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INTRODUCTION TO SOLAR CELL AND THE IMPACT OF SOLAR CELL IN DAILY LIFE USAGE

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ABSTRACT :

The light from the Sun is a non-vanishing renewable source of energy which is free from environmental pollution and noise. It can easily compensate the energy drawn from the non-renewable sources of energy such as fossil fuels and petroleum deposits inside the earth. The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Silicon based solar cells were the first generation solar cells grown on Si wafers, mainly single crystals. Further development to thin films, dye sensitized solar cells and organic solar cells enhanced the cell efficiency. The development is basically hindered by the cost and efficiency. In order to choose the right solar cell for a specific geographic location, we are required to understand fundamental mechanisms and functions of several solar technologies that are widely studied. In this article, we have reviewed a progressive development in the solar cell research from one generation to other, and discussed about their future trends and aspects. The article also tries to emphasize the various practices and methods to promote the benefits of solar energy.

INTRODUCTION :

Solar cell is a key device that converts the light energy into the electrical energy in photovoltaic energy conversion. In most cases, semiconductor is used for solar cell material. The energy conversion consists of absorption of light (photon) energy producing electron–hole pairs in a semiconductor and charge carrier separation.

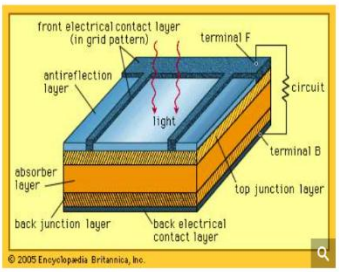

diagram of a solar cell structure

A commonly used solar cell structure. In many such cells, the absorber layer and the back junction layer are both made of the same material.

Encyclopædia Britannica, Inc.

A p–n junction is used for charge carrier separation in most cases. It is important to learn the basic properties of semiconductor and the principle of conventional p–n junction solar cell to understand not only the conventional solar cell but also the new type of solar cell. The comprehension of the p–n junction solar cell will give you hints to improve solar cells regarding efficiency, manufacturing cost, consuming energy for the fabrication, etc. Solar cells can provide virtually unlimited amounts of energy by effectively converting sunlight into clean electrical power. Large-scale implementation of photovoltaic technology hinges on our ability to inexpensively produce high-efficiency solar cells (Schuller *et al.*, 2010). Thin-film solar cells could provide a viable pathway towards this goal by offering low materials and processing costs. However, the energy

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conversion efficiencies of such cells are fairly low, owing to the large mismatch between electronic and photonic length scales in these devices.

Generations of solar cells

Solar cells are usually categorized into 3 generations:

1. First generation solar cells are mainly based on silicon technology with moderate performance of 15-20% efficiency and is most commonly used nowadays.
2. Second generation solar cells are based on amorphous silicon, CIGS or CdTe, where efficiency of such cells is low.
3. Third generation solar cells use organic materials and has potential to overcome efficiency above 30%. Recently researchers of perovskite solar cells scored above 20% of efficiency.

What solar cell is made of?

1. Light absorbing material

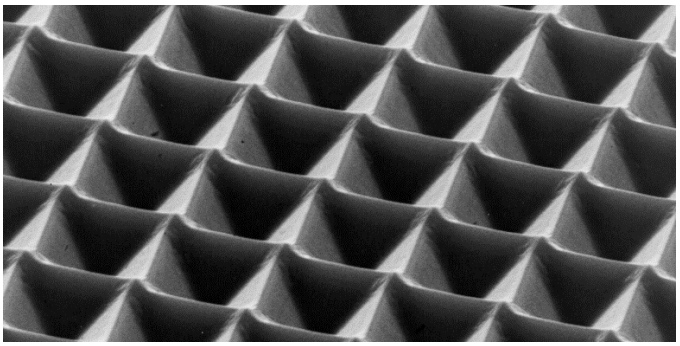
It is a semiconductor material, the main part of solar cell, which is used to absorb solar light. And as mentioned before – the most common material for solar cells is silicon, mainly because it is one of the most abundant minerals on Earth.

2. Solar light trapping layers

These layers have a purpose to decrease light reflections from the front side of the cell or, in other words, to increase transmission through the front surface of the solar cell and to decrease light escape from the cell, when it is already inside:

- Special layers called – Antireflection coatings (most common is silicon nitride (SiN), which causes solar cells to look blueish).
- Surface texture (chemically etched or laser assisted surface structure, what resembles pyramids – see image below).

Often these two means are combined in front surface. On the back side of the cell only texture is present.



