ANALYSIS OF SILICON DIOXIDE AND SILICON NITRIDE ANTI REFLECTION COATING FOR SILICON SOLAR CELL

Thesis is present in partial fulfillment for the award of
Bachelor of Engineering (Hons) Electrical
Universiti Teknologi MARA

HAIRIL HUZAIRI B ABD HAMID
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
SHAH ALAM

ACKNOWLEDGEMENTS

All praises be to mighty Allah SWT the Most Gracious and Most Merciful for the strength and blessing throughout the entire research until the completion of this thesis. Peace be upon our Prophet Muhammad SAW whose has given light to mankind.

Firstly, I would like to take this opportunity to express of my greatest gratitude and appreciation to my supervisors, Mr. Fairul Nazmie B Osman for advices, guidance, patience, encouragement operational and enthusiastic support in the duration of thesis preparation until completed.

Surely, a special thanks to my beloved parent, Abd Hamid B Ahmad and for their support in moral and financial sector. Because of them, by blessed of Allah S.W.T, I could complete this project successfully.

Last but not least, thanks to all my friends who contributed directly or indirectly in giving their cooperation encouragement and moral support to me make the completion of this thesis.

ABSTRACT

Photovoltaic is a renewable energy technology that converts the sunlight directly into electricity through a photovoltaic (PVs) cell, commonly called a solar cell. Basically, they are made from semiconductor material such as silicon, gallium arsenide, amorphous and many more semiconductors. Photovoltaic energy has become popular nowadays because of its ability to provide nearly permanent, uninterrupted power. What is more interesting, there is no operating cost. However, disadvantage lie in the low power per unit area of sunlight, which necessitates a large area of arrays.

The performance of a photovoltaic array is dependent upon the intensity of the sunlight and also the material used for the solar cell device itself. Two main parameters in solar cell technology are the contact to the cell and the use of anti-reflective coating (ARCs), which are of capital importance in the improvement of the efficiency of semiconductor solar cells. However, this research gives the focus on the use of anti-reflective coating (ARCs) in attaining high efficiency of solar cell.

In this research, the analysis of silicon dioxide and silicon nitride for single and double layer thin film coatings on the reflectance spectrum of silicon surfaces has been investigate. The research has been carried out using ATLAS device simulator by Silvaco. This research is focusing to obtained higher efficiency and lower reflectance by different wavelength, thickness and refractive index. The material used for AR coating also important to give the lowest reflection in improving the efficiency. The ratio of available photocurrent is often known as external quantum efficiency. The source photocurrent is the amount of current generated by the light source and the available photocurrent is the amount of the current absorbed by semiconductor.

By comparing the plot of spectrum response and the reflectance of analysis with and without AR coating, solar cell with ARC is more efficient. With this analysis it was concluded that the effect of the wavelength, refractive index and the thickness of the material will be affected to the efficiency and the reflectance coating.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Solar cells represent the fundamental power conversion unit of a photovoltaic system. Solar cells are made of special materials called semiconductors such as silicon, which is currently the most commonly used. Basically when sunlight falls onto a solar cell, the solar cell material absorbs some of the light particles sometimes called photons. Each photon contains a small amount of energy. When a photon is absorbed it starts a process of freeing an electron in the material of the solar cell. Because both sides of a solar cell are electrically connected with a wire, a current will flow when the photon is absorbed. When light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This describes thus the process of converting sunlight directly into electricity. As long as the solar cells are exposed to light this process of creating free electrons continues and electricity is produced.

Silicon is best known as semiconductor optical material with relatively high refractive index. The most important application of silicon in the visible spectrum is photovoltaic solar cells. Conversion of solar energy into other energy forms is more effective if the reflectance of light- receiving surface of solar device is minimal in the solar spectrum range. [1] Efficiency of a solar cell and its lifetime can be raised by coating the light sensitive surface of the cell with an anti reflection coating (ARC). [1] ARC reduces the reflectance of the light incident radiation on the cell surface and also protects it from radiations and atmospheric effects.

Studies on dual layer ARC have been reported that the most stable configuration with respect to variations in film thickness have been found to be designs with a high refractive index (n) on the substrate and low refractive index toward the ambient.[6]