Advancement in the field of solar energy by enforcing the efficiency using Nano Solar cell

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Abstract:

Nanoscience and Nanotechnology consists of processing, separation, consolidation and deformation of materials from one atom or molecule. The supply of fossil fuels will be a bare minimum available during this century. Hence renewable energy sources such as wind and solar energy have yet to become major contributors to our energy supply due to their cost and efficiency. One of the application of solar energy can be utilized using solar cell for mankind. Solar cell works on the theory that explains, when the photons strike a suitable semiconductor device, the light energy in photons is converted into electric current. The solar cell which consumes solar energy can be efficiently used in wide range by the development of solar cell using hybrid nanostructures. Nanostructures based solar cell can be explained as a method of increasing surface area and increasing the photon capture, which is a multiple Nanosolar cell. The efficiency of solar energy is to convert heat into electricity by creating much smaller and more robust transducers, which will be beneficial in a wide range of applications. The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Potential advancements in nanotechnology opens door to the production of cheaper and slightly more efficient solar cells. Photovoltaic cells based CdTe, CuInGaSe (CIGS), CuInSe (CIS) and organic materials are being developed with the aim of reducing the price per watt. Utilizing nanotechnology inexpensive solar cell would help to preserve the environment. These solar cells successfully blend the needs for efficiency, low cost, and longevity and will be easy to install due to their flexibility weight and light.

Keywords: Fossil fuels, solar energy, Nanosolar cell, Efficiency, Photovoltaic cell.

Introduction:

Solar energy is an important renewable energy obtained by light and heat from the sun. This energy is harnessed using a range of ever evolving technologies such as solar heating, photovoltaic, solar thermal energy and for photosynthesis process too. Among the technologies solar cell place an important role in storing the solar energy. The solar cells are simply act as photovoltaic cell which converts light energy (solar energy) directly to electricity. Conventional solar cells are made out of semiconducting materials usually silicon. When light hits cell they absorb energy and knock out electrons. Solar cells are highly durable and reliable. Today solar cells are simply not efficient enough and are currently too expensive to manufacture. For large scale electricity generation i.e. they have only efficiency around 10%. Hence the new technique from Nanotechnology plays a good role helping the solar cell to achieve good efficiency which is given by Nanosolar cell. A Nanosolar cell is a solar cell based on substrate with a coating of Nanocrystal. The potential advancement in nanotechnology also opens the door to the production of cheaper and more efficient solar cell.

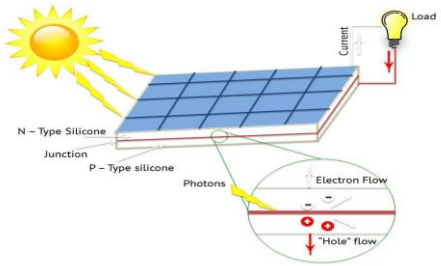
Construction and Fabrication of Solar and Nanosolar Cells:

The solar cell module consists of the silicon semiconductor surrounded by protective materials in a metal frame. The protective material consists of an encapsulate of transparent silicon rubber. A polyester film makes up the backing. The electronic parts are standard and consist mostly of copper. The frame is either steel or aluminium. Silicon is used as the cement to put it all together. Since pure silicon is shiny, it can reflect the sunlight. To reduce the amount of sunlight lost, an anti-reflective coating is put on the silicon wafer. Wafers used for silicon cell are also used in fabrication of electronic device such as IC, transistors etc.

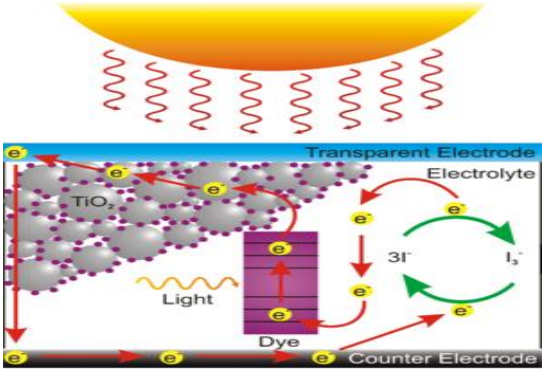
A Nanosolar cell made up of thin films using CdTe, CuInGaSe (CIGS), CuInSe (CIS), the films and Nanocrystals are basically they are dye sensitized cell (TiO_2 nanoparticles) which is immersed under an electrolyte solution, above which is a platinum-based catalyst. As a conventional alkaline battery, an anode (the titanium dioxide) and a cathode (the platinum) are placed on either side of a liquid conductor (the electrolyte). On top is a transparent anode made of fluoride-doped tin dioxide deposited on the back of a glass plate. On the back of this

