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TO STUDY THE SOLAR CELL AND ITS PROGRESS IN THREE GENERATION

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ABSTRACT
A solar cell is an electrical system that uses the photovoltaic effect to transform light energy into electrical energy. A solar cell is a p-n junction diode in its most basic form. Solar cells are a type of photoelectric cell, which is characterized as a device whose electrical characteristics change when exposed to light, such as current, voltage, or resistance. Individual solar cells can be combined to form modules known as solar panels. The common single-junction silicon solar cell can produce a maximum open circuit voltage of approximately 0.5V to 0.6V. These solar cells are very small. When combined into a large solar panel, large amounts of renewable energy can be generated.

Keywords:
Solar Energy, Solar cell, Fossils fuel, Power, Photovoltaic , Renewable

INTRODUCTION
The world's fossil fuel resources are unable to sustain our current energy requirements beyond the next few decades, so the need for inexpensive alternatives is now urgent. Organic devices are well positioned to meet the needs of both the electronics and energy industries because their manufacturing does not require expensive processing steps and can be adapted to a range of applications.As a result, there has been a lot of interest in this field in recent years, and several research groups a ll over the world are now looking into the semiconducting properties of conjugated materials and their applicatio ns in LEDs, photovoltaics, and transistors.This practise of generating electricity using organic solar cells is one way scientists are attempting to alleviate some of the world's problems. The light from the Sun is a non-depleting, clean source of energy that is free of emissions and noise. It can effectively compensate for energy derived from non-renewable sources such as fossil fuels and underground petroleum deposits. From one generation to the next, solar cell manufacturing has gone through a range of improvements. Solar cells made of silicon were the first generation, and they were mostly single crystals grown on Si wafers. Thin films, dye-sensitized solar cells, and organic solar cells were developed further to improve cell performance. cost and productivity are the main roadblocks to growth. To select the best solar cell for a given geographic loca tion, we must first comprehend the fundamental mechanisms and functions of several widely studied solar techn ologies.

SOURCE OF ENERGY
Energy is classified into two main groups: Renewable and Non-renewable.

Renewable Energy
Renewable energy will be energy that is produced from common sources for example sun, wind, downpour, tides, and can be produced over and over as and when required. They are accessible in bounty and by a long period most of the cleanest wellsprings of energy accessible on this planet. For eg: Energy that we get from the sun can be utilized to create power. Additionally, energy from wind, geothermal, biomass from plants, tides, etc can be utilized this type of energy in another structure. Sustainable power sources neither run out nor have any critical destructive impacts on our current circumstance.

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Non – Renewable Energy

Non-renewable energy is energy that is derived from limited-quantity sources on the planet that will be depleted in fifty years. Non-renewable resources are harmful to the atmosphere and can have a negative impact on our well-being. They are referred to as non-renewable because they cannot be regenerated in a reasonable amount of time. Fossil fuels, natural gas, oil, and coal are examples of non-renewable energy sources.

According to recent forecasts, the global oil output rate is projected to begin declining permanently over the nex t 10-20 years. However, in the past, the burning of fossil fuels has harmed the fragile balance of nature on our planet. Every year, approximately 10-20,000 kg of carbon dioxide is released into the atmosphere, mostly due to the burning of fossil fuels. Plants today are unable to withstand this massive increase in CO_2.

As a result, CO_2 concentrations in the atmosphere continue to go up, contributing significantly to the greenhouse effect, which will raise the global mean surface temperature. Depending on possible pollution scenarios and real climate sensitivity. The worldwide mean surface temperature has expanded by 0.3-0.6 since the late nineteenth century and the worldwide ocean level has ascended by 10-25cm, no doubt because of human activities. The outcomes of this temperature change have effectively expanded the recurrence and seriousness of catastrophic events and are probably going to have additional staggering impacts for people and other life frames in all pieces of Earth inside the following many years.

