A COMPARISON STUDY OF THE COMMERCIAL SOLAR SYSTEMS MATERIALS AND ITS APPLICATIONS

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ABSTRACT

Solar Energy Materials and solar cells are intended as a vehicle for the dissemination of research results on materials science and technology related to photovoltaic, photothermal and photoelectrochemical solar energy conversion.
Materials Science is taken in the broadcast possible sense and encompasses physics, chemistry, optics, materials fabrication and analysis for all types of materials. This project is carried out with the purpose to do a comparison study of the commercial solar cells and materials, measurement of solar panels performance, selection of solar cells and materials, integration of the proposed solar cells and materials to the commercial photovoltaic system and discussion of the future solar cells development. The ultimate objective of the project is to select a photovoltaic cell materials from the commercial market with better efficiency and yet lower cost. Hopefully the project would provide a better understanding of the photovoltaic systems materials and could have contributed the effort in promoting the application of the green house energy materials especially in our tropical countries. Different test methods are conducted on the commercial photovoltaic materials. The results shows that the efficiency of the CIGS solar PV materials shows up to 16% and it has the most stable output power as compare with the rest. Through the detail analysis, power losses and factors are analysed, it shows that the efficiency can be further improve by minimising the ohmic losses and other external factors. The CIGS application is growing rapidly due to its consistency performance, flexibility and cheaper price.

ABSTRAK

Bahan tenaga suria dan sel suria adalah bermaksud sebagai satu sistem untuk penyebaran hasil kajian bagi ilmu sains bahan dan teknologi berkaitan dengan fotovoltaik, photothermal dan photoelectrochemical penukaran tenaga suria. Sains Bahan adalah satu bidang yang luas merangkumi fizik, kimia, optic, fabrikasi bahan dan analisis untuk semua jenis bahan. Projek ini dilakukan dengan tujuan untuk melakukan suatu perbandingan komersil sel suria dan bahan-bahan, panel suria pengukuran kinerja, seleksi sel suria dan bahan-bahan. Integrasi sel suria dan bahan-bahan yang akan dicadangkan untuk sistem fotovoltaik komersil serta perbincangan masa depan pengembangan sel suria juga dibincangkan. Tujuan akhir dari projek ini adalah untuk memilih bahan sel fotovoltaik daripada pasaran komersil dengan efisiensi yang lebih baik pada kos lebih rendah. Mudah-mudahan projek ini akan memberikan pemahaman yang lebih baik mengenai bahan dan sistem fotovoltaic dan juga boleh menyumbang usaha dalam mempromosikan penerapan bahan tenaga rumah hijau kami terutamanya di negara-negara tropika. Bahan-bahan komercil fotovoltaik diuji dengan berbagai cara. Hasilnya menunjukkan bahawa kecekapan bahan PV matahari CIGS menunjukkan hingga 16% dan mempunyai output kuasa yang paling stabil jika dibandingkan dengan yang lain. Melalui analisis, kuasa kerugian dan faktor-faktor yang dianalisis, ini menunjukkan bahawa kecekapan boleh ditingkatkan dengan meminimumkan kerugian Ohmic dan faktor-faktor luaran lain. Aplikasi bahan CIGS ini berkembang pesat kerana konsistensi kinerja, fleksibiliti dan harga lebih murah.

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LIST OF SYMBOLS/ABBREVIATIONS/NOTATIONS/TERMS

Voc	-	Open Circuit Voltage
Jsc	-	Short circuit current density
FF	-	Fill Factor
Rsh	-	Shunt Resistance
Rs	-	Series Resistance
Ipk	-	Peak current
Vpk	-	Peak Voltage
I-V	-	Current-Voltage
QE	-	Quantum Efficiency, λ
η	-	Efficiency
PV	-	Photovoltaic
CIGS	-	Copper indium gallium (di)selenide, $CuIn_xGa_{(1-x)}Se_2$

