ISSN 2063-5346

DEVELOPING A LOW-COST SOLAR CELL USING NANOTECHNOLOGY

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Article History: Received: 01.02.2023 **Revised:** 07.03.2023 **Accepted:** 10.04.2023

Abstract

Nanotechnology is extremely versatile and has a broad range of potential uses. Since a few years ago, nanotechnology has been widely used to support innovative research methods. Analysts are interested in this subject to nurture novel materials and applications despite this. Nan science has evolved into a distinctive and innovative discipline of specialized movement. The extraordinary design of nanoscale technology and the special properties of nanostructures are some of the factors. The solar cell industry has recently seen rapid expansion as a result of the rising demand for environmentally friendly energy sources and worries about global environmental change. Cost must be taken into account for any solar invention. To create solar cells for a large-scale energy age would be both prohibitively expensive and inherently inefficient. In any case, it is expected that nanotechnology will improve, opening the door to the creation of solar cells that are less expensive and slightly more effective. Nanotechnology has significantly advanced the study of solar energy. Nanotechnology, the most sophisticated invention produced by mankind to date, has an impact on all energy systems with its methods for managing energies, particularly solar energy. This essay discusses current advances in solar cell-related nanotechnology and proposes the use of traditional solar PV cells for display. For the mass power era, nanotubes and quantum dots may assist lower the cost of PV cells and modules while also increasing the effectiveness of cell switching in nanotech solar cells.

Keywords: *Low-Cost, Solar Cell, Nanotechnology*

INTRODUCTION

Photovoltaic cells are regular solar cells. These batteries are constructed of silicon, a semiconducting substance. They use energy, but photons, when light causes a commotion in the neighborhood. By removing silicon's electrons, this assimilated energy enables electron flow. An electric field can be created by introducing various pollutants, such as phosphorus or boron, to silicon. Since it only permits one direction for electrons to flow, this electric field functions somewhat like a diode. Thus, the result is an electron flow, better known to us as power. Ordinary solar cells can only achieve efficiencies of about 10% and are expensive to produce, which are their two main drawbacks. With silicon cells, failure, the biggest disadvantage, is practically certain. This is justified by the assumption that the entering photons, or light, should possess enough energy, or "band hole energy," to expel an electron. If the photon's energy is lower than the band hole's energy, it will pass through. The extra energy will be lost as intensity if it has more energy than the band hole.

Solar cells built on nanotechnology have a very high energy conversion productivity and are thought to be a significant candidate for future PV innovation. The following effects lead to the enormous energy change productivity: (a) nanostructure crystallite sizes are comparable to transporter dissipating lengths, effectively reducing the dispersing rate and increasing the effectiveness of the transporter assortment; and (b) nanostructures have strong retention coefficient due to expanded thickness of states. Additionally, the band hole can be controlled to maintain in a given photon energy range by varying the size of the nanostructures. In any event, it is crucial to produce sporadic variants of individual nanostructures with a consistent size below 20 nm in order to achieve these benefits at non-cryogenic temperatures. The inability to produce vast variety of nanostructures with the desired periodicity and size control for a reasonable price has been a key barrier to the advancement of a nanostructure-based PV breakthrough. Due to their prohibitively high assembly costs, the standard nanofabrication techniques of epitaxial material growth, electron-pillar lithography, and responsive particle scraping are inappropriate for solar applications. The use of colloidal particle testimony, semiconductor group fusion in natural polymers, semiconductor microcrystallites consolidation in glass lattices, strain-prompted self-coordinated development, and other nonlithographic creation techniques have all been investigated as alternatives. However, the majority of these techniques fall short in key areas such as periodicity, control on nanostructure size conveyance, and adaptability in terms of semiconductor material selection. In order to produce intermittent variations of semiconductor nanostructures with exceptional size control (10%) and a significant degree of periodicity, we have developed an intriguing low-cost nanogrowth innovation. This technique uses an electrochemical mixture of semiconductor nanostructures on a prepared aluminum substrate that has undergone electrochemical anodization. This process makes use of methods that are widely used in the commercial electrochemical assembly sector, making it affordable, dependable, appropriate for large-scale production, and also allowing the use of a wide variety of substrate and semiconductor materials. Unquestionably, this idea can be used to arrange multijunction structures as well, which could improve the effectiveness of picture modification. The goal of this research is to provide a low-cost innovation for the nonlithographic way of manufacturing highly productive solar cells.