SOLAR CELL

A solar cell is an electronic system that captures sunlight and converts it to electricity directly, either by the photovoltaic effect or by converting the solar energy to heat or chemical energy first. Solar panels are made up of cell assemblies that are used to create solar modules that absorb energy from the sun. Solar power is the term for the energy provided by these solar modules. It's about a small-size, octagonal in shape, and bluish-black in colour. Solar cells are sometimes packed together to form solar modules, which are larger units.

SOLAR PANEL

Alexandre-Edmond Becquerel discovered the photovoltaic (PV) effect in 1839. Following that, Russel Oh invented the first modern silicon solar cell in 1946. Previously, photovoltaic solar cells were thin silicon wafers that converted sunlight into electricity. Modern photovoltaic technology is focused on the formation of electron holes in each cell, which is made up of two separate layers (p-type and n-type materials) of semiconductor material. When a photon with sufficient energy impinges on the p-type and n-type junction in this structure, an electron is expelled and travels from one layer to the next by absorbing energy from the striking photon. In the process, an electron and a hole are formed, and electrical power is produced. Silicon (single crystal, multi-crystalline, amorphous silicon), cadmium-telluride, copper-indium-gallium-selenide, and copper-indium-gallium-sulfide are the most common materials used in photovoltaic solar cells. The photovoltaic solar cells are classified into different groups based on this material.

WHY SOLAR CELLS NEEDED

- Telecommunications stations, lighthouses, satellites, and remote site water pumping all required long-lasting power sources that could be used in sites far from both the main power system and people. It has to be low-maintenance as well.
- Non-polluting and silent energy sources are required for persons living in locations that are not connected to the main electricity grid, as well as some grid-connected home sites, tourist sites, tents, and campsites.
- Clocks, calculators, cameras, and light meters, all demand a minimum quantity of electricity that is required and efficient.
- Renewable and sustainable energy is required to mitigate global warming.

WORKING PRINCIPLE OF SOLAR CELL

As light enters the p-n junction, photons can easily pass through the thin p-type layer and into the junction. The photons in the light energy supply the junction with enough energy to produce a number of electron-hole pairs. The incident light causes the junction's thermal equilibrium to be broken. The depletion region's free electrons will easily reach the n-type side of the junction. Similar manner, depletion holes will easily reach the p-type side of the junction. When the newly formed free electrons reach the n-type side of the junction, they are unable

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to cross it due to the junction's barrier potential. Similarly, once the newly formed holes reach the p-type side of the junction, they are no longer able to cross it and have the same barrier potential as the junction. As the concentration of electrons on one side of the junction, i.e. the n-type side, rises, the concentration of holes on the other side, i.e. the p-type side, rises. The p-n junction would act like a small battery cell on the p-type side of the junction. A voltage is defined, which is referred to as photovoltage. There will be a relatively small current flowing through the junction if we connect a small load across it.

