UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF ZINC OXIDE (ZNO) NANOFLOWER FOR ELECTRON TRANSPORT MATERIAL OF DYE-SENSITIZED SOLAR CELL

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Electrical And Electronic Engineering Technology (Electrical and Electronic) with Honours.

by

FARIDZUAN BIN BAKAR
B071610283
940816065393

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2019

© Universiti Teknikal Malaysia Melaka

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF ZINC OXIDE (ZNO) NANOFLOWER FOR ELECTRON TRANSPORT MATERIAL OF DYE-SENSITIZED SOLAR CELL

Sesi Pengajian: 2019

Saya **FARIDZUAN BIN BAKAR** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

© Universiti Teknikal Malaysia Melaka

☐	SULIT*	Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.
☐	TERHAD*	Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.
☒	TIDAK TERHAD	

Yang benar,	Disahkan oleh penyelia:
....	....
FARIDZUAN BIN BAKAR	Ahmad Nizamudin b. Muhammad Mustafa
Alamat Tetap:	Cop Rasmi Penyelia
X	
X	
X	
Tarikh:	Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

© Universiti Teknikal Malaysia Melaka

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF ZINC OXIDE (ZNO) NANOFLOWER FOR ELECTRON TRANSPORT MATERIAL OF DYE-SENSITIZED SOLAR CELL is the results of my own research except as cited in references.

Signature: ……………………………………

Author : FARIDZUAN BIN BAKAR

Date:

© Universiti Teknikal Malaysia Melaka

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Electrical and Electronic) with Honours. The member of the supervisory is as follow:

Signature: ……………………………………………….

Supervisor : Ahmad Nizamudin b. Muhammad Mustafa

© Universiti Teknikal Malaysia Melaka

ABSTRAK

Cahaya matahari boleh menhasilkan arus dan voltan untuk menjana tenaga elektrik. Oleh kerana pengeluaran karbon dioksida yang menyebabkan pemanasan global, sel solar adalah calon peranti tenaga bersih yang baik. Sel suria pewarna pewarna dikenali sebagai pengeluaran kos rendah kerana bahan mudah diperoleh. Proses ini mengubah cahaya yang kelihatan ke dalam tenaga elektrik. Kajian ini akan memberi tumpuan kepada nanopartikel zink oksida untuk digunakan. Projek ini adalah mengenai pembangunan nanopartikel seng oksida untuk elektron yang mengangkut bahan. Kerja ini adalah untuk melihat nanopartikel zink oksida yang digunakan sebagai lapisan pengangkutan elektron. Dalam tahun-tahun akan datang, dijangka sumber tenaga alternatif yang menjanjikan (DSSCs) akan meningkatkan sumbangan penting kepada pengeluaran tenaga keseluruhan. Hal ini disebabkan oleh menawarkan fabrikasi murah dan ciri menarik seperti ketelusan. Oleh itu, tenaga mempunyai banyak kelebihan berbanding teknik tenaga lain seperti mengelakkan kerugian penghantaran, beroperasi tanpa bunyi dan memerlukan penyelenggaraan yang sangat sedikit. Selain itu, tidak ada pelepasan gas dan gas rumah hijau dalam sistem sel solar.

© Universiti Teknikal Malaysia Melaka

ABSTRACT

Sunlight possesses generated current and voltage to generate the power energy of electricity. Due production of carbon dioxide causing global warming, the solar cell is the good candidate clean energy devices. A dye-sensitized solar cell is known to be the low-cost production because the material is easy to get. This process transforms any visible light into electrical energy. This research will focus on zinc oxide nanoparticles to be used. This project is about the development of zinc oxide nanoparticles for electrons transporting material. This work is to observe the nanoparticles of zinc oxide used as the transport layer of electrons. In the coming years, it is expected that the promising alternative energy source (DSSCs) will increase the significant contribution to overall energy production. This is mainly due to offering a low-cost fabrication and attractive features such as transparency. Thus, the energy has many advantages over other energy techniques such as avoiding transmission losses, operating without noise and requiring very little maintenance. Moreover, there are no toxic and greenhouse gas emissions in solar cell systems.