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CHAPTER 1

INTRODUCTION

1.1 Introduction

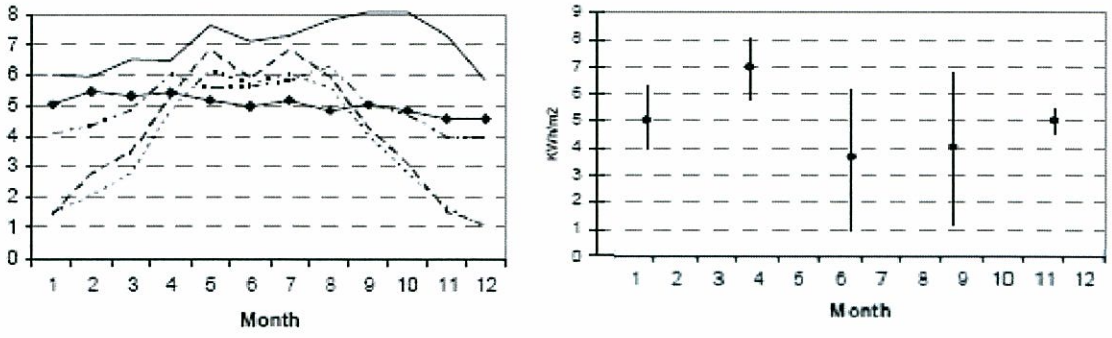

Figure 1.1: Daily global solar radiation charts. Daylight = Sunlight + Skylight

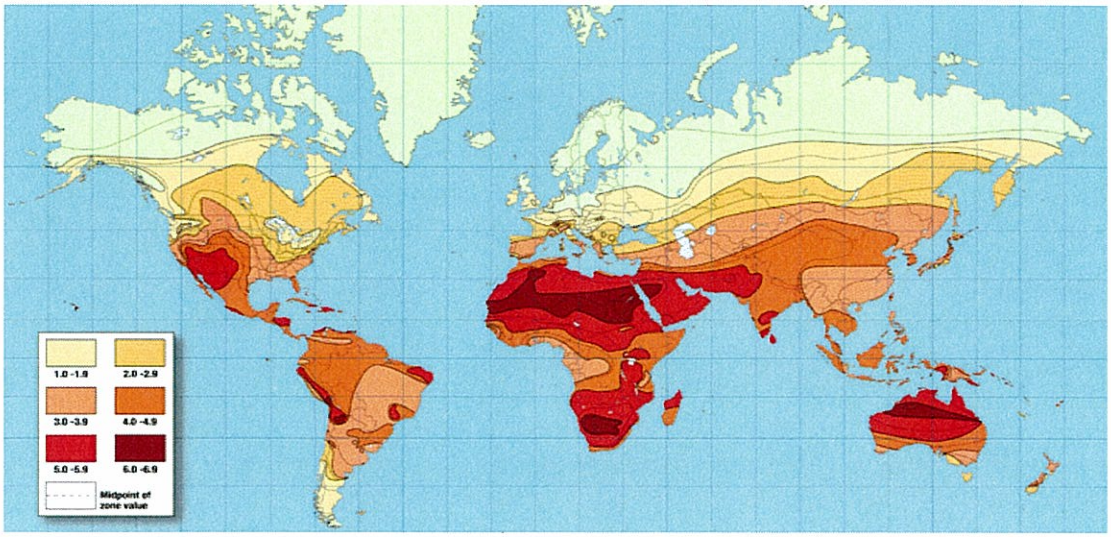

Figure 1.2: World Solar Map – Malaysia have plenty of daylight: 4-4.9 Sun Hour Day (KwH/m²/Day)

Traditionally Solar cells are used to power remote residences, satellites, highway signs, water pumps, communication stations, navigation buoys, streetlights and calculators, but as new photovoltaic materials and technologies emerge, the interest for using photovoltaic for large-scale power production is growing.

Solar Cells, covering single crystal, polycrystalline and amorphous materials utilizing homojunctions and heterojunctions, Schottky barriers, liquid junctions and their applications. Also of interest is analysis of component materials, individual cells and complete systems, including their economic aspects.

Photothermal Devices, in the broadest sense, including solar absorber devices, heat storage materials, radiative cooling systems and their applications.

Photoelectrochemical and Photochemical Device, covering photoelectrodes, photocatalysis, photoconversion and solar desalination systems and their applications.

Optical Properties of materials, including light trapping, texturising, solar concentrators which include imaging and non imaging optical collectors.

Light control, including systems for energy efficient architecture and daylighting, chromogenics and smart windows.

The pertinent issues are comprehensive and encompass bulk materials, coatings and thin films and surface treatments, from basic as well as from applications-oriented and manufacturing related perspectives.

1.2 Objective

The main objective of the project is to make a comparison study of the current commercial Solar Systems, Solar Cells and Solar Materials.

Recommendations will be proposed for different type of applications at the end of the comparison study. The proposed recommendations are meant to improve and promote the utilization of the solar power by selecting and appreciating the advancement of the solar cell materials in order to have better performance efficiency and cost effectiveness. Major comparisons and evaluations of various solar cell materials will be in terms of its performance ratio, cost matters and feasible applications.

1.3 Description

The Project is based on the Solar Power Technology. The Solar Power Technology is a system that absorbs light from the Solar & converts it to electrical energy and/or heat energy. Currently, there are many types of Solar Systems and Materials in the market. These might cause confusions and difficulties during the process of selecting suitable Solar systems and Solar cells materials. With a good comparison study of the various commercial Solar Systems and Solar Cells materials, it may help to have a proper selection of Solar Cells materials with maximum absorption, lower cost and higher performance. The propose better Solar systems and Solar Cell materials may lead to an greater improvement to the daily products, such as Solar batteries chargers, Solar incubators, Solar hand phones, Solar fans, Solar air-conditioners and etc.

1.4 Ultimate Goal of Project

With a comprehensive of comparison study of the Solar Cells and Materials properties such as Cell current-voltage curves (J-V), Quantum efficiency (QE), Materials cost, Performance ratio and etc, a recommendation of a proper selection of Solar Cells and Materials will be the utmost objective of the project. However, pertaining to the availability of the Solar power and Solar cells materials, the possibility of the integration of proposed Solar cells materials to the current products

or systems will be explored. The ultimate goal of the project is to shortlist the solar cell materials which are closed to as cheap as conventional electricity or even lower for the development of the new green house power products which aims to improve the daily products applications (i.e.: hand phone charger, eggs incubator, etc) and yet minimize the global warming effects.

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