Ain Shams University
Faculty of Engineering
Electronics and Communications Engineering Department

Design of PV modules including a layer between solar cells and glass cover to increase PV module lifetime

A Thesis
Submitted in Partial Fulfillment of the Requirements of the Degree of
Master of Science in Electrical Engineering

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(Electronics Engineering and Electrical Communications)

Alshorouk Academy High Institute of Engineering 2013

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Statement

This thesis is submitted to Ain Shams University for degree of Master of Science in Electrical Engineering.

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

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

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Curriculum Vitae

Name	: Mohammed Mokhtar Abd-elatif Zayed
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ABSTRACT

The current design of solar cell modules (PV modules) makes solar cells completely attached to the coat of the glass, which means that the damage of the glass envelope leads to the replacement of the module completely. This means that the solar cells are lost even though they are intact and not damaged. This research suggests that these modules should be used even after the glass has been damaged.

This work studies the effect of introducing air layer between solar cells and the tempered glass of the PV module, such layer enables one to replace only the tempered glass in case of its damage instead of replacing the PV module totally. Thus the cost of replacement of PV modules at the end of its lifetime is drastically reduced. As a result significant reduction in PV systems cost may be achieved.

Keywords:

Anti-Reflecting Coating layer (ARC layer), Photovoltaic modules (PV modules).

Thesis Summary

Introduction

The current design of solar cell modules (PV modules) makes solar cells completely attached to the coat of the glass, which means that the damage of the glass envelope leads to the replacement of the module completely. This means that the solar cells are lost even though they are intact and not damaged. This research suggests that these modules should be used even after the glass has been damaged.

Research Goal

This research aims to benefit from solar cells even after the glass layer of the solar cells has been damaged.

Research Plan

- Conduct a survey of the research carried out in the field of manufacturing solar cells, especially the design of anti -reflection coating layer (ARC).

- Calculation of the reflected energy in the case of changing the refractive index of the ARC layer and calculating the optimal refractive index which leads to minimum reflection under the vertical fall of radiation.

- Design a solar cell module (PVmodule) that contains a layer between solar cells and glass. This is unlike the standard design in which the cells are fully attached to the coat of the glass. Making mathematical module of the proposed design and knowing the effect of the proposed layer between the cells and the glass cover on the energy reflected from the solar cell module in case of falling Vertical rays and falling non-vertical rays.
- A detailed economic study was conducted to determine the effect of the presence of the proposed layer on the default age of the solar cell module as well as the economic impact on the cost of energy generated by solar cells.

Chapter (1): This Chapter discusses short introduction about sun, sources of energy, semiconductors, solar cell materials, literature and background.

Chapter(2) : This section discusses the study of the anti-reflecting coating layer (ARC) and the calculation of reflected energy in the case of changing the refractive index, as well as calculating the optimal refractive index that leads to minimum reflection under the conditions of the vertical fall of radiation.

Chapter (3): This section discusses the design work of the module of solar cells (PVmodule) which contains a layer between the solar cells and glass. Comparing this design with the standard design of solar cells, in which the cells are fully attached to the glass cover in terms of the following:

- Energy and electric power of solar cells.
- Efficiency of solar cells**.**
- Impact of refractive index change for both the (ARC) layer and the proposed lamination layer**.**

Chapter (4): discusses the work of a detailed economic study to see the effect of the presence of the proposed layer on the age of the default solar cell module as well as the economic impact on the cost of energy from solar cells.

Chapter (5): This section deals with a simple summary of the research and suggestions for future work in this Research.

Keywords:

Anti-Reflecting Coating layer (ARC layer), Photovoltaic modules (PV modules).

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