iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** III **Month of publication:** March 2020

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue III Mar 2020- Available at www.ijraset.com

Improvement of Solar Efficiency using Nanotechnology and Mirror Concentrator

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Abstract: ***Due to drastic changes in the requirement of energy and energy resources (non-renewable), the orientation and research increases in order to increase output power from renewable energy. Nowadays solar energy produces a more powerful impact on society so that the efficiency of the solar panel, as well as photovoltaic cells, becomes a more important factor to be improved. In this paper, we are focusing on the increased efficiency of the solar cell. Apart from it, we are researching on material, construction and costing of the panel frame, solar energy is available on large scale with no costing so that the conversion of solar energy into electrical energy becomes a crucial role in this era. Solar panel with nanotechnology and a centralized concentrator mirror gives more efficiency than normal construction. The temperature increases in solar panel ultimately reduce the open circuit voltage so that by back end nitrogen cooling help to increase the efficiency of solar panels. Nanotechnology increases efficiency as well as reducing manufacturing costs.***
Keywords: Solar, Efficiency, Nanotechnology, Mirror concentrator, Factor affecting.

I. INTRODUCTION

Energy is the fundamental need for all mankind. It ensures a better quality of life. Nowadays all over the world energy is one of the leading issues and every country is looking for various energy resources as its demand is increasing sharply. Non-renewable energy sources are very expensive as well as harmful to the environment that's why it is important to improve the efficiency of solar cells/ panel. Over the centuries the sun provides energy in the light as well as heat form, today solar energy is used to produce electricity by using photovoltaic cells. Nanotechnology helps to overcome current performance barriers and substantially improve the conversion of solar energy into electricity. In order to cope with current energy CRISIS, it is highly desirable to build solar energy infrastructure in developing nations alongside other energy solutions which can solve in part energy increasing demand. The purpose of nanotechnology is to reduce cost and ultimately to improve efficiency using quantum dots. The solar power system is one of the renewable energy systems which uses PV modules to convert sunlight into electricity. This generated electricity can be directly used or stored by the use of batteries. Solar electricity is a clean source of electricity that suit a wide range of applications. The manufacturing of the panel depends on the load with a connected unit. 1000W of PV module can generate about 1000kwh per year in a location west of Cascades.

II. MAJOR SYSTEM COMPONENT

A. PV module
B. Solar charge controller
C. Inverter
D. Batteries
E. Load Auxiliary energy sources

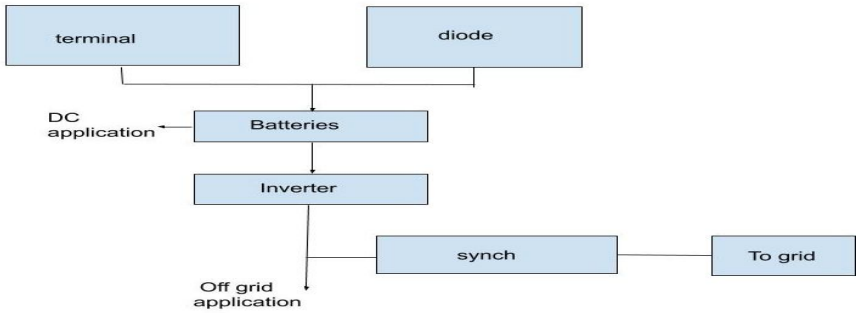

Figure1: Grid connection with renewable energy

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1) Connecting cells in parallel yields a higher current
2) Parallel string (Number of connected string)

Although modules can be interconnected to create an array with the desired peak DC voltage and loading current capacity using independent MPPTS (Maximum Power Point Trackers) is preferable, otherwise shunt diode can reduce.

A solar cell or photovoltaic cell is an electrical device that converts the energy of light into electricity by using photovoltaic effects which is physical or chemical phenomenon In basic terms a single junction silicon solar cell can produce a maximum open circuit voltage of approximately 0.5 to 0.6 volts.

III. REQUIRED THREE BASIC ATTRIBUTES:

1) The absorption of light; generating either electron hole pair or excitons.
2) Separation of charge carriers or opposite types.
3) Separate extraction of those carriers to an external circuit. Shadowing power loss in arrays with series/parallel connected cells.