© Universiti Teknikal Malaysia Melaka

DEDICATION

This book dedicated to Mom and Dad.

Thank you for your love and sacrifice

© Universiti Teknikal Malaysia Melaka

ACKNOWLEDGEMENTS

Bismillahirahmanirahim.

Firstly, I would like to thanks Allah Almighty for His blessing for his power for me to complete this thesis and my final year project called “DEVELOPMENT OF ZINC OXIDE (ZNO) NANOFLOWER FOR ELECTRON TRANSPORT MATERIAL OF DYE-SENSITIZED SOLAR CELL”.

Furthermore, I would like to take this opportunity to express my deepest gratitude to Mr. Ahmad Nizamudin b. Muhammad Mustafa as my supervisor. His invaluable guidance and full support for give knowledge that make this project complete according to planning. I appreciate him with unlimited positive advice and helping me in order to understand the chemical term for the whole project.

I would like to express my gratefulness towards my parents Mdm. Basharah bt. Awang that always give me the full support and advice until completing my Final Year Project. Lastly but not least, my sincerely appreciation also extends to all my friends who give encouragement and helping me in completion of this project at Universiti Teknikal Malaysia Melaka.

Thank You.

© Universiti Teknikal Malaysia Melaka

TABLE OF CONTENTS

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

LIST OF TABLES

© Universiti Teknikal Malaysia Melaka

LIST OF FIGURES

© Universiti Teknikal Malaysia Melaka

© Universiti Teknikal Malaysia Melaka

LIST OF APPENDICES

© Universiti Teknikal Malaysia Melaka

LIST OF ABBREVIATIONS

CdTe	-	Cadmium Telluride
CIGS	-	Copper Indium Gallium Selenide
DSSCs	-	Dye-Sensitized Solar Cells
TiO2	-	Moment of inertia
Voc	-	Open-Circuit Voltage
Isc	-	Short-Circuit Current
Jsc	-	Short-Circuit Density
ITO	-	Indium tin oxide
TCO	-	Transparent conducting oxide
NC(s)	-	Nanocrystal(s)
FWHM	-	Full width at half maximum
Ru	-	Ruthenium
ZnO2	-	Zinc oxide
J-Vcurve	-	Current density vs. voltage plot
I	-	Iodide
I3	-	Triiodide
ETL	-	Electron Transport Layer

© Universiti Teknikal Malaysia Melaka

LIST OF SYMBOLS

Ω	-	Ohm
$	-	US Dollar

© Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

1.1 Background

Due to the growth of the globe that the population makes an increasing demand for electrical city. At the same time, the earth is experiencing a threatening global warning and therefore the best solution will be used renewable energy sources such as solar cell power. However, a solar panel in the market is so expensive. Today's energy technology is steadily increasing and solar cells have created markets for many applications, from small electronic to large power stations. Solar power is a growing energy technology. The conversion efficiency of silicon-based solar cells has reached an efficiency of 25.6% for mono-Si and 20.4% for PolySi (Gooijer, Dijk and Gymnasium, 2016). The solar cells of the second generation are based on thin-film technologies. Amorphous Si (10.1 %), CdTe (19.6 %) are some of the well-established solar cell devices of the second generation. The solar cell devices of the third generation such as Organic (10.7 %) and dye-sensitized solar cells (14.1 %) (Gooijer, Dijk and Gymnasium, 2016). Dye-sensitized solar cells (DSC) are considered to be one of the most promising alternatives to conventional silicon based photovoltaic devices due to their ease of manufacture, flexibility and low production cost of around 1/5 of the Silicon-based PV solar cells ' production costs. Though DSC is substantially cheaper and easier to manufacture and promising laboratory research reveals interesting and fast progress in the efficiency of the DSC. Therefore, dye-sensitized solar cells DSCs emerged as a new class of low-cost energy conversion devices with simple manufacturing procedures. In addition, in diffuse light or cloudy conditions,

© Universiti Teknikal Malaysia Melaka

DSSC shows higher conversion efficiency than polycrystalline Si. Monocrystalline photovoltaic devices are believed to become a viable contender for future solar converters on a large scale. Nevertheless, the efforts are continually being undertaken to improve the performance of DSSCs and hence the competitiveness of this technology in the world Market. It is now possible to completely depart from the First and the second generation's solar cells devices by replacing the phase contacting the semiconductor by an electrolyte thereby forming dye-sensitized solar cells.

