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THE DEVELOPMENT OF SOLAR CELLS TECHNOLOGY

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Abstract- In this work we summarized the development of solar cells technology starting from the single crystal silicone cell and ending with the latest; the nano solar cells.

I. INTRODUCTION

Solar energy is the mother of energy above our planet, where emit rays all energies because they are moving all the machines and the mechanism of the land heats the surrounding air and land and the generation of wind and push water recycling cycle, and heating the oceans, and develop the plants and feed the animals and with the time the fuel is fossil in the ground and this energy can be converted directly or indirectly to the heat and cold, electricity and a driving force in ways. Sunlight electromagnetic spectrum visible rays constitute 49% of them and the unseen as ultraviolet (2%), and infrared 49%. Solar vary depending on the movement and then from the ground, vary sunlight and severity density above ground a map by seasons of the year over the hemispheres and the distance from the Earth and tendencies and put it above the geographical locations throughout the day or during the year according to the clouds density, which eclipsed because they reduce or control the amount of radiation that link the land unlike the sky free wakes clouds or fumes. The rays of the sun fall on the walls and windows of buildings and land and water, and absorb radiation and store in a block (material) thermal, this stored heat radiate then into buildings. This thermal mass is considered a solar heating system is the same function as the batteries in an electric system, solar (photovoltaic) voltages. Both store the sun's heat to be used later. Convert all those solar energy into electricity is very expensive and most solar cells are made from silicon metal, silicon found in abundance in the earth's crust, the sand and this needs such as chips for manufacturing processes difficult include the use of a clean room and booths air circuit and as a result, the cost of generating electricity from solar energy about four times the cost generated by conventional means Raised Nano solar cell technology a lot of interest based on what in the field of energy from the important expectations not only in academia as well has produced a unique ability to build new structures on a large scale at the atomic level, new materials and devices with the possibility of job applications in a large number of vital areas and allowing developing nations to join the developed economies, nanotechnology is the second industrial revolution, social, economic and environmental benefits and applications in the field of private energy after the rapid expansion of research and technological development where he was able to provide many and promising solutions, including what is the user, including what is the use phase where he managed to make a cheap and flexible cells can be sprayed on walls or printed on paper or even fabric Helps solar cells developed nanotechnology to increase the conversion efficiency of light using quantum or grapheme patches up its efficiency to between 30 and 40% at the present time because of the quantitative limitation of electrons, which means that the photon and one could cause the release of more than electrons and therefore gives higher efficiency solar cell It also contributes to further reduction of pollutants emitted from combustion engine through the use of Nanofilters can purify and clean the exhaust mechanically through transformers motivating and based on noble metal nanoparticles or molecules through envelopes catalyst on the walls of the cylinder and catalytic nanoparticles

II. TYPES OF SOLAR CELLS

a. Crystalline Silicon Cells Unilateral: Until recently, most cells manufactured from pure silicon with a continuous structure without impurities Mon crystalline silicon mono crystal is usually made

from small grains of crystal Drawn slowly melted of the mass of silicon. Multi-crystalline, the efficiency of this type of cells reach 11-16%, which means that the absorption of these cells from the upcoming radiation from the sun its power 1000 W / m^2, and so on a sunny day near the equator means that the wattage of these cells produces (110-120) W [1,2].

b. Multi-Crystalline Silicon Cells: Multi-crystalline small granules of silicon crystal composed and can produce a thin layer of the multi-crystalline silicon by alloy formation of multi-crystalline silicon dissolved and then cut into slices square the. Many Cells crystalline wafers of silicon crystals scraped off of the cylindrical silicon chemically treated in furnaces to increase electrical properties and then paint the surfaces of cells in anti-reflective, These cells have an open circuit voltage of .5V DC and a short circuit current of 155mA despite the fact that the cells of this type of cells are cheaper and easier than unilateralism cells crystallization but they are less efficient because efficiency up 9-13%, because the charge carriers generated before.