The low efficiency and high construction costs of conventional solar cells are their two fundamental shortcomings. The major flaw of silicon cells is inadequacy, which is practically inescapable. This is justified by the assumption that the entering photons, or light, should possess enough energy, or "band hole energy," to expel an electron. If the photon's energy is lower than the band hole's energy, it will pass through. The extra energy will be lost as intensity if it has more energy than the band hole. These two hits alone are responsible for the loss of about 70% of the radiation energy that strikes the cell. Small chunks of substance called nanoparticles are many times smaller than a human hair. Because nanoparticles are so small, a large proportion of their iotas live on their surfaces rather than inside them. Accordingly, surface interactions control the conduct of nanomolecules. They typically differ from larger lumps of the same substance in terms of properties and attributes as a result. There are three main benefits to thin-film solar cells with nano-organized layers. First of all, because of numerous reflections, the effective optical path for assimilation is much larger than the actual film thickness. Second, because light-generated electrons and openings must follow a much more confined path, recombination catastrophes are significantly diminished. As a result, in contrast to the few micrometers in conventional thin-film solar cells, the protective layer thickness in nano-organized solar cells can be as low as 150 nm. Third, the energy band hole of different layers can be adjusted to the appropriate plan esteem by varying the size of the nanoparticles. This gives the protection of solar cells more planning flexibility.

LITERATURE REVIEW

By using substance shower affidavits, Bari and Patil (2010) have revealed the composition and depiction of bismuth selenide thin films. The Bi/Se ratio varied between 0.9 and 2.03, and various depiction studies were used to account for the formation, morphology, structure, and other characteristics of minor motion pictures. The arrangement's boundaries, such as time, temperature, and pH, were altered. Pictures taken using nuclear power microscopy (AFM) revealed a smooth film structure. The increase in the Bi/Se proportion increased the band hole esteem. Temperature expansion and the Bi/Se ratio both increase the film's conductivity. As the Bi/Se ratio increased, the initiation energy decreased.

ZnS nanoparticles have been incorporated via an aqueous approach by Chandran et al. (2010). The image obtained via TEM did not completely resolve the grain size. The band hole of the material was determined using the example's UV-Vis Ingestion Range. The crystallite size, calculated using the Scherrer equation, was estimated to be around 20.036 nm. The analysis done with a Transmission Electron Magnifying Lens (TEM) revealed that the nanoparticles were round in shape. The grain size was estimated to be between 20 and 30 nm. The band hole of the ZnS nanoparticles, which was higher than that of the mass ZnS, was discovered to be 4.03 eV. This served as evidence that there was effective quantum confinement.

The effects of distinct complexing specialists on the structuring and portrayal of ZnS slender pictures framed by Compound Shower Statement have been extensively discussed by Shin et al. (2012). In their investigation, they discussed the effects of different complexing specialists on the underlying, compound, morphological, optical, and electrical properties. While the ZnS thin films created with the help of a few complexing specialists had polycrystalline hexagonal structure and the optional ZnS was not framed, the ZnS thin films created without complexing specialists displayed nebulous stage. They saw that as specialists became more complicated, the thickness increased. The electrical resistivity was over 105 cm and had not been altered by complexing specialists. In general, movies without a complexing specialist had a higher conveyance and band hole than movies with a complexing specialist. Throughout the CBD, the pH was maintained at 10 and the temperature at shower C.

In 2014, Moreh et al. created ZnS dainty videos using a splash pyrolysis technique. The depiction of girly flicks revealed a single peak that had grown stronger as the temperature increased. With an increase in toughening temperature, the small strain, separation thickness, and Full Width at Half Maximum (FWHM) decreased, demonstrating an improvement in the quality of the precious stone following strengthening. The cross section consistent "a" values agreed with the results obtained by other investigators, and the grain size also increased with the strengthening temperature.

