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A Review Paper on Increasing Efficiency of Solar Cells Using Artificial Intelligence and Nanotechnology

[1]Srijani Ghosh, [2]Arafat Ali Mondal, [3]Priyanta Guha

[1]Student, [2]Student, [3]Electrical Engineer
Renewable Energy
Heritage Institute of Technology, Kolkata, India

Abstract : With the increasing demand of electricity, the conventional sources of energy is running out. So, scientists have introduced alternating sources of energy to meet the demand of the energy. Solar energy is one of the alternating energy sources. In this energy conversion process, solar cells absorb direct and indirect sunrays and convert it into electrical energy. But main problem with solar cells is its efficiency and storage. The solar cells can reach upto 42% of its efficiency. Nanotechnology on the other hand is the most developed technology which can help increasing the generation and storage of solar energy. Using of nanoparticles in energy sector can help boosting the efficiency and generation of the solar cells by increasing the light scattering. Whereas artificial intelligence (machine learning), helps scaling up the manufacturing of solar cells. This paper presents a detailed review on how to increase the efficiency and generation of solar cells along with the storage using nanoparticles and artificial intelligence.

Key Words **– Solar PV Cell, Solar Cell Efficiency, Nanoparticles, Thin film, Renewable Energy, Nanotechnology, Artificial Intelligence.**

I. INTRODUCTION :

Now-a-days, the demand of electricity is increasing in industries and domestic areas. As the conventional energy storage is running out day by day, the demand of alternating energy sources is increasing to meet the demand of electricity. Solar energy is one of the popular alternative energy sources in current date. The energy emitted from the sun is absorbed by a solar module and converted into electricity. This solar module is made up of a number of solar cells. But these solar cells are not efficient enough to compete with the electric grids. Although numerous studies are done in last five years to make notable progress in solar PV cells design and performance for their applications. The studies have developed crystalline silicon cells, amorphous silicon cells, perovskite cells, dye sensitized solar cells, CIGS cells, CdTe solar cells etc. Crystalline solar cells which are now on trend in photovoltaic market have the efficiency of 20%. Also, these crystalline solar cells are costly. To reduce the cost thin film solar cells are developed. In the last few years, the nano-tech solar cells via nanotubes and quantum dots are developed to reduce the cost of solar PV cells and modules to generate bulk power, as well as to improve the cell conversion efficiency, specially the organic solar cells. Organic solar cells are very much preferred in terms of renewable energy for their affordability, stability and flexibility. Nanotechnology here is used to make these cells more viable to power today's society. The advantages of using nanotechnology in improving the solar cells are – lower costs, enhance efficiency of solar cells by increasing light trapping and photo carrier collection while fabricating solar cells, increase the conversion of light into energy thus boost up the power generation, in organic solar cells, nano-particles are used to overcome the trade-off between the light absorption and the carrier collection. In general, the up-conversion nanoparticles are used to absorb infrared light and emit visible light which solar cells can absorb. In organic solar cells, Plasmonic Metallic nano-particles are used. AI algorithm in this case used to predict the demand of the load and shift the load to optimize the consumption of excessive energy from both solar and battery systems also, it helps forecasting data of weather condition. In increasing the efficiency of solar cells, AI is chosen to automate the system, reduce the emission by optimizing the supply chain, detect malfunction of the machinery. Various AI networks helps improving the efficiency of solar cells and scaling up the manufacturing of solar cells.

II. LITERATURE REVIEW :

2.1 Cloud Covers

The main barrier of a solar cell arrives in cloudy weather. Cloudy weather hampers the power generation of a solar photovoltaic cell, as in this weather, less sunlight falls on solar cells. Using Modern nanotechnology, i.e. nano-wires in solar cells helps the cell to boost absorption and retention of sunlight.[1] Also, we can predict forcasting of the weather, wind speed and irradiance by using artificial intelligence to predict short time renewable output power. In this way grid stability and dispatching can be maintained.[2] Thus the efficiency of the solar cells can be increased upto 25% than the cells currently available in the market.[3]