c. Gallium Arsenide Cells: Silicon is not the only material used in the photovoltaic industry, there gallium Arsenide which owns the structure of crystalline similar to silicon as consisting of successive atoms of gallium and the arsenide with a high absorption for the light coefficient, can work under the temperature conditions somewhat without a decrease in its performance cells silicon and cost high higher than the cost of silicon cells and used this kind in space applications. Gallium arsenide is used in the manufacture of devices such as microwave frequency integrated circuits, monolithic microwave integrated circuits infrared light-emitting diodes, laser diodes, solar cells and optical windows [3].GaAs is often used as a substrate material for the epitaxial growth of other III- V semiconductors including: Indium gallium arsenide, aluminum gallium arsenide and others [4,5].

d. This kind with the membranes of cells (zero crystallization): And the silicon material are deposited on the body thin layers on the surfaces of glass or plastic, so that its technology is characterized by easy but less efficiency

• **random silicon cells**: Silicon atoms are in this type of arrangement is less of the kind of crystalline cells, there is no correlation complete with the neighboring atoms are connected as linked to the so-called ligament Dangler. The manufacturing process are made by mixture of a gas contains silicon and hydrogen SiH_4) (a small amount of impurities such as boron, which decomposes electrically by a way that could be a thin layer of silicon on the random pillars Suitable flexible as steel material, hydrogen and The hydrogen gas by providing electrons contains additional combine with silicon links dangling to be a layer of silicon, hydrogen and affect impurities present in the gas distribution charge carriers to improve printability conductivity of the material, of the features of these cells it thinner and cheaper than silicon cells are crystalline and more absorption for the solar beam It is an appropriate solar cells to not continuous use and efficiency of up to 12% and decreases with exposure to the sun for random silicon cells differ from cells manufactured for the area correlation (P - N) This type of cells have an area called (P - IN)

•**the copper indium selenite cells:** A semiconductor composites of copper, indium and selenite (CIS) and reaches the efficiency of this type of cells to 12% and cons of this type is limited in the membrane thickness slave to these cells is greater than the random silicon cells .Sometimes CI (G) S or CIS cell) is a thin-film solar cell used to convert sunlight into electric power. It is manufactured by depositing a thin layer of copper, indium, gallium and selenite on glass or plastic backing, along with electrodes on the front and back to collect current. Because the material has a high absorption coefficient and strongly absorbs sunlight, a much thinner film is required than of other semiconductor materials.

• **cadmium cells telluride (C d T e)** :Another semiconductor material suitable for the use of photovoltaic cells, the pros of these cells is the ability to manufacture using simple and cheap operations of electroplating Cadmium telluride (CdTe) is a stable crystalline compound formed from cadmium and tellurium. It is mainly used as the semiconducting material in cadmium telluride photovoltaic and an infrared optical window. It is usually sandwiched with cadmium sulfide to form a p-n junction solar PV cell. Typically, CdTe PV cells use an n-i-p structure CdTe is used to make thin film solar cells, accounting for about 8% of all solar cells installed in 2011[6].