PROCESS OF MAKING SOLAR CELLS

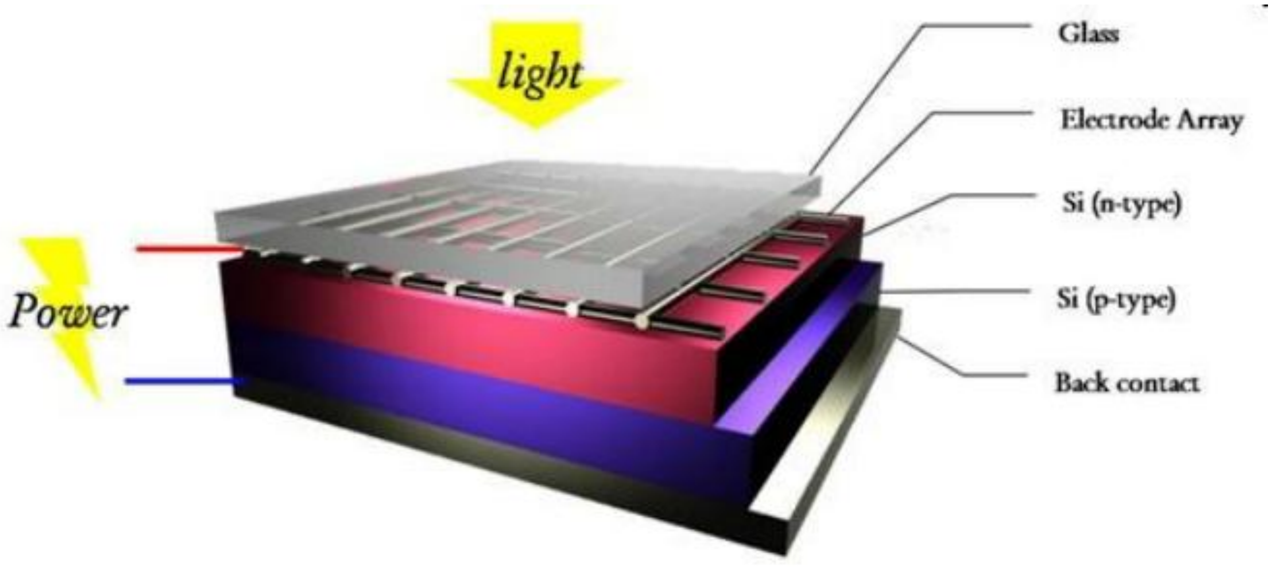
Silicon is the same material that microchip transistors (tiny switches) are made of, and solar cells function in a similar way. Silicon is a semiconductor, which is a type of material. Conductors are materials that allow electricity to flow freely through them, especially metals. Many materials, like plastic and wood, act as insulators, preventing electricity from flowing through them. Semiconductors, like silicon, are neither conductors nor insulators: they do not naturally conduct electricity, but we can make them do so under certain conditions.

A solar cell is a sandwich made up of two layers of silicon that have been processed or doped in a specific way to allow electricity to flow through them in a specific way. Since the lower layer is doped, it has a small number of electrons. Positive-type silicon is referred to as p-type silicon (because electrons are negatively charged and this layer has too few ofthem).

The upper layer is doped in the opposite direction, resulting in a small overabundance of electrons. It's known as n- type silicon, or negative-type silicon. When a layer of n-type silicon is placed on top of a layer of p-type silicon, a barrier is formed between the two materials (the all-important border where the two kinds of silicon meet up). Since no electrons can pass through the membrane, no current will flow and the lamp will not light up, even though we attach this silicon sandwich to a flashlight.

Something exciting happens as we drop light on the sandwich. Light can be thought of as a stream of energetic "light rays" known as photons. Photons give up their energy to the silicon atoms when they join our sandwich. The incoming energy knocks electrons out of the p-type layer below, causing them to jump over the barrier to the n-type layer above and flow around the circuit. The more light that reflects, the more electrons that jump to the surface and the more current that flows.

FIRST GENERATION



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About 90% of the world's solar cells are made from wafers of crystalline silicon (Si). Single crystals mean mono crystalline or mono-Si and multiple crystals mean multi-crystalline or multi-Si are found in the cubes (polycrystalline, multi-Si, or poly c-Si).

First-generation solar cells use a single, simple junction between n-type and p-type silicon layers, which also are sliced from different crystals, as seen in the box above. As a result, an n-type crystal is made by heating silicon chunks with small quantities of phosphorus, antimony, or arsenic as the dopant, while a p-type ingot is made with boron as the dopant.A few extra features are added (such as an anti-reflective coating that enhances light absorption and gives photovoltaic cells their distinctive blue color, protective glass on the front and a plastic backing, and metal connections that enable the cell to be wired into a circuit), but most solar cells are based on a simple p-n junction. Bell Labs scientists invented the invention in 1954, generating electricity by shining sunlight on silicon extracted from sand. Thin wafers (approximately 200m) are used in traditional solar cells. However, as compared to second-generation cells, also known as thin-film solar cells (TPSC) or thin-film photovoltaics (TFPV), which are around 100 times thinner, they're absolute slabs (several micrometers). While most are still made of silicon (amorphous silicon, a-Si, in which atoms are randomly arranged rather than precisely organised in a normal crystalline structure), some are made of other materials, especially cadmium-telluride (Cd-Te) and copper indium gallium diselenide (CIGD) (CIGS).

