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Role of Semiconductors in Solar Energy

Ritik Singh[1], Kamlesh Kumar Singh[2*]

[1,2]Department of ECE, ASET, Amity University Lucknow Campus, India
[1]ritik.singh7@s.amity.edu, [1]kksingh@lko.amity.edu (Corresponding Author)

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Abstract

The sun generates solar energy, which is non-depleting, renewable, and environmentally friendly. Every hour, enough sunlight energy strikes the earth to supply the world's annual energy demand. In today's generation, electricity was required every hour. Solar energy is used for a wide range of applications, including industrial, commercial, and residential. It may easily obtain energy from direct sunshine. As a result, it is extremely efficient while also being environmentally friendly. We looked at the energy obtained from sunshine in this piece, as well as future trends and challenges. Furthermore, the essay tries to explore societal energy functions, energy production, photovoltaics, concentrated solar power (CSPs), solar cell efficiency, fuel generation, and semiconductor roles.

Keywords

Solar Energy, Energy Production, Photovoltaic cell, CSPs

1. Introduction

Solar based energy are the energies acquired by catching heat energy, energy from sunlight. Energies from the Sun is alluded to as solar energy. Innovation has given various approaches to use this bountiful asset interoperability. Energies from the Sun is alluded to as solar energy. Innovation has given various approaches to use this bountiful asset. It is a green innovation since it doesn't radiate ozone depleting substances. Sun oriented energy is bounteously accessible and has been used since long both as power and as a wellspring of warmth.

2. Energy Production

Solar energy is the produced by power from daylight, either directly using photovoltaics, or in a roundabout way the use of CSP. In CSP systems, lenses or mirrors and tracking structures to awareness a huge vicinity of daylight to small beam are used. Solar power will be ending up the sector's largest supply of energy in next 30 years In the 1980s, commercially focused solar power plants were developed. The 392 megawatts, Ivanpah Power Plant in California's Mojave Desert is considered the

largest power plant in the world.

- **Photovoltaics**

Photovoltaic (PV) technologies – more commonly known as solar panels – generate power using devices that absorb energy from sunlight and convert it into electrical energy through semiconducting materials. These devices, known as solar cells, are then connected to form larger power-generating units known as panels. The conversion of mild into electricity the use of semicon-ducting substances that display the photovoltaic impact, a phenomenon investigated in physics, photochemistry, and electro-chemistry, is referred to as photovoltaics (PV). Commercially, the photovoltaic impact is used to generate energy and as pho-tosensors. Power electronics are used to govern the energy system.

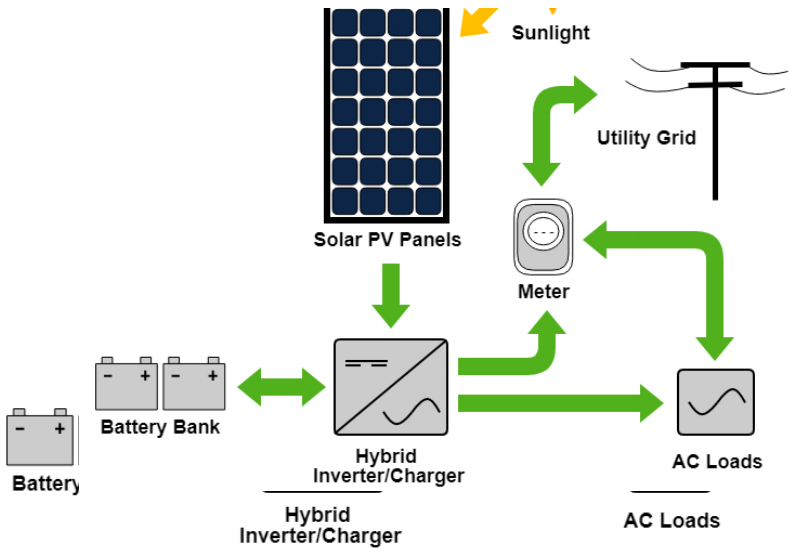

Fig. 1 Solar Energy Based System

- **Semi-Conductor With P-N Junction**

The voltage is generated in a solar mobile through "photovoltaic effect". The accumulation of slightly generated partnerships across the p-n junction causes movement of electrons toward the n facet and holes toward the p-type aspect of the junction. In the case of fast switching conditions, there is no increase in price because the suppliers emit the device as luminous flux.