e. Nano-cells: The efficiency measure of the ability of the solar cell a certain area (be Surface) coming from the sun energy is absorbed and converted by (30%) into electrical energy, and there are several types of relevant competencies and different features solar cells, but there is a theoretical efficiency of the different solar cells. Among the most famous of solar cells, which have been marketed are silicon cells of 27.5% efficiency and this percentage seems small, but if we assume that we have a solar panel (made up of several cells) with an area of one square meter box, Will be produce 275 watts, this energy is covered energy consumed cost b $ 12 per year, but These techniques Not used, the proportion of the high cost of manufacturing solar cells from silicon to these efficiency of 27.5% per square meter is $ 150, and here comes the role of nanotechnology (micro) in Materials Engineering atomic-sized (very small)[7,8].Potential in nanotechnology and advance may open the way for the production of solar cells is slightly cheaper and more effective. The solar cell is inexpensive also help in provide electricity to rural areas or Third World countries. Solar cell industry has grown rapidly in recent years due to the by strong interest in the field of renewable energy, and the problem of global climate change. Nanotechnology has already shown significant breakthroughs in the field of solar energy. Nanotechnology may be able to increase the efficiency of solar cells; buthis most promising application of nanotechnology is to reduce the manufacturing cost. The use of Nano technology in solar cells inexpensive help to preserve the environment. Nano structured layers in the solar cell film offers three important advantages.
First: due to multiple reflections, effective optical path is much larger than the thickness of the absorption of the actual film.
Secondly: the light generated electrons and holes need to go through a much shorter path and thus reduce recombination losses to a large extent. As a result, the absorption layer thickness in Nano-structured solar cells can be thin up to 150 nm instead of several micrometers in conventional solar cells, thin.
Third: the energy gap of the various classes can be tailored to the desired value of the de sign by changing the size of the Nano-particles.

III. TYPES OF NONMATERIAL'S

Nanoparticles balls: the most important carbon nanoparticles balls that belong to fluorinate category, which differs slightly installation where its multiple crusts as it are an empty place.
Nanoparticles: particles that the word modern use of nanoparticles, but the particles were found in nature, or of manufactured goods since ancient times and could nanoparticles as an atomic or molecular grouping microscopic definition ranging in size from a few atoms to one million atoms.
Nanotubes: These are segments of folds are cylindrical and are often open end of the pipe and the other sealed a semi-circle, made the tubes from organic materials or inorganic enjoy this pipeline strength and solidity and electrical conductivity.

1. Fiber nanoparticles

Characterized fiber nanoparticles that surface area to a large scale as the number of large surface atoms for the total number, and take several forms as the six-party fiber and spiral fiber-like grains of wheat compounds nanoparticles: These are substances added to it nanoparticles during the manufacture of those materials. It has been identified classification of nonomaterials into several sub-categories, according to the identity and similarity of their properties and their applications in diverse fields and can be summarized as follows:

1. metals and metallic liquid
2. ceramic material
3. Polymers
4. Overlapped materials
5.

2. Fluorine

Fluorine is one of the four types of naturally occurring forms of carbon, first discovered in 1980 carbon molecules composed entirely and takes the form of a hollow sphere or tube. They are

similar in structure of graphite, which includes carbon paper hexagonal rings, but they contain pentagonal rings or Seven, which enable the three-dimensional structures to be formed. Fluorine is produced in small quantities naturally in the fire, but it was noted for the first time in the soot caused by ablation of graphite with a laser [9, 10].

3. Nanotubes

Carbon nanotubes (CNT) is the particular form of the fullerene form, which is similar in structure to the carbon, but to form an elongated tubular structures, 1-2 nm in diameter. It can be produced in its simplest form, with very large proportions and can be 0.1 mm in length. In its simplest form, including nanotubes and a single layer of carbon atoms arranged in a cylinder, known as the single wall Carbon nanotubes as they can be, as several concentric tubes formed center (multi-wall carbon nanotubes) with diameters of up to 20 nm, and the length of 0.1 mm. Carbon nanotubes have a great tensile strength, and is considered to be 100 times stronger than steel, while being just one-sixth of its weight, making them potentially more powerful and smaller fibers known. And they also show a high conductivity, high space, a unique kind of electronic properties of molecular absorption and potentially high capacity. Applications that are currently being investigated include polymer compounds (conductive and structural filler), electromagnetic shielding, electron field emitters (flat panel displays), super capacitors, batteries, hydrogen storage materials and structural composite. A major focus of current research on nanotubes on the cobalt production rates even kilogram (or more) amounts because many applications require large quantities. As has been nanotubes of other materials, including the production of silicon and germanium.