The declaration and portrayal of ZnS thin films created by compound shower affidavit had been made public by Limei et al. (2009). Zinc sulfate was used as a precursor in the framing of the ZnS sparse movies. The investigations revealed that the pre-arranged ZnS sparse movies' attributes were modified by the arrangement emphasis. The white specks, which might be colloidal particles sedimenting mixed in with ZnS, were shown by the SEM designs. With the increase in ZnSO4 fixation, the fragile movies' sheet blockage had decreased. The fragile movies had a transmissivity of over 80%. With the increase in toughening temperature, the transmissivity had decreased. Additionally, it was shown that movies with less centralization of zinc sulfate had increased transmissivity.

The design of ZnS minimal movies doped with Copper (Cu) using compound shower affidavit method was described in detail by Ortiz-Ramos et al. (2014). The response arrangements incorporating Zn and Cu salts, Ethylene Diamine Tetra Acidic Corrosive (EDTA), and Thioacetamide were used to organize the videos. According to the XRD analysis, the undoped ZnS films had a cubic glasslike structure, and the amorphization of the films was caused by the expansion of Cu. The addition of Cu particles as debasement in interstitial locations or deformities of the cross section revealed by the Raman spectroscopy revealed the cubic construction or -ZnS in the ZnS with a change in diagram. Cu was present in the ZnS thin flicks, as seen by the longer totals in the AFM images. A novel contribution to the CBD strategy, the addition of Cu in slight amounts caused modifications in the optical characteristics and resistivity.

The optical and underlying characteristics of Cu doped ZnS nanocrystals were described by Hasanzadeh (2016) using a wet material mixture in a two-fold refined water arrangement with Mercapto-Propionic Corrosive (MPA) as the covering specialist. The obtained nanocrystals typically ranged in size from 3 to 6 nm. The ZnS:Cu nanoparticles possessed a zinc blende precious stone construction at room temperature, according to the XRD design.

SOLAR NANOTECHNOLOGY

The use of nanotechnology might increase the efficiency of solar cells.

A. Plastic:

Nanoscale The primary element of plastic, a sparse, adaptable solar board, is titanium/color complex. Incorporating TiO2 nanoparticles impinge on photons with energies greater than or equal to its band hole (>3.0 eV), which results in the activation of electrons in the conduction band and the formation of positive openings in the valence band. They may become trapped and react by sticking electron donors or acceptors to the surface of the photo impetus, or they may recombine nano- or radiatively (scattering the information energy as intensity). The difference between these cycles influences how effective TiO2 nanoparticles are in general for different applications.

Titanium nanoparticles have received a lot of attention over the past twenty years. TiO2 has the capacity to convert solar energy into electrical energy for use in solar cells by absorbing light in the range of perceived light. Due to their versatility, nanomaterials have a wide range of applications, including those in paint, toothpaste, UV protection, photocatalysis, photovoltaic, sensing, electrochromics, and photochromics.

With this solar technology, you can nearly always produce electricity, even on an upward surface, and it works well in cirrus lighting situations. The Complete Energy Gathered from Plastic outperforms other solar boards and informs architects, glass producers, and others in the structure and development professions about solar energy and plan possibilities.

Solar boards can be used in both overcast and foggy conditions. Our flexibility and modest size allow us to conform to the details of your designs. This implies that utilizing rigid, black silicon solar panels is not your only option. Plastic can be used to build solar-powered constructions that honor the quality of your expressions.

B. Nano Wires:

Nanowires are extremely small wires with a width measured in nanometers. Their normal width ranges from 40 to 50 nanometers, although their length isn't really constrained. They can be as long as needed because they can be extended by just connecting more wires from beginning to end or by simply making them longer. They are especially interesting for readings on the uses of nanotechnology in nanoscience.

Nanowires are made of metal, just like regular wires. Their magnitude is the primary real difference between ideas. Additionally, they vary in complexity and applications. While they are capable of many of the same tasks as standard wire, they also have a wide range of additional abilities.

Nanowires are essentially tiny wires that desire to significantly reduce the size of electrical devices while enabling us to increase their functionality. The requested lengths and widths for the nanowires are 10 nm and 10 m, respectively. Nanowires typically have enough space between them (> 1 nm in the quantum limited course) to allow for close-by precious stone patterns to be securely attached to their parent materials. the semiconductor, opto-hardware, and other appealing industries are currently using the shrinking length scales.