A. *Module*

1) Monocrystalline
2) Silicon
3) Polycrystalline silicon
4) String ribbon
5) Cadmium Telluride
6) Copper Indium Gallium Selenite

(Using glass mirror panel, this PV solar panel power is increased by 30% using broken mirror)

With solar panel to boost the power output of regular p.v photovoltaic DIY solar panel. This method done correctly. can increase p.v output by up to 50% but you risk over beating the cell.

B. *Solar Charge Controller*

A solar charge controller manages the power going into the battery bank from solar array. It ensures that the deep cycle batteries are not overcharged during the day and that the day and that the power doesn't run backwards to the solar panels. Overnight and drain the batteries managing power is its primary job.

C. *PWM Solar Charge Controller*

PWM stands for pulse width modulation. These operate by making a connection directly from the solar array to the battery bank.

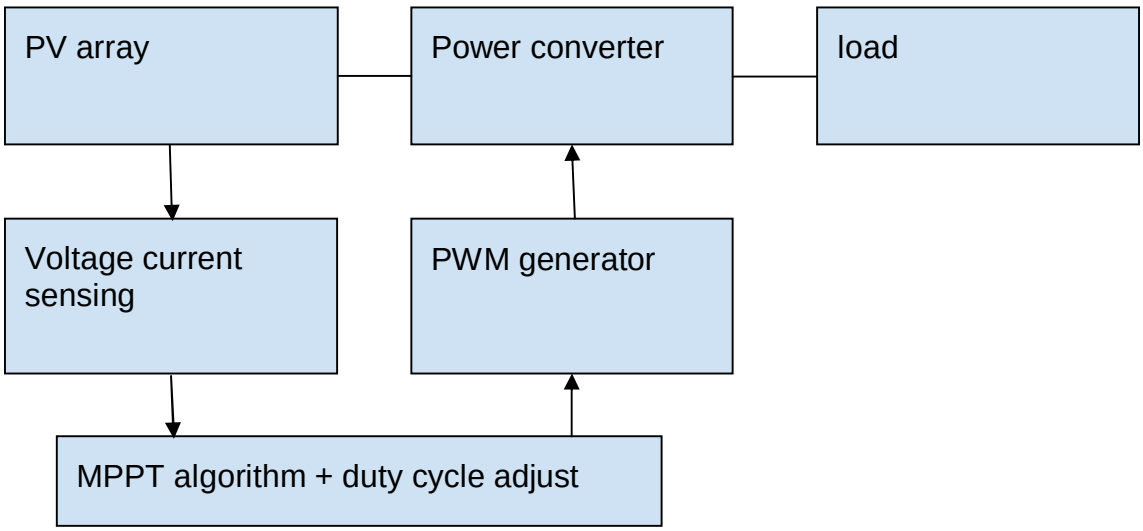

Figure2: Solar array with MPPT

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D. MPPT Charge Controller

MPPT algorithm that included in charge controller used for extracting maximum available power from PV module under certain conditions. The voltage at which PV module can produce maximum power varies with solar radiation, ambient temperature, solar cell temperature.

IV. NANOTECHNOLOGY ROLE IN IMPROVEMENT OF EFFICIENCY IN SOLAR CELL:

The main part of solar module /panel is a solar cell. overall efficiency of solar panel is depending on individual efficiency of solar cell. solar cell made up of various materials like silicon, crystalline silicon, etc. Impurities added to silicon such as phosphorus or boron to establish the electrical energy.

Nanomaterial help to reduce manufacturing cost as well as improve the efficiency of solar cell. The doping phenomenon is used while making crystals in nano part.

The band gap energy in silicon reduces the efficiency and create limitations to improve efficiency due to the nature of electron to know out from band. Nanocarbon tube conducting layer deposited on n type silicon to form a Schottky junction PV cell with a conversion efficiency of 1.9 under AM 1.5 illumination

So that efficiency increased to 8.6% just by chemical charge transfer doping with trifluoromethanesulfonic. ((cf3so2)2NH) So while manufacturing of solar cell nanotechnology help to reduce cost as well as improve the efficiency. Now improvement of efficiency at panel end level i.e. glass mirror concentrator.