4. Quantum Dots

Considered quantum dots one of the forms of the most famous of nanomaterial's, so named because the electrons which are enclosed in three dimensions (length, width and height), i.e., that quantum dots are Nanoscale nanomaterial's (hundreds of atoms only) enclosed materials have energy gap higher (and we mean here the energy needed by an electron gap card in order to be liberated from corn), this quantitative limitation of electrons in the three-dimensional earn these quantum dots Unique property in dealing with light effectively making it a perfect candidate to form a solar cell. The picture below micrograph point's quantum dots show atoms scattered on both sides of the quantum dots.

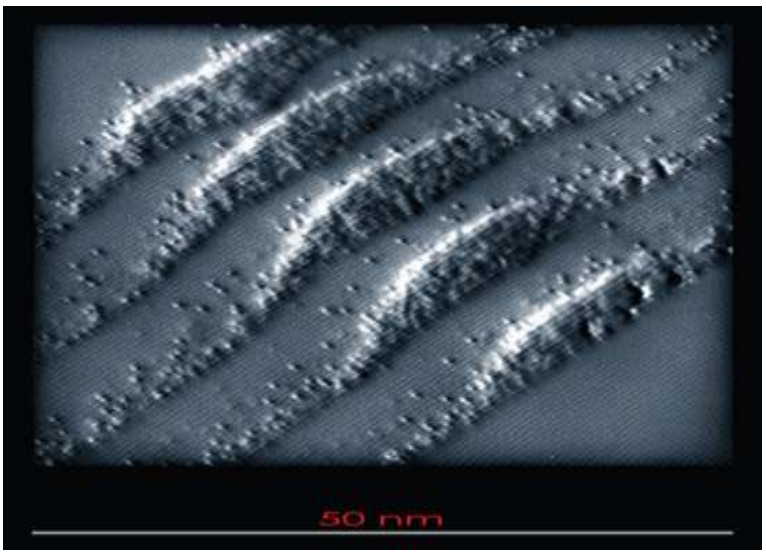

Figure 1: Quantum Dots

The Nano materials at the quantum dots possess high efficiency in converting light into electricity due to quantitative limitation for electrons and referred to earlier, which means that the photon and one could cause the release of more than electrons and therefore gives higher efficiency solar cell and figure below represents what is happening in the solar cell containing the amount of points was established method for the installation of quantum dots, semi-free impurity material, which caused discharge power is not useful, but rounded quantum dots treats the surface of quantum materials from impurity iodized materials, which lead to the reduction of the proportion of dopant

materials, which allow the production of electrons larger even It is co-opted, beside the material lead sulfide. While zinc oxide particles which ranges molecule diameter between 15-20 nm is responsible for the transfer of electrons and polarized to the outer electrons so that the outer electrons connected to an electrical circuit to generate electrical power in[7].When points absorbs a quantum of light from the sun, are issued electrons contain energy, to attract the electrons out of quantum dots to the circuit, which is the generation of energy, and that is not attracting the electrons, the electrons give energy to the ocean or the neighboring in thermal energy is useful, because the transfer of electrons from the quantum dots through the zinc oxide particles, and must be carefully installed zinc oxide particles so that there will not be impurity materials Working on electrons leaking .Improving the efficiency of solar cells using semiconductor quantum dots (QD) and one from the starting point to increase the efficiency of the con version of the solar cells is the use of semiconductor quantum dots (QD). Using quantum dots, the band gaps can be adjusted specifically for the conversion of light is also the longest wave, thus increasing the efficiency of solar cells. These solar cells are so-called quantum point is, at the present time are still subject to basic research. As physical systems for solar cells QD, semiconductors and other materials such as Si / Ge or C / T / C combinations were considered. The potential for these solar cells Si / Ge QD advantages are:
Higher absorption of light, particularly in the area spectral infrared, Compatibility with standard silicon solar cell production (in contrast to the third / V semiconductor) Increase the current image at higher temperatures.