C. Nanotechnology Solar cell:

These innovative plastic solar cells work by dispersing microscopic nanorods within a polymer. because they generate electrons when they absorb light with a specific frequency. These electrons pass through the nanorods until they reach the aluminum terminal, where they are condensed to form a flow and are converted to power. There are two main factors that make the production of this type of cell less expensive than conventional ones. To begin with, silicon is not used in the production of these nanoscale solar cells. Second, no expensive hardware is required for the assembly of these cells.

The possibility that these nanorod solar cells could be "tuned" to ingest light makes this possibility even more feasible. Because more episode light could be used, this might increase the solar cell's overall effectiveness.

ADVANTAGES OF NANOTECHNOLOGY SOLAR CELL

• Lower manufacturing costs and more assembling flexibility.

• It is easy to make and doesn't require special methods.

• In order to reduce the cost of solar cells, titanium has been manufactured and possesses the qualities of light retention and soundness.

• The nanowires used in this system have been adjusted to capture photons, making it possible to use the highest levels of energy even in indoor lighting.

THE SOLAR CELL IS IMPROVED BY NANOTECHNOLOGY

Nanotechnology solar cells are now less productive than conventional ones, but their lower cost more than makes up for this. The ability to wrap the nanoparticles with tiny semiconductor gems known as quantum specks should enable nanotechnology adaptations to be more productive than conventional ones while also being more cost-effective in the long term. In contrast to typical materials, where one photon produces just one electron, quantum spots have the capacity to split high-energy photons into multiple electrons. Electrons go from the valance band into the conduction band. The patches also get a wider range of sunshine wavelengths, which can boost transformation productivity by up to 65%. Quantum specks could be used in another field by inventing fake hot transporter cells. In hot transporter cells, the excess energy from the photons produces higher-energy electrons, which boosts the voltage. Normally, the extra energy from a photon is lost as intensity.

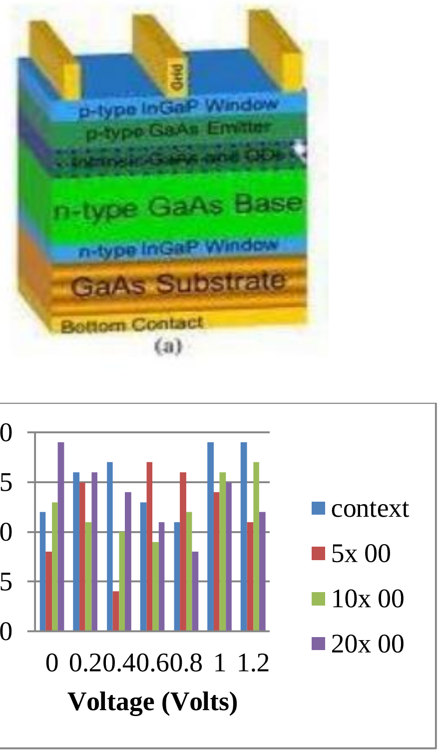

Figure 1: a) A concept for a solar cell augmented by quantum dots (QDs). (b) Curves of current density vs voltage for cells with and without 5–20 layer enhancement under one sun's global air mass 1.5 (AM1.5g) illumination.

The major obstacle to achieving higher image change proficiency in a nanostructured anode is the transportation of electrons across the molecular network. By facilitating the flow of electrons to the gathering anode surface of the DSSC, the CNT network backing is used to anchor light-gathering semiconductor particles. Charge injection from charged Cds excite the Discs nanoparticle in SWCNT. When the Cdse and CdTe CNTS connections can initiate the charge transfer process under apparent light irradiation. The improved cut off thickness was attributed to the improved interconnectivity between the MWCNTs and titanium dioxide particles in the permeable titanium dioxide layer.

REDUCTION OF COSTS THROUGH NANOTECHNOLOGY

Regular translucent silicon solar cells are produced utilizing a low-temperature method akin to printing. Nanotechnology decreased setup costs by supplying flexible rolls, temperature, and vacuum affidavit processes. less expensive to assemble than rigid transparent boards. This trademark will also apply to semiconductor thin-film-made cells. The Nanosolar firm has developed a solar coating that is the most effective solar energy source ever made. By reducing the cost of production for their Power Sheet cells from $3 per watt to just 30 cents, they distinguished them from existing solar innovation frameworks. As a result, solar energy is now more affordable than coal, a historical first.