To improve the efficiency of solar cell the bulk silicon ions are converted into nano size particles. In earlier days conventional materials in which one photon generated only one electron but nowadays quantum dots/ nano particles have a potential to convert a high energy photon into multiple electron in order to improve the solar efficiency. Conventional crystalline silicon solar cell is manufactured by using low temperature and high cost but nowadays nanotechnology reduced installation cost achieved by producing flexible rolls temperature.

Normal solar cell can absorb maximum 48% of incoming solar radiation about half of which can be converted into electricity. Whereas nanowires or nanocrystal cells absorb 90% of incoming solar radiation. It is double of thin silicon construct solar cells. As per research and testing conducted in NASA and research laboratory of U.S, quantum / nanotechnology for solar cell is thrice time more effective than normal silicon construction.

V. SAMPLE DESIGN FOR CALCULATION OF SOLAR MODULE:

Calculate how much energy the load consumes in kwh/day: -

η inverter= Output/Input

i.e. Input power= Output power / η inverter Input power = 100 watt/50%

Input power= 200 watt

Rated Input power is 450 watts, so we need only one inverter.

P=V*I

i.e. I=P/V

I= (200 watt)/(12v) = 16.67 amps

Since the change controller capacity is 10 amps and we are drawing 16.67 amps, we need 2 charge controllers.

100 watts *(1 kw)/ (1000 watt) * 2 hrs./day = 0.2 kwh/day

η inverter= Output energy /Input energy

i.e. Input energy = Output energy / η inverter

Input energy = (0.2 kwh/day) /50%

Input energy = 0.4 kwh/day

From Solar Battery: - 200-watt power and 0.4 kwh energy

The minimum number is what you need because this is the worst month which is what you need to design for Dec i.e. minimum radiation

consider, 2.88 kwh/m2 day in Dec

[2.88 hr./day] *[20 watt/ 1 solar panel] *[1 kw/1000 watt] = 0.057 kwh per day/ 1 solar panel

req_ 0.4 kwh/day

no. of solar panel?

[0.4 kwh per day]/[0.0576 kwh per day/1 solar panel] = 6.94 solar panels i.e. total 7 solar panels

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A. MIMP Battery
B. Random day selection without sun i ,e 3 days

Consider load is 0.4 kwh/ day
after 3 days load = 1.2 kwh/ day
12 kwh * (1/12v) = 0.1 kilo amp per hr. *[1000-amp battery/ 1k amp per hr.]
= 100-amp hrs.
Mostly each battery is 5 amp per hr. so we need 20 batteries to get 100-amp hour.

