

Review Article

A Brief Review on Performance Enhancements in Solar Panels

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A B S T R A C T

There have been a lot of discussions about going green in the upcoming years. But to what extent are we talking? There has been a lot of emphasis on the utilization of solar energy using solar PV modules. A lot of comprehensive discounts are being offered to the construction of solar PV modules. More people are being encouraged to use the PV panels for the productive use of solar energy. Continuous researches in the field of performance enhancement for the solar PV modules are continuously made by various research groups. This paper puts together a brief review of the various possible methods to improve the overall performance of the solar PV panels.

Keywords: Photo-Voltaic Panels, Performance Enhancement

Introduction

In today's world we know due to urbanization and an increase in population the demand for electrical energy has also increased. Almost every product which is manufactured, its processor components utilise electrical energy directly or indirectly. The more the population the more will be the demand for products and therefore a greater amount of electricity shall be required to manufacture these products in industries or to operate these products.

In-country like India electricity is mainly generated by using coal in thermal power plants. Such type of resources produce a lot of pollution and is also depleting at a very fast rate so there is a need for generating electricity by avoiding the use of such fuels which fall under the category of fossil fuels. The best alternative available to date is utilising solar energy which is available in abundance and is totally free of cost (Terashima, Sato and Ikaga 2020).

To generate electricity from solar energy mainly we use solar PV panels which come in a variety of design configurations (Figure 1). The efficiency of these PV panels is low that is the amount of electricity produced by them effectively

from solar energy is relatively less (Gardashov et al. 2020). In this direction, a lot of research is going on to increase the efficiency of the Solar PV panels so that no amount of electricity could be produced to meet the ever-increasing demand for electricity (Fine, Dworkin and Friedman 2019). Lots of scientists and researchers have suggested different validated ways in the past few years but still, there is a lot of research work to be done to improve the solar panels. This article highlights a few pertinent works which were validated and found to be successful in the direction of increasing the efficiency or performance of solar PV panels

Literature Review

The table below provides the relevant studies in regard to the enhancement of the performance of the solar panels. The studies ranged from improving the performance to the solar panels to increasing the lifetime and lowering the living costs.

The table presents a comprehensive summary of the past studies in the field of enhancing the performance of the solar cells. This table has been sorted in the most relevant study basis with the most recent studies.