SECOND GENERATION

Solar cells are typically tiny wafers that are only a fraction of a millimeter thick (approximately 200 micrometers, or 200m). However, when compared to second-generation cells, also known as thin-film solar cells (TPSC) or thin-film photovoltaics (TFPV), which are around 100 times thinner, they're absolute slabs (several micrometers or millionths of a meter deep).Though many are still composed of silicon (amorphous silicon, a-Si, in which atoms are randomly organized rather than precisely structured in a normal crystalline structure), some are made of other materials, notably cadmium-telluride (Cd-Te) and copper indium gallium diselenide (CIGD) (CIGS). Second-generation solar cells may be laminated onto windows, skylights, roof tiles, and a variety of "substrates" (backing materials) including metals, glass, and polymers because they're exceedingly thin, light, and flexible (plastics).

The versatility that second-generation cells gain comes at the cost of efficiency: Solar cells from the first generation still outperform them. So, although a top-tier first-generation cell might attain efficiencies of 15–20 percent, amorphous silicon fails to reach beyond 6%-7%, the greatest thin-film Cd-Te cells only accomplish approximately 10%-11%, and CIGS cells only accomplish 6.9%–11.9%. So this is one reason why, despite their many benefits, second-generation solar cells have yet to have a significant impact on the market. Second-generation solar cells can be folded up into windows, skylights, roof tiles, and a variety of "substrates" (backing materials) like metals, glass, and polymers because they're incredibly thin, light, and flexible (plastics). Second-generation solar cells achieve versatility at the expense of efficiency: traditional first-generation solar cells continue to outperform them.

THIRD GENERATION

Third-generation technologies aim to enhance the poor electrical performance of second generation (thin-film technologies) while maintaining very low production costs. Generally, third-generation cells include solar cells that do not need the p-n junction necessary in traditional semiconductor, silicon-based cells. The third generation contains a wide range of potential solar innovations including polymer solar cells, nanocrystalline cells, and dye-sensitized solar cells. Consider pure sunlight each square meter of Earth pointing directly at the Sun receives up to 1000 watts of raw solar power. This is the theoretical influence of direct midday sunlight on a cloudless day, with solar rays shooting perpendicular to the Earth's surface and providing optimum illumination, or insolation, as it's called in the industry.

We can only collect a portion of this theoretical energy since standard solar cells are only around 15% effective. That is why solar panels must be so large: the amount of power you can generate is obviously proportional to the amount of area you can afford to cover with cells. A single solar cell (approximately the size of a compact disc) can generate about 3–4.5 watts; a standard solar module made up of about 40 cells (5 rows of 8 cells) can generate about 100–300 watts; and multiple solar panels, each made up of about 3–4 modules, can generate an absolute maximum of several kilowatts .

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In fact, in average northern latitudes, we're likely to get 100–250 watts per square meter depending on the time of day (even on a cloudless day). When we multiply for a year's worth of output, we get between 700 and 2500 kWh per square meter (700–2500 units of electricity).

CONCULSION

We have studied the progression of solar cell research from one generation to the next in this paper, as well as addressed future developments and aspects. The paper also seeks to highlight the different practices and strategies for promoting solar energy's benefits. Solar energy has emerged as one of the most demanding renewable energy sources to develop. It offers several advantages over other energy sources, such as fossil fuels and petroleum. It's a viable and dependable way to fulfill the world's rising energy need. This industry faces a number of hurdles, including cutting production costs, raising public awareness, and providing the greatest infrastructure Solar energy is becoming increasingly important, and solar cell research has a promising future worldwide. Though the methods for converting solar energy into electricity are simple, energy, which is already close to the theoretically expected upper limit of 30%. One alternative would be to use thinner films on glass substrates to reduce the amount of silicon. Which cheap also. Today, the manufacture of these solar cells still necessitates a number of energy-intensive processes carried out at high temperatures and high vacuum conditions, as well as several lithographic steps, resulting in rather high manufacturing costs.

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