C. Solar Power System

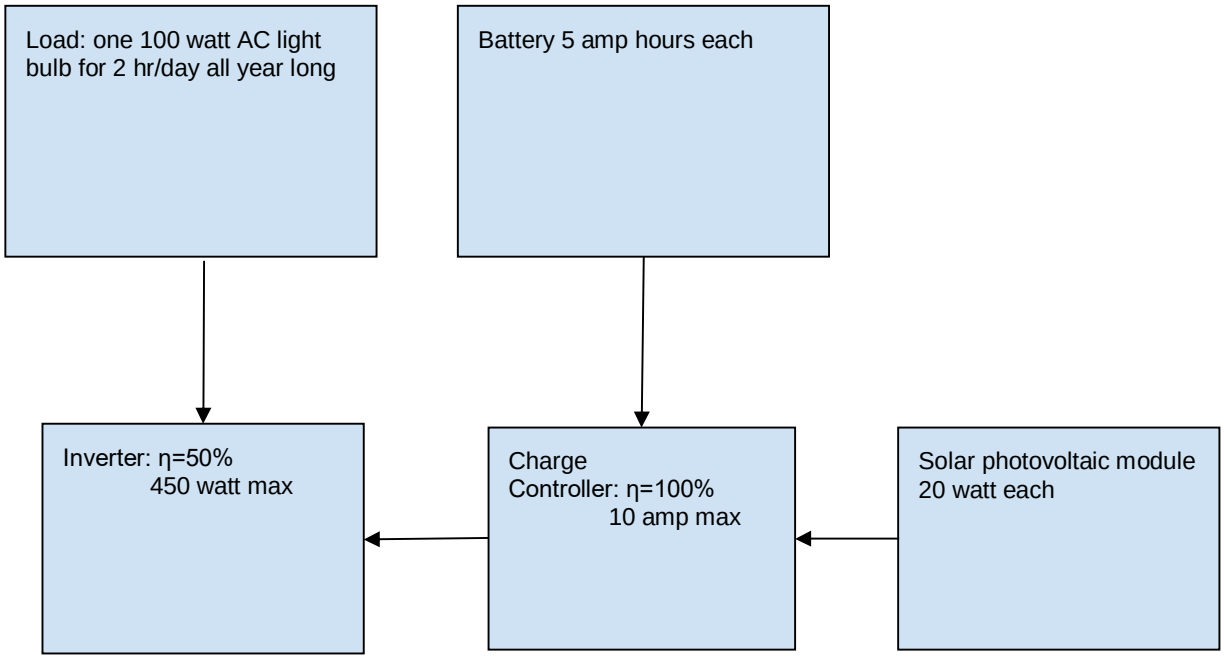

Figure3: Designing of solar module set

Solar panel with 20% efficiency and area of 1 m square will produce 200 kwh at standard test condition.

VI. FACTORS AFFECTING SOLAR CELL EFFICIENCY:

A. Reflectance
B. Thermodynamic efficiency
C. Charge carrier separation efficiency
D. Charge carrier collection efficiency
E. Condition efficiency
F. Dust- reduce the amount of light emitted to the solar cell

VII. EQUATION FOR CONVERSION EFFICIENCY AND FILL FACTOR:

η (%) = {[Vmax * Imax]/ Pin} *100
= [Voc*Isc*FF/Pin] *100
FF= [Vmax*Imax]/[Voc*Isc]
where, Isc = short circuit current density
Voc= open circuit voltage
Pin = incident light power
Imax= current density at max power op in I-V curve.

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VIII. COMPARISON

SR.NO	PARAMETERS	OLD SYSTEM	SYSTEM WITH NANOTECHNOLOGY AND CONCENTRATOR MIRROR
I.	CONSTRUCTION	SIMPLE BUT LESS EFFECTIVE	COMPLEX
II	EFFICIENCY	LOW	HIGH
III	COST	MEDIUM	LOW
IV	REQUIREMENT	SILICON SOLAR CELL AVAILABILITY AND IMPLEMENT	NANOCRYSTAL CELL AND CONCENTRATED MIRROR
V	AVAILABILITY	EASILY	NOT EASY
VI	MATERIAL	SILICON	NANOCRYSTALLINE STRUCTURE SILICON
VII	RESEARCH	REQUIRED	REQUIRED
VIII	LIFE	UP TO 10 TO 12 YEAR	UP TO 20 TO 25 YEAR
IX	TEMPERATURE	MORE	LESS (DUE TO NITROGEN)

IX. ADVANTAGES

A. Lower installation and maintenance cost.
B. Superior efficiency-Mirror concentrator has a system efficiency over 20%, this will ultimately reduce land utilisation as well as area related cost.
C. Ease of recycling-concentrators are composed mainly of easily recyclable materials, steel, aluminium, plastic.
D. Using nanotechnology system is more versatile and durable than conventional solar panel.
E. System is better faster and cheaper as compared to conventional solar panel.

X. DISADVANTAGES

A. It is difficult to exploit solar installation optimally using nanotechnology.
B. It produces direct current which needs to be converted into AC.

XI. FUTURE SCOPE

Renewable energy is the only source of energy available in nature and as non-renewable sources reduce day by day, renewable energy takes the lead part to protect it.
As per government concern, the next 10 to 12 years are very crucial for the development of solar energy in every sector. So that the improvement in energy efficiency through solar plays a vital role. As per research going on the nano-particle and Monocrystalline particle help to improve the efficiency of the solar module. This paper provides the path toward solar evaluation.

XII. CONCLUSIONS

A normal solar cell can absorb a maximum of 48% of incoming solar radiation about half of which can be converted into electricity. Whereas nanowires or nanocrystal cells absorb 90% of incoming solar radiation. It is double of thin silicon to construct the solar cell. As per research and testing conducted in NASA and research laboratory of U.S, quantum/nanotechnology for a solar cell is three times more effective than normal silicon construction. Earlier days conventional material in which one photon can generate only one electron, but nowadays quantum dots or nanoparticles have the potential to convert high energy photon into multiple electrons in order to improve solar efficiency. Conventional crystalline silicon solar cell is manufactured by using a low temperature and high cost, but nowadays nanotechnology reduces the installation cost.