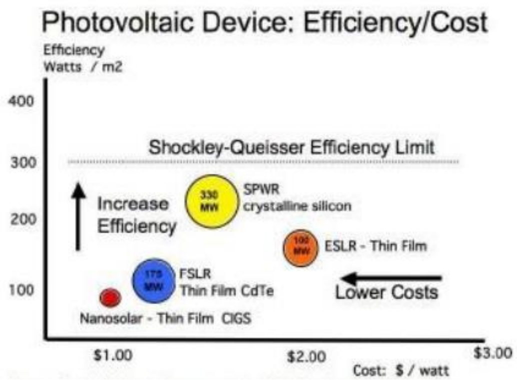

Figure 2: Efficiency vs. Cost Tradeoff

The practical efficiency of photovoltaic devices is limited by production costs and tradeoffs in materials, manufacturing processes, and PV gadget packaging. Shapeless silicon, cadmium telluride (CdTe), copper indium deselenide (CIS), and copper indium gallium deselenide materials are just a few of the PV device materials that are thoroughly delineated in The Lewis Gathering in terms of their efficacy patterns. The Lewis Gathering's better proficiency or lesser creation are the reasons for this. (CIGS). These thin film materials may allow PV devices to be substantially more affordable.

SOLAR CELL USE IN NANOTECHNOLOGY APPLICATIONS

1) Nanotechnology-based reasonable solar cells would contribute to environmental protection.

2) Covering plastic photovoltaic cells that are affordable enough to cover the entire roof of a house with solar cells with current roofing materials. At that point, it might be possible to harness enough energy to practically run the house. If many homes used this, we would use less petroleum-based products for the electric grid, which would help prevent contamination.

3) The military would be impacted by nanotechnology-based solar cells as well. The U.S. Armed Forces and Konarka Innovations had previously collaborated on planning for a more effective way to power their soldiers' electrical equipment. The executive vice president of Konarka, Daniel McGahn, claims that "the average field combatant today carries 1.5 pounds of batteries. A fantastic work demands the transfer of 140 pounds of solar hardware components, 60 to 70 pounds of which are batteries, and creates some longer-lasting recollections.Nanotechnology would significantly increase warriors' mobility if it could modify cells.

4) Reasonable solar cells could also aid in bringing electricity to remote locations or underdeveloped nations. Due to the low power interest and indirect distribution of the regions, connecting these areas to an electrical grid is useless. This is an extremely clever utilization of solar energy in spite of everything.

5) A small solar cell could power lighting, high-temperature water heaters, medical equipment, and cookery. It would significantly alter the way of life for millions, if not billions, of people. Plastic photovoltaic solar cells can generate power, store energy, and assist reduce the emission of carbon dioxide even though their productivity isn't all that great. They can be used to cover automobiles or to make windows out of solar cells.

6) Flexible solar cells with roller handles may be able to convert solar energy into a perfect, environmentally friendly, and useful source of power.

CONCLUSION

A low-cost, highly effective solar cell would have a huge impact on society. The hardware sector would benefit, fighters would be protected, rural areas would receive power, and the environment would be preserved. The psychological consequences of nanotechnology, which are frequently positive, might fundamentally change and even advance society. The use of nanotechnology ("nano") in movies holds out the prospect of increasing the efficacy of solar energy shielding while reducing assembly costs.

Even if nanotechnology is simply useful for providing low-power gadgets with sufficient energy, the societal repercussions would be significant. By improving the retention efficacy of light and the overall radiation-to-power, it would help protect the environment, lighten the load on troops, provide power to rural areas, and have a wide range of business applications.

Each type of energy has its own unique characteristics and conditions, such as the main area where the breeze speed is better, and solar energy is used in locations where the climate is consistently sunny rather than cloudy or stormy. The best option for the situation is chosen to generate power. As it is a completely free resource from nature and can never be in short supply, the level of producing environmentally friendly energy is steadily rising today. As it enables the display of solar cells, the nanotechnology used in solar energy benefits the entire globe greatly.

FUTURE SCOPE

Future improvements to the photovoltaic performance of color-sharpened solar cells are desired, and these will likely be made by enhancing the polymer electrolyte's characteristics and portion rate of gamma illumination.

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