power AMTEC System	42
3.6	Parabolic Dish Concentrating Collector	44
3.7	Basic Parabolic Geometry	45
3.7.1	Parabola	45
3.7.2	Paraboloid	51
3.8	Reflection of Parallel Rays	54
3.9	The Blackbody Radiation	59
4 RESULTS AND DISCUSSION		
4.1	AMTEC Electrodes	61
4.1.1	Normal Working Temperature Range	61
4.1.1.1	AMTEC's Electrode: TiN	62
4.1.1.2	AMTEC's Electrode: RhW	63
4.1.1.3	AMTEC's Electrode: Rh ₂ W	65
4.1.1.4	Comparison Among TiN, RhW and Rh ₂ W Electrodes	67
4.1.2	Working Temperature Beyond 1200 Kelvin	68
4.1.2.1	AMTEC's Electrode: TiN	68
4.1.2.2	AMTEC's Electrode: RhW	70
4.1.2.3	AMTEC's Electrode: Rh ₂ W	72
4.1.2.4	Comparison Among TiN, RhW and Rh ₂ W Electrodes	74
4.2	Design Consideration of Parabolic Dish	76
4.2.1	Without Considering the Loss Factors	76
4.2.1.1	Determination of Parabolic Dish Reflector Size	76
4.2.1.2	Solar Receiver/Absorber Dimension	79
4.3	Role of the Electrode Materials	79
4.4	Time, Temperature and Grain Size Relation	81
4.5	Result of Normal Temperature Range Operation	81
4.6	Result of Operating Temperature Beyond 1200 Kelvin	83
4.7	Solar Parabolic Dish Collector Dimension	84

5 CONCLUSION AND FUTURE WORK	
5.1 Conclusion	86
5.2 Future Work	87
REFERENCES	89
APPENDIX – Solar Radiation in Malaysia	
A1 (i) Monthly average daily global solar radiation for selected cities in Malaysia (Whr/m ²)	91
(ii) Monthly average daily sunshine hours for selected cities in Malaysia (hours)	91
BIODATA OF THE AUTHOR	92