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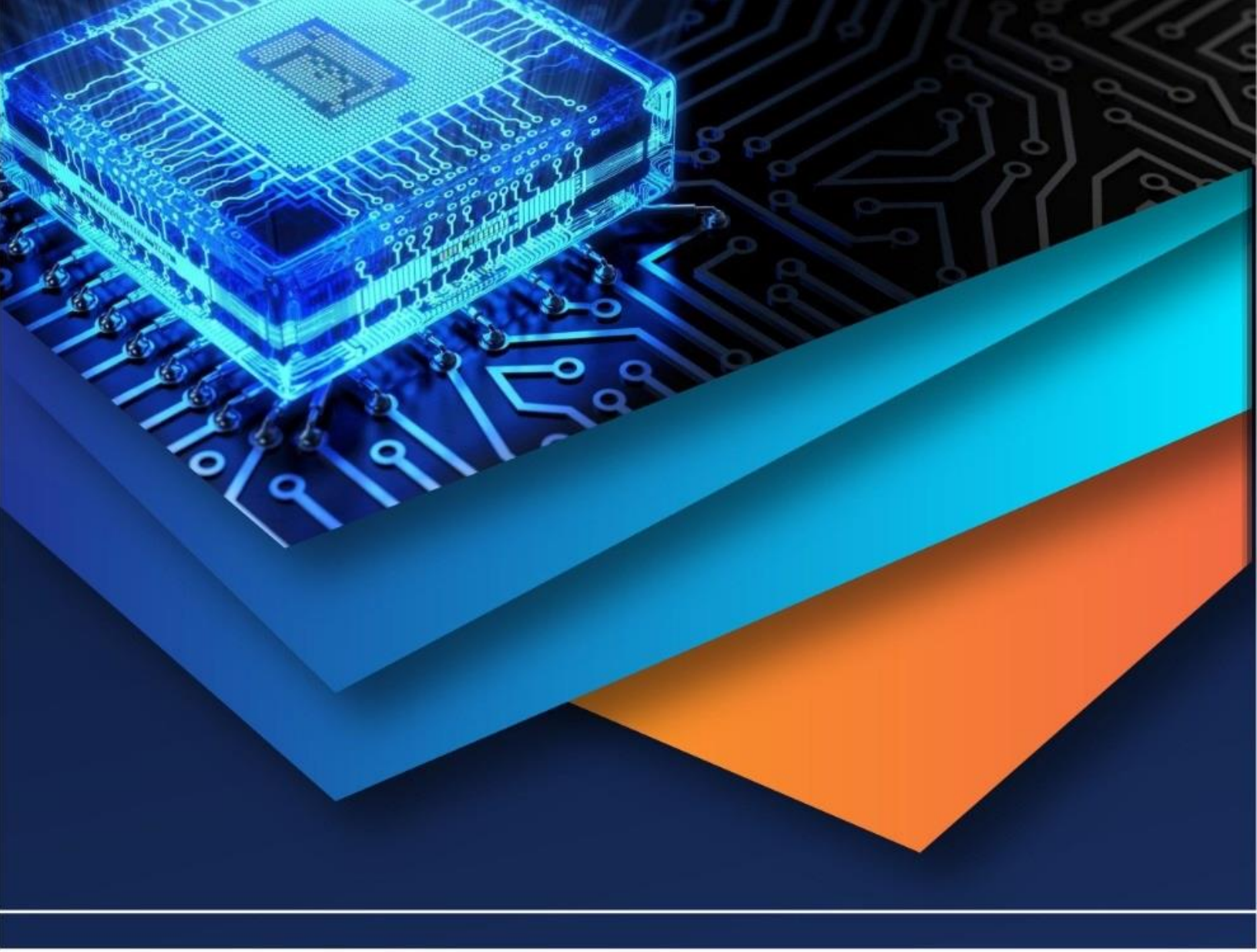

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