3. Charge separation (pn junction)

Solar cell has a built-in potential voltage which is a force for electrons created by solar light to move to contacts. This built-in potential is formed with special type of junction called – *pn* junction. This type of junction became a fundamental part of nowadays electronics industry.

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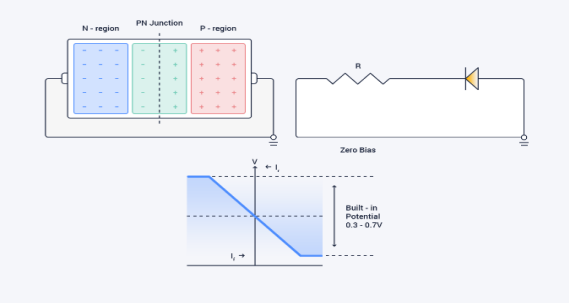

4. Charge collection (contacts)

As an electricity generating device, solar cell needs to have contacts to move charge to terminals and accumulate it or to be used immediately with, for example, household appliance. There are several contact structure variations used in photovoltaics. Most of silicon solar cells have contact structure that can be called standard and for sure everyone has seen it (see picture below). It changes a little bit in time, when further device optimization occurs, but looks similar as well.

This metallization type contains of metal (most commonly silver paste is used) grid on upper side of a cell, and a full layer of metal (aluminum is most common) on the back side of cell. Why metal can't be used to cover all the surface of the cell? Logically, seems that more metal is better as there will be lower resistance and charge carrier will have a shorter path. However, metals absorb all the light and shadow the cells, causing cells not to work in optimal regime.

METHODOLOGY OF SOLAR CELL :

The methodology, known as Value of Solar Methodology, takes into consideration the unique nature of solar PV generation in which systems produce electricity on peak, produce power at the location of use, do not require continuous fuel purchases, and have significant security and environmental advantages over fossil fuels. These characteristics generally increase the value of solar electricity as they allow utilities to avoid the costs of fuel, plant O&M, generation, reserve capacity, transmission, and distribution in their centralized assets.

Value of Solar Methodology represents an opportunity for states and utilities across the country to begin to assess the benefits of distributed generation and better plan for energy investments that provide maximum benefits to society.

Valuation studies can help utilities, regulators, and policy makers to:

- Evaluate Existing Net Metering Programs
- Design Community Shared Solar Tariffs
- Value Exported Solar Energy
- Determine Qualifying Facilities Rates
- Evaluate Real Time Pricing with AMI
- Advance Value of Solar Tariffs

To help advance dialogue around the appropriate value of distributed solar resources in Wisconsin, Iowa, and Michigan, the Midwest Renewable Energy Association (MREA) contracted with Clean

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Power Research to develop recommendations for solar valuation

Advances in Energy Storage

Since the sunlight is not always available, all these businesses of PV solar cells may not work at night and a lot of electricity will go unused . Therefore energy storage is an important factor in solar cell market. A comparison and summary of various types of solar cells . Several energy storage devices are available in the market but those are highly expensive and a short life span. Recently, in 2014, Harvard University researchers developed a new type of battery based on organic molecules called Quinone. It is found in plants and is economical in a sense that it can store sunlight energy for a couple of days. The world's first solar cell energy storage is introduced by Wu and his co-workers at Ohio State University. This device not only can store energy but can also reduce the costs of renewable energy by 25%, relying on a new aqueous, rechargeable lithium-oxygen battery used in sunlight

CONCLUSION :

Nowadays, solar cell technologies play an import role in electrical power production due to greater power consumption and large population. The efficiency of solar cells is one of the most important parameters in directly converting light to electricity . To improve the conversion efficiency of solar cells, graphene has been extensively researched to use as counter electrodes, electron donors, or acceptors .

Solar power generation has been developed as one of the most demanding renewable sources of electricity. It has several advantages compared to other forms of energy like fossils fuels and petroleum deposits. It is an alternative which is promising and consistent to meet the high energy demand. Though the methods of utilizing solar energy are simple, yet need an efficient and durable solar material. Technology based on nano-crystal QD of semiconductors based solar cell can theoretically convert more than sixty percent of the whole solar spectrum into electric power. The polymer base solar cells are also a viable option. However, their degradation over time is a serious concern. There are various challenges for this industry, including lowering the cost of production, public awareness and best infrastructure. Solar energy is the need of the day and research on the solar cells has a promising future worldwide.

- Single/ Mono-crystalline silicon solar cell.
- Poly/Multi-crystalline silicon solar cell.
- Single/ Mono-crystalline silicon solar cell.
- Poly/Multi-crystalline silicon solar cell.

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