AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics and Communications Engineering Department

Comparative Study Between Gallium Arsenide and Standard Silicon Solar Cells On Spacecraft and Terrestrial Applications

A Thesis

Submitted in partial fulfilment of the requirements of the degree of
Master of Science in Electrical Engineering
(Electronics and Communication Engineering)

Submitted by

Mahmoud Mustafa Muhammad Mahmoud

B.Sc. of Electrical Engineering
(Electronics and Communication Engineering)
Obour Higher Institute for Engineering and Technology, 2008

Supervised By

Prof.Dr. Wagdy Refaat Anis

Dr. Rasha M.F. Ghoneim

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Cairo-Egypt

Examiners' Committee

Name: Mahmoud Mustafa Muhammad Mahmoud.

Thesis: Comparative Study Between Gallium Arsenide and Standard Silicon Solar Cells On Spacecraft and Terrestrial Applications.

Degree: Master of Science in Electrical Engineering (Electronics and Communication Engineering).

Name, Title and Affiliation **Signature**

1. **Prof. Dr. Wagdy Refaat Anis**
Electronics and Communication Eng.Dept.
Faculty of Engineering - Ain Shams University.

2. **Dr. Rasha M.F. Ghoneim**
Space Laboratory- National Research Institute Of Astronomy and Geophysics.

Date:

AIN SHAMS UNIVERSITY

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Electronics and Communications Engineering Department

Statement

This dissertation is submitted to Ain Shams University for the Degree of Master of Science in Electrical Engineering (Electronics and Communication Engineering).

The work included in this thesis was carried out by the author at the Electronics and Communication Engineering Department,
Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis was submitted for a degree or a qualification at any other university or institution.

Name: Mahmoud Mustafa Muhammad Mahmoud.

Signature:

Date:

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FACULTY OF ENGINEERING

Electronics and Communications Engineering Department

Curriculum Vitae

Name of Researcher Mahmoud	Mahmoud Mustafa Muhammad
Date of Birth	29 August 1986
Place of Birth	Cairo,Egypt
First University Degree	B.Sc. in Electrical Engineering
Department Engineering. Dept.	Electronics and Communication
Name of University	Obour Higher Institute for Engineering & Technology.
Date of Degree	June 2008

To My Parents

I present to you this thesis to express my

deep gratitude and love.

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“Comparative Study Between Gallium Arsenide and Standard Silicon Solar Cells On Spacecraft and Terrestrial Applications”

Mahmoud Mustafa Muhammad Mahmoud
Supervised by:
Prof. Wagdy Refaat Anis and Dr. Rasha M.F. Ghoneim.

Abstract

According to the current world needs for energy depending on renewable sources and especially solar energy , many types of research on solar cells and materials.Solar cells become the future of energy generation and the basic source of power in space and terrestrial applications.The field of solar cells energy converts has had a century of successful development and application and two centuries since Becquerel 1839 when Becquerel first discovered that a photo-voltage was developed when light was directed on to one of the electrodes in an electrolyte solution, it was born in the early days of solid-state electronics and space application .There are over 3000 space satellites deployed which are powered by solar cell arrays .

Ability of energy generation from the solar cells depends on sun radiation intensity, material used to manufacture solar cells and position of solar cell system on Earth. Sun radiation intensity for any position differ from season to season; therefor some systems use solar tracking.

This thesis provides a comparative study between two materials Silicon and Gallium Arsenide solar cells on terrestrial application where we make a design building a system with technical and economical analysis.We study here two photovoltaic (PV) systems that used silicon and GaAs materials : PV fixed system (without tracking) and manual tracking.

For space applications we measure the correlation between solar radiation pressure and solar cell materials (Silicon and GaAs) for satellites , and we showed that the effect of solar radiation pressure on silicon is larger than on GaAs.

Key words : Photovoltaic (PV) system, GalliumArsenide (GaAs), Silicon (Si), ON Grid, Economics, solar radiation pressure, low earth orbit (LEO)

Prof. Wagdy Refaat Anis Dr. Rasha M.F.Ghoneim

SUMMARY

This thesis discusses the most important topic in the energy field which Egypt needs nowadays, Egypt is one of the major regions in the world blessed by God with high solar irradiance, and as many studies have revealed that with the present rate of usage, all fossil fuel resources will be practically depleted within few decades thereby stressing the need to develop cheaper sources of renewable energy with high efficiency among which solar cells should play an important role.This thesis is divided into five chapters and an appendix.

Chapter One: This chapter discusses short introduction about solar cells.

Chapter Two: This chapter discusses basic parameters of solar cell, solar cell made materials, examples of terrestrial & space applications .

Chapter Three: This chapter discusses short introduction about the GaAs and Silicon used in solar cells, Two approaches are applied, photovoltaic system (PV) without tracking system (Fixed System) and PV with manual tracking systems to show the differences between using Si and GaAs solar cells. The study take place through different factors.

Chapter Four: In this chapter, we calculate the orbital elements due to solar radiation pressure on Silicon and GaAs solar cells . There are many perturbations that affect on a satellites which may deviate from their designed paths which tend to change their orbital elements. Such perturbations are gravitational and non gravitational.The actual position and velocity components of satellites are calculated at any instant of time. Hence calculating the actual orbital elements which are affected by perturbations (Oblateness of Earth, Atmospheric drag, Solar radiation pressure.. This leads to dominate the perturbation of altitudes for LEO and MEO; The Result shows that the effect of Solar Radiation Pressure on silicon solar cell is greater than on GaAs solar cell .

Chapter Five : This chapter concludes the study and suggests work after this research.

Appendix and References : Extra material and references for this thesis.

Supervised by :

Prof. Wagdy Refaat Anis **Dr. Rasha M.F.Ghoneim**

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