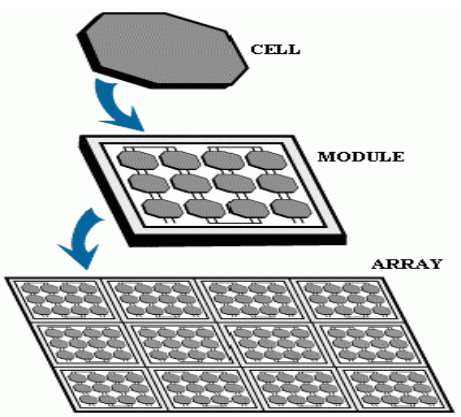

Fig. 2 Solar Pannel

An array can be formed by connecting many modules. In general, the greater a module or array's surface area, the more electricity it produces. Direct-current (dc) electricity is generated by photovoltaic modules and arrays. They can be coupled in both series and parallel electrical configurations to provide any voltage and current combination desired.

- **Concentrated Solar Power**

CSP (concentrated solar power) is a technique for generating electricity using mirrors. Natural sunlight is reflected, concentrated, and focused on a certain point by the mirrors, which is then transformed into heat. The heat is subsequently converted to steam, which powers a turbine and generates electricity. Because CSP technology can store the heat produced, the process can be repeated indefinitely. It can thus be utilised on days when there is no sun, as well as before and after dawn and sunset.

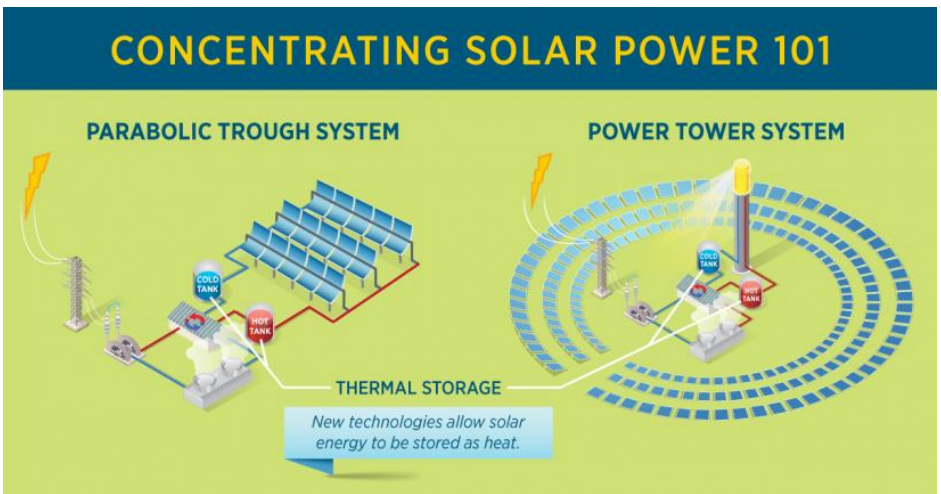

Fig. 3 Concentrating Solar Power

CSP systems work by concentrating the sun's solar energy onto a receiver, which then converts it to heat. The heat is subsequently turned to steam, which powers a turbine that generates electricity. Thermal energy storage devices can be used by CSP plants to store power until it is needed, such as during periods of low sunlight. CSP is a versatile renewable energy source because of its capacity to store energy.

Hybrid power plants can be created by combining CSP systems with other power sources. For example, CSP can be integrated with thermal-fired power plants that use fuels like coal, natural gas and biofuel.

CSP technologies are divided into four categories:

i) Parabolic trough systems:

Solar energy is concentrated via curved, trough-shaped reflectors, which are focused onto a receiver pipe in a parabolic trough system. The pipe normally holds thermal oil, which is heated before being utilised in a steam generator's thermal power block to generate electricity.

ii) Power tower systems:

Heliostat mirrors track the sun and focus its energy onto a receiver at the top of a tower in these devices. Inside the receiver, a fluid (typically molten salts) is heated and utilised to generate steam, which drives a turbine generator.

iii) Linear fresnel systems:

There are many collectors arranged in rows. The flat mirrors on the ground reflect the sun onto the receiver pipe above. Fresnel can include storage in a power block or generate steam directly, similar to trough and tower systems.

iv) Parabolic dish systems:

A parabolic-shaped dish serves as a concentrator, reflecting solar energy onto a receiver installed on a structure with a sun-tracking system. A heat engine then generates the accumulated heat. The dish can reach extremely high temperatures, making the technology suitable for use in solar reactors.

3. Benefits of Using CSP

CSP provides a community with numerous benefits. These systems emit no pollution while generating electricity because they rely on the sun, a renewable resource. CSP systems can store energy in batteries that can be tapped for energy on demand, allowing them to satisfy local power demands more reliably, especially during peak usage periods.