Renewable energy from Malaysia consists of biomass, biogas, modest hydro and solar cells as well. Biogas is usually identified as new petrol generated within the lack of oxygen by your breakdown of the normal subject. Biomass creates subject operating out of carbon dioxide, hydrogen along with oxygen in term of modest hydro could be the improvement regarding hydroelectric strength as it is usually renewable energy in which changes sunlight energy into electrical energy. There are four common solar cells and there are monocrystalline, polycrystalline, thin film and hybrid solar cell.

Monocrystalline cells develop the best efficiency among any kind of cells however as the increased generation expense in comparison with polycrystalline cells possess generally cheaper every watt as the strength develop but the polycrystalline cells slightly much less efficient when compared with monocrystalline cells yet need more space of roof area to get the same result volume. In thin film solar cells or also known as amorphous, silicon cells comprise silicon atoms within a skinny layer rather than a very composition. Thin film solar cell can absorb the light readily compared to the other traditional solar cells. Therefore, the cells can be much slimmer and thinner.

Photovoltaic is currently the fastest developing technology in which accustomed to make electrical energy throughout electricity production. Over 90% of the material

© Universiti Teknikal Malaysia Melaka

found in solar based on silicon for the reason that source material. This material is among the most valuable pieces of solar panels based on silicon. Thin films with silicon-based solar panels tend to be an inexpensive choice. There are about three most common thin films solar panels these days, for instance, Copper Indium Gallium Selenide (CIGS), Cadmium Telluride (CdTe) along with Amorphous Silicon (a-Si). TCO or transparent conductive oxide applicable to solar cells to increase the efficiency of the converted solar cells and matched with the absorption spectrum of the solar cells. This is because solar cells suffer efficiency loss due to spectral mismatch. Although CIGS has the highest efficiency yet CdTe has slightly different efficiency and also low cost in manufacturing. These low cost can reduce the money used in production and bill payment for user.

A dye-sensitized solar cell is one of the thin film solar 4 of the solar cell. A dye-sensitized solar cell made of low-cost materials and cheaper manufacturer. The flexibility of the dye-sensitized solar cell gives the advantage as it makes life goes easier. This is because due to the flexible dye-sensitized solar cell, it can be carrying out even can be folded and save more space. It can absorb diffused sunlight and fluorescent light. Moreover, the solar cells also work in cloudy weather and low light condition.

The electrolyte solution used in developing the solar cell contains volatile organic solvents and must carefully seal. Generally, dye-sensitized solar technology uses a liquid electrolyte that has temperature stability problems. For example, at the low temperature, the electrolyte may freeze and stopping power production as well as lead to physical damage. While at a higher temperature it will cause the electrolyte to expand and the panel sealing process a major problem.

A dye-sensitized solar cell is still in the early stages of the development cycle. With widespread studies and experiment, the efficiency may gain as high as the traditional

© Universiti Teknikal Malaysia Melaka

solar cell. The dye-sensitized solar cell has more advantages compared to the other solar cell as the manufacturing need low-cost production. Besides that, it can be made only in the laboratory or even in the garage. Overall, the dye-sensitized solar cell technology actually an attractive technology whereby using the natural 5 dyes it may create different colour or even pattern for the solar cell. Although the efficiency not as high as the other, currently even small increases in the dye-sensitized solar cell conversion efficiency may cause them suitable for some roles.

1.2 Project Objectives

Thus this project includes several objectives and aims:

i. To study Zinc oxide (ZnO) material for electron transport layer (ETL).
ii. To fabric dye synthesized solar cell which a Zinc oxide (ZnO) Nano flower as electron transport layer.
iii. To characterize dye synthesized solar cell and analysis the efficiency.

© Universiti Teknikal Malaysia Melaka