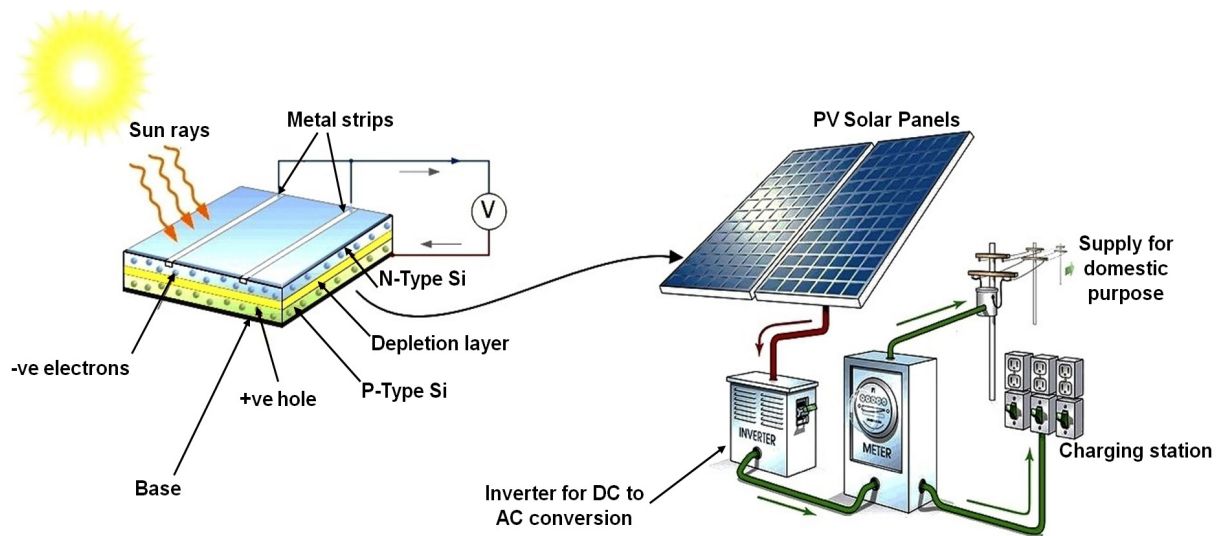


Figure 1. The circuit diagram in PV circuit

Table I. Review of the Past Studies on Solar Panels for Performance Enhancement

Source	Sector of improvement	Findings
(Kafka and Miller 2020)	Using multiple angles for solar panels	The research is based on increasing the surface area for the solar panels to be incident to the solar rays. This was accomplished in this research by using a flexible platform for the panels which could move as per the sun's incident direction so as to maximize the overall radiation absorption.
(Abd Elbar and Hassan 2020)	Installation of single slope solar still	The researchers in this paper have designed and included the addition of single slope solar still in the existing solar module especially in semi-arid areas. This resulted in an increase in productivity by 3.2%.
(Kabeel and Abdelgaied 2019)	Using reflectors along with air injection system	This research aims at improving the cooling rate of the panels by using reflectors. Studies have shown that the cooling rate vastly influences the performance of the solar panels. The cooling system has been provided with air injection as well so as to improve the cooling rate, and thereby increase the overall efficiency of the solar panel.
(Abdo et al. 2020)	Using hydrogels beads for cooling of the solar panels	The study suggests that the solar panels also require cooling which can be accomplished by using coolant. The study shows a feasible report that the use of coolant to prevent the over-heating of the panels can increase the power capacity of the solar panels.
(López-Vizcaíno et al. 2017)	Improving of battery by using Vanadium ions	The study has a detailed report on the performance improvement by replacing the existing ions in the battery of solar panels with Vanadium ions. This increases the storage capacity of the battery; hence more current can be stored in the battery during peak hours, which can be used in the cooler time of the day.
(Chowdhury et al. 2020)	Increasing the life-time and lowering life costs	The authors in this study have found that the disposal of solar equipment waste can pose to be a severe health hazard. This study provides a comprehensive report on the recycling of the PV module and the management of the solar cells.

(Alagoz and Apak 2020)	Increasing the performance by physical cleaning of the panel surface	The study focuses on performance enhancement by using surface acoustic waves. The overall efficiency of the PV panels is lowered when the surface of the panel becomes dirty or other particles accumulate on the top surface.
(Amalraj and Michael 2019)	Use of Al ₂ O ₃ and CuO particles for solar panel applications	It is a known fact that nano-particles enhance the properties of the various applications. Using the nano-particles in solar panels improves the cooling efficiency of the panels.
(Biwole, Eclache, and Kuznik 2013)	Improving performance by using phase-change materials	It has been found that there is a loss of efficiency in the solar panels due to the heating. The present study used phase-change materials to counter this effect and thereby increase the overall performance improvement of the solar PV panel.
(Dehghanpour, Parvin, and Abdolahi 2015)	Surface texturing to improve photon trapping capability	The study found out that the performance of the solar PV panels can be improved by using an ArF Excimer laser. This increases the absorption of different irradiations in different wavelengths such as red, blue, green, etc.
(Refat, Elbar, and Hassan 2020)	Using saline water preheating and porous material	The performance of the solar water heater can be improved by using a method of saline water preheating. The study also found that the use of porous materials can be also done to enhance the performance of solar panels.
(G. Li, Tang, and Zhong 2012)	Using optical single axis tracked solar panel	The research showed that the performance of the solar panels can be improved by using optical tracking of the solar panels. This will increase the duration of the solar radiation falling incident on the solar panels.
(Mahmoud, Fath, and Ahmed 2018)	Using hybrid solar still along with humidification/dehumidification process	The study found out the overall performance of the solar cells can be increased by using a desalinated system by varying the humidification/dehumidification process. The results showed that the performance improved as the salinity increased.
(Zhong et al. 2011)	Using multiple axis for mounting solar panels	The study focussed on improving the duration of the solar radiation falling vertically on the solar panels by using the south-north axis, three-positioned panels. It was found that this method improved the efficiency of the solar panels to a great extent.

Conclusion

The solar panels have been in use for a long time now. There have been continuous researches to improve the efficiency of the solar panels. This paper provides a holistic view of the different methods in which the performance of the solar PV panels can be enhanced. This paper can provide readers with a wide array of information in improving the performance of the solar PV panels. This can be done by using the different methods described by various authors. Not all methods are complicated ones, but simple steps like keeping the surface clean and using coolant can also contribute to improving the efficiency of the solar PV panels. The addition of PCM (Phase Change Material) to the solar panels can be one of the most wider and simpler methods to improve the performance of the solar panels (Z. Li et al. 2019).

There is still a lot of scope for further improvement of the solar PV panels through continuous researches. This can

further lower the life-costs and encourage more households to adopt the solar panel installations at both domestic as well as commercial levels.

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