DESIGN AND STUDY THE EFFECT OF CONTACT AREA ON GaAs SOLAR CELL USING SILVACO ATLAS DEVICE SIMULATOR

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ABSTRACT

Photovoltaics 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 (AR coating), which are of capital importance in the improvement of the efficiency of semiconductor solar cells [1]. However, this project give the focus on contact area parameter in attaining high efficiency of solar cell.

Two types of solar cells were designed by using Silvaco Atlas device simulator. They were single junction (GaAs) solar cells and multi junction (GaAs-AlGaAs) solar cells. ATLAS device simulator by Silvaco International was introduced for used as a tool in modeling solar cell. This project was conducted only to design and simulate both solar cell based on virtual fabrication but not involves real fabrication. This ATLAS simulator extracts the electrical characteristics of a solar cell based on virtual fabrication of its physical structure, allowing for direct manipulation of materials, dimensions and dopings. Both single junction and multi junction solar cells were analyzed in this simulator. The analysis involve solar cell response (photogeneration), spectral response and solar cell efficiency.

One of the important part in the single junction solar cell was to observe the effect of contact area on their efficiency. The efficiency of solar cell is affected by varying the area

TABLE OF CONTENTS

		Page
DECLARATION		i
ACKNOWLEDGEMENT		ii
ABSTRACT		iii
TABLE OF CONTENTS		v
LIST OF FIGURES		viii
LIST OF TABLES		x
ABBREVIATION		xi
CHAPTER 1	**INTRODUCTION**	
1.1	Background	1
1.2	History	2
1.3	Advantages and Disadvantages	3
1.4	Objectives	4
1.5	Previous Research	5
CHAPTER 2	**LITERATURE REVIEW**	
2.1	Introduction	6
2.2	Solar Radiation	6
2.3	How Solar Cells Work	9

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.

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 PV technology may be identified: consumer products, e.g. watches and calculators; generation of electricity into large public supply networks; and remote power supplies [1].

The solar cell is the basic unit in a Photovoltaic system. Photovoltaic cells are connected electrically in series or parallel circuits to produce higher voltages, currents and power levels. Photovoltaic modules consist of PV cell circuits sealed in an environmentally protective laminate and are the fundamental building blocks of PV systems. Photovoltaic panels include one or more PV modules assembled as a pre-wired, field-installable unit. A photovoltaic array is the complete power generating unit consisting of any number of