THICKNESS STRUCTURE ANALYSIS OF SILICON SOLAR CELL USING SILVACO SIMULATOR

This thesis is presented in partial fulfillment for the award of the Bachelor of Electrical Engineering (Honours)

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ABSTRACT

Solar cells made from semiconductor materials such as silicon and gallium arsenic. Both materials can produce higher efficiency than other semiconductor materials. Its performance is dependent upon the intensity of the sunlight and also the material used for the solar cell device. The main parameters in solar cell technology are the contact to the cell, the p+ layer, n+ layer and the use of anti-reflective coating (AR coating), which are of capital importance in the improvement of the efficiency of semiconductor solar cells. The focus was given more on the single junction silicon solar cells. The single junction solar cells have the best energy conversion rates of any silicon technology nowadays. Silvaco simulator was introduced for designing and simulating the solar cell. Silvaco Athena tool was used to develop the solar cell structure and Silvaco Atlas tool was used to extract the electrical characteristic of the solar cell. Several samples were created and the effects of the each solar cell were analyzed. By varying the solar cell thickness, the thinner solar cell gives better efficiency because of the reduction of photogeneration rate in deeper area. The rate of carrier generation will be the highest near the incident surface and will decrease exponentially with the distance deeper into the semiconductor.

Keywords:

Solar cells, Photovoltaic system, Off-grid system.

ACKNOWLEDGEMENTS

This research work has been carried out between Ogos 2008 and Mac 2009 in the Department of Electrical Engineering Universiti Teknologi MARA Malaysia (UiTM). Many people have helped me in the realization of this work and I would like to take this opportunity to express my gratitude to all of them. I am deeply grateful to my supervisors En. Mohd Hanapiah Abdullah and Pn. Norulhuda Abd Rasheid for their support and guidance.

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1.0 INTRODUCTION

1.1 Background

Solar cells are made of various semiconducting materials. The direct conversion of sunlight into energy using solar cells is called the photovoltaic effect. The word photovoltaic is a combination of the Greek word for light and the name of the physicist Allesandro Volta. The conversion process is based on discovery by Alexander Bequerel in 1839[4,6]. The photoelectric effect describes the release of positive and negative charge carriers in a solid state when light strikes its surface.

Photovoltaic generation has now emerged as an established commercial technology with a number of major manufacturers producing equipment. In addition to its use for power supplies in spaces, three main areas of terrestrial application of solar cells technology may be identified consumer products such as watches and calculators, the generation of electricity into large public supply networks and remote power supplies.

The absorbed light causes electrons in the material to increase in energy, at the same time making them free to move around in the material. However, the electrons remain at this higher energy for only a short time before returning to their original lower energy position. To collect the carriers before they lose the energy gained from the light, a pn junction is typically used. The pn junction consists of p+ and n+ semiconductor layer[4].

In this project, the different possibilities to improve the efficiency of solar cells will be found and propose to simulate different silicon structured layers thickness to determine the best structured cell that aim at higher efficiency using in a single pn junction. The single junction solar cells have the best energy conversion rates of any silicon technology nowadays[3]. Apply anti-reflective coating (AR coating) to improve their efficiency[2,5]. The Silvaco simulator is use to design the solar cell structure and simulating the solar cell.