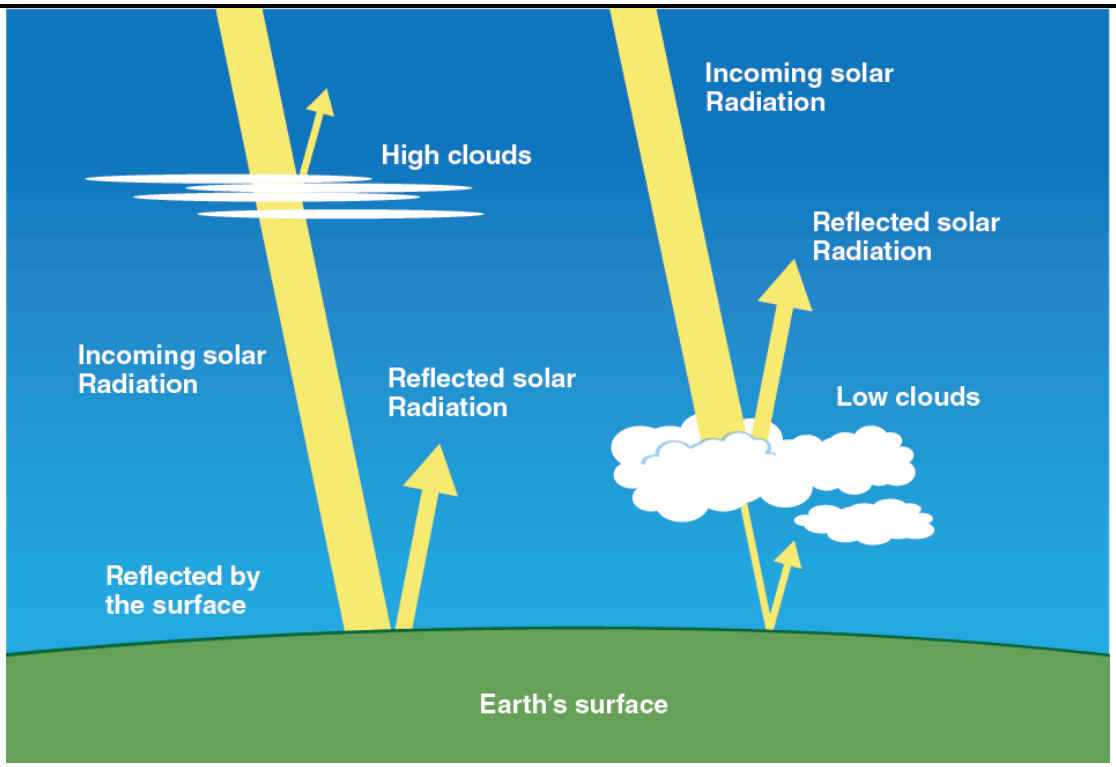

Fig 1 : Cloud Covers Affecting Solar Cell Generation

2.2 Heat Build-up

As solar cells can't generate efficiently on higher temperatures, the warm countries usually faced the problem of heat build-up in solar cells. Nano enhanced cooling technology in solar photovoltaic cells can be helpful to cool down the cells and prevent heat build-up in the cells.[4]

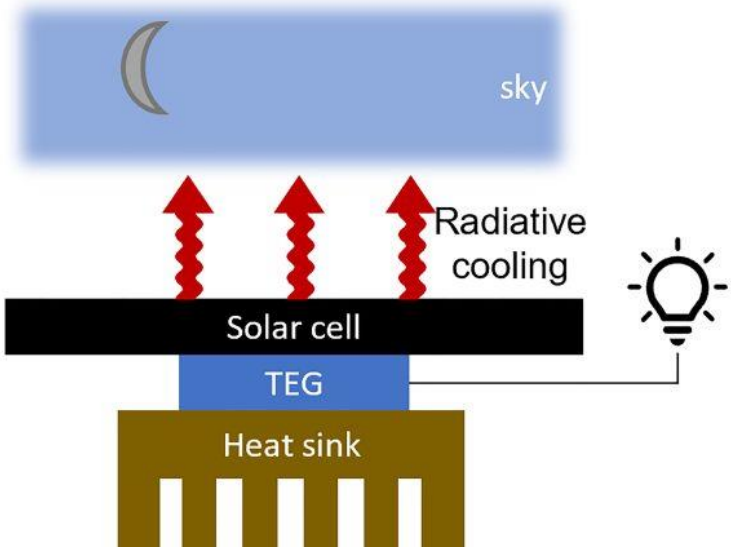

Fig 2 : Heat Build-up Affecting Solar Cell Efficiency

2.3 Sun Intensity

Another barrier of the solar cell efficiency is the sun intensity. The variable intensity of the sun changes the efficiency of the solar cell. In the afternoon time, when the sun intensity is at its peak the solar cell generates maximum power. We can determine the maximum sun intensity of a day or a month by using artificial intelligence.

3 Futures of Nanotechnology and Artificial Intelligence in the Field of Solar Energy

Implementation of nanotechnology and nano-materials and artificial intelligence in the field of solar sector has created havoc. The nanofluids and nano-wires increased the efficiency of the dye-sensitized and perovskite solar cells more than the efficiency of the solar cells currently available in the market. Whereas weather forecasting and predicting parameters by artificial intelligence help increasing the photovoltaic cell's efficiency. The use of these two technologies in solar sector is growing day by day. These technologies solve the most important problems of solar energy sector. It also reduced the size of the energy sector and produce lighter and portable devices. Also, there are many more innovative future scopes of nanotechnology and artificial intelligence in solar energy sector under development.

4 Conclusion

Solar power is a conventional and unlimited source of energy. This energy is used to generate power by solar cells. When the sunlight fall on the surface of solar cells the electrons inside the cell get excited and generate power. Although, now a days solar cells are used in energy sector to generate power but the solar cells used in current date are not efficient enough to meet our electricity need. To enhance the efficiency of the cells nanotechnology is used in the cells. Most of the solar cells depend on the artificial intelligence for working efficiently. Artificial intelligence used to automate the energy sector also which helps saving the manpower and made the cells more efficient.

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REFERENCES

[1] **https://www.intechopen.com/chapters/73145**

[2] **https://ratedpower.com/blog/artificial-intelligence-renewable-energy/#:~:text=AI%20systems%20can%20use%20forecasts,plant%20availability%20and%20schedule%20maintenance.**

[3] **https://venturebeat.com/business/sol-voltaics-uses-nanotechnology-to-make-solar-energy-25-percent-more-efficient/**

[4] **https://www.sciencedirect.com/science/article/abs/pii/S0038092X21007623**