CSP systems are low-cost to operate and create high-efficiency power. Engineers recently discovered that specific CSP technologies may be integrated into fossil fuel power plants, reducing carbon emissions and increasing efficiency while processing both fuels. Concentrating solar power has a lot of potential to transform the global energy market, and as the technology improves, it will become more widely used.

4. Efficiency of Solar Cells

Efficiency of a system is estimated from its energy of output to its energy of input. This is the ratio of usable electrical energy produced by solar photovoltaic cells to the amount of solar energy incident on the cell under controlled testing conditions. Few experimental solar cells have achieved efficiencies of around 50%, most commercial solar cells have efficiencies of less than 30%. The "band gap energy" is responsible for limiting the efficiency of solar cells, unlike the Carnot efficiency, which limits the thermal efficiency of heat engines.

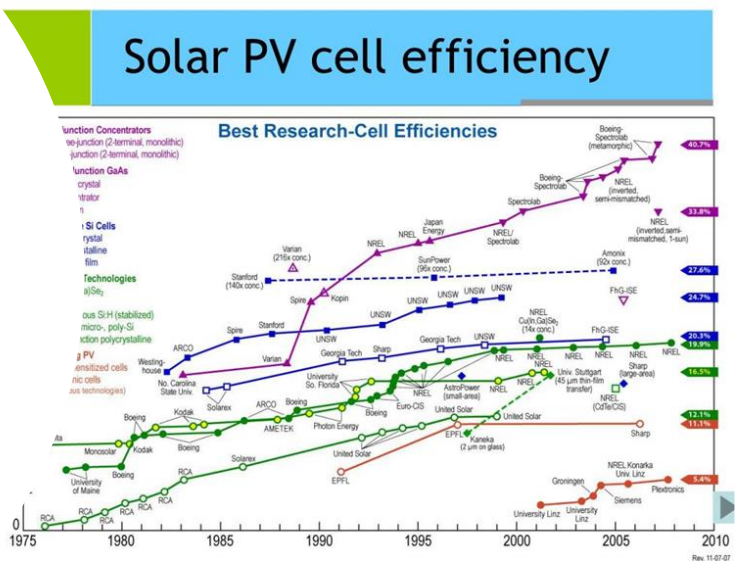

Fig. 4 Solar PV Cell Efficiency

Solar cell's efficiency is determined as the fraction of incident power. It is then converted to electricity and is given by:

$$P_{max} = V_{OC} I_{SC} FF$$

$$\eta = \frac{V_{OC} I_{SC} FF}{P_{in}}$$

Where:

Voc = open-circuit voltage;

Isc = short-circuit current;

FF = fill factor and

η = efficiency

5. Role of Semiconductors In Solar Energy

P-kind and n-kind silicon are the 2 varieties of semiconductors utilized in sun cells. P-kind silicon is made with the aid of using blending with atoms with one much less electron of their outer electricity degree than silicon, inclusive of boron or gallium. A hole is generated due to the fact boron has one much less electron than is needed to shape bonds with the encircling silicon atoms.

PV cells are made of a lot of semiconductor materials. When a semiconductor is uncovered to light, it absorbs the electricity and transfers it to electrons, which can be negatively charged debris withinside the material. This extended electricity lets in electrons to go with the drift as an electrical present day thru the material. This energy is retrieved through conductive metallic contacts (the grid-like traces on sun cells) and utilised to strength your private home and the relaxation of the electrical grid.

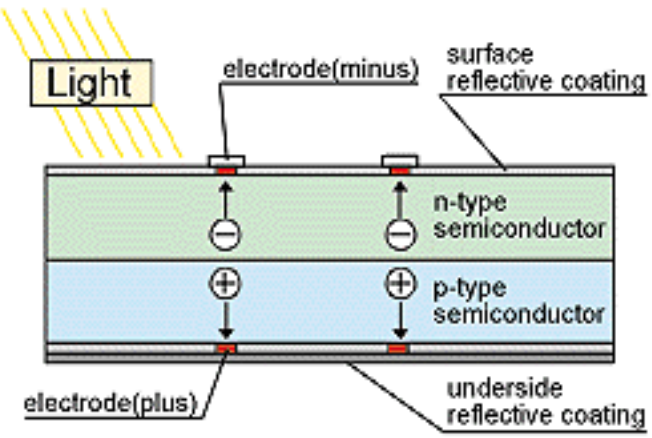

Fig. 5 Semiconductor Based PV Cell

6. Conclusion

Solar strength is a tremendous supply of without delay useable power and ultimately creates different strength sources: biomass, wind, hydropower and wave electricity.

Use of sun power is the best renewable means able to in the long run supplanting modern-day worldwide power deliver from non-renewable assets, but on the fee of a land place of as a minimum half of one million km^2.

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