conductive plate is a thin layer of titanium dioxide (TiO_2), which forms into a highly porous structure with an extremely high surface area. The (TiO_2) is chemically bound by a process called sintering. TiO_2 only absorbs a small fraction of the solar photons (those in the UV). The plate is then immersed in a mixture of a photosensitive dye and a solvent. After soaking the film in the dye solution, a thin layer of the dye is left covalently bonded to the surface of the TiO_2. A separate plate is then made with a thin layer of the iodide electrolyte spread over a conductive sheet, typically platinum metal. The two plates are then joined and sealed together to prevent the electrolyte from leaking. The photo anode consists of 12 μm thick film of transparent 10–20 nm diameter TiO_2 nanoparticles covered with a 4 μm thick film of much larger (400 nm diameter) particles that scatter photons back into the transparent film. The excited dye rapidly injects an electron into the TiO_2 after light absorption. The injected electron diffuses through the sintered particle network to be collected at the front side transparent conducting oxide (TCO) electrode, while the dye is regenerated via reduction by a redox shuttle, I_3/I, dissolved in a solution. Diffusion of the oxidized form of the shuttle to the counter electrode completes the circuit.

Working of Solar and Nanosolar cell:



A solar cell is a sandwich of n-type and p-type silicon. It generates electricity by using sunlight to make electrons move across the junction between the different wafers of silicon. When sunlight shines on the cell, photons (light particles) bombard the upper surface. The photons carry their energy down through the cell. The photons give up their energy to electrons in the lower p-type layer. The electron use this energy to jump across the barrier into the upper, n-type layer and escape out into the circuit. The electrons flowing in the circuit, make the lamp glow.



In a Nanosolar cell, the Sunlight passes through the transparent electrode into the dye layer where it can excite electrons that then flow into the titanium dioxide. The electrons flow toward the transparent electrode where they are collected for powering a load. After flowing through the external circuit, they are re-introduced into the cell on a metal electrode on the back, flowing into the electrolyte. The electrolyte then transports the electrons back to the dye molecules. Dye-sensitized solar cells separate the two functions provided by silicon in a solar cell design. Normally the silicon acts as both the source of photoelectrons, as well as providing the electric field to separate the charges and create a current. In the dye-sensitized solar cell, semiconductor is used solely for charge transport, the photoelectrons are provided from a separate photosensitive dye. Then the charge separation occurs at the surfaces between the dye, semiconductor and electrolyte.

The dye molecules are quite small (nanometer sized), so to capture a reasonable amount of the incoming light the layer of dye molecules needs to be made fairly thick, much thicker than the molecules themselves.

Drawbacks of Solar Cell which leads to enhancement of Nanosolar cell:

At present the cost of solar cell are high. The efficiency of solar cell is low. The installation of photovoltaic system requires large investment in terms of cost. Large area is required to capture the sun's light and to convert to energy. They can only be harnessed in daytime and sunny. Solar energy is unreliable depending on the climate. The batteries are large and heavy which needs more storage space. They also need replacing time to time. Solar cells gives bulkier panels which require large area to place them.

Nanosolar cells are made of Nano particles which are cheaper to buy. They are compact and require less space. The efficiency is more in Nanosolar cell to normal solar cell, as the path taken by the absorbed light requires lesser space to travel and generate the power. Nanosolar cell also helps to convert solar energy into electricity energy even on cloudy days.

Advantages of Nanosolar cell:

The effective optical path for absorption is much larger than the solar cell thickness. The light generated electrons and holes need to travel over a much shorter path and thus recombination losses are greatly reduced. Nanosolar cells are feasible with high durability and functionality with increased precision and productivity. In plastic solar cells, nano rods are closely packed and transfer their electrons more directly to the electrons, so they can tune the Nanorods to absorb different colors to span the spectrum of sunlight.

Applications of Solar and Nanosolar cell:

Solar cells are applied to make a solar modules, which converts solar energy into electrical energy. These are also applied as solar hot water panel for mankind purpose. They were also applied for space missions. They are used as the main power source in orbiting satellites, since they give us best power to weight ratio.

Nanosolar cells are applied more because of their compact size in nature and for their best efficiency. Nanosolar cells made up of composite polymers are applied to solar cells to obtain multispectral cell, which are used by NASA on Mars missions. Nanotechnology in solar cells also have military applications, help the soldiers to carry a convenient light batteries for multipurpose uses of electronic devices. They are also applied in covering cars with plastic nano solar cell which can generate the power and save the fuels and also help to reduce the emission of carbon gases.

Conclusions:

In the perspective of energy demand in the earth, the solar energy plays a key role as a free and an important renewable energy. The solar cell makes use of this solar energy, which can be powered for remote locations. An assemblies of Solar cells as Solar panel plays a tremendous impact for mankind in providing the energy in form of electricity, which are pollution less and Environment friendly and act good role in global warming. As Solar cell are quite high in cost which are made of Si, Nanosolar cell are used for their wide applications with increased in absorption efficiency with cheaper manufacture cost. They are also in compact size provides better performance than solar cell. Nanosolar also gives good spectral response. Since they help us in preserving solar energy conservation, they can be benefitted for the purpose extra-terrestrial applications.

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