Improve the radiation hardness compared to conventional solar cells. In versions of nanotechnology in the long term it should cost bellower, and the use of quantum dots, and should be able to reach higher levels of efficiency that traditional. Coat nanoparticles with quantum dots semiconductor crystals small connectors. Unlike traditional materials which one photon generates only one electron, quantum dots have the ability to high energy conversion. Quantum dots work the same way, but they produce three electrons for every photon from the sun's rays that strike points. Moving electrons from the valence band to the conduction band between the points also attract more of the spectra of sunlight waves, thus increasing conversion efficiency of up to 65 percent. The other area of quantum dots can be used is a creation of the so-called hot carrier cells. Usually additional power provided by photon loss in the form of heat, but with a hot energy carrier excess cells of photons leads to electrons higher energy, which in turn leads to a higher voltage and the transfer of electrons through the network of the particles is a major problem in higher efficiency to achieve convert the image in the pole nanostructured. Solar cells manufactured of quantum dots only includes simple existent devices in most laboratories in the world, so there is hope that this article nanoparticles tops in the field of solar energy and contribute to reducing our use of substances harmful to the environment, nanotechnology may be able to increase the efficiency of solar cells, but the application the most promise of nanotechnology is to reduce the manufacturing cost. Find out where chemists at the University of California, way to produce cheap plastic solar cells that can be painted on virtually any surface, events generated by these solar cells, the new plastic is only about 1.7%,These solar cells new plastic benefit from the tiny Nano rods are dispersed within a polymer, behave bars nanoparticles as wires because when the light-absorbing specific wavelength is generated by electrons long, flowing electrons through the bars of nanotechnology until it reaches an electrode made of aluminum which combine to form a stream and used as electricity , this type of cells with a manufacturing cost less than conventional cells for two main reasons; The first is that these plastic cells are not made of silicon, which can be expensive. Second, the manufacturing of these cells does not require expensive equipment such as chambers clean and vacuum chambers traditional silicon solar cells. Another possible advantage of these solar cells is that the Nano-rods can be adjusted or twelve tuned to absorb a variety of wavelengths of light, this can significantly increase the efficiency of the solar cell because it can be utilized more of the incident light There is research going on in order to put an end to the conflict existing between achieving high efficiency and low cost solar cells, where they are using colloidal quantum dots [11, 12]. They semiconductor particles in diameter does not exceed a few nanometers, these particles can be sprayed as a

commentator on large flexible substrates. And quantum dots represent a material system can be tuned with a high degree, where you can determine the band gap not only by selecting semiconductor material, but also by the particle size ,Any solar system seeks to achieve returns converting very high energy, it is necessary to collect from the sun efficiently large energy photons (blue) high-energy, and that is absorbed as well as photons (infrared) with a low-power, and through the solar devices composed of cells multi surfaces, any layers of light-electric cells have a Gaps different range and placed on top of each other, and will combine the capacity of each layer within the device or through an external circuit . Enable developing a solar-efficient cells, where it was put very thin membrane of nanoparticles silicon single nanometer size directly in the solar cell silicon, he found that it increases the production of electrical energy efficiency by 60% when the work of the cell in the in UV range of the solar spectrum. As possible to improve productivity in the range of visible light spectrum by 10%, using nanoparticles the size of 2nm.

IV. CONCLUSION

Nanotechnology is the second industrial revolution, social, economic and environmental benefits, and applications in the field of energy, particularly solar energy. After the rapid expansion of research and technological development, research is still in its early stages, the solar modules nanoparticles in the future may provide the benefits such as the flexibility reduce costs, generate clean energy and efficiency of 65%, compared to about 20 to 25% for the first generation, crystalline silicon PV cells based P managed to provide many and promising solutions, and we conclude from this study, the following results:

There is now an increasing interest and compete seriously about investing in the development of programs and of alternative energy technologies, particularly solar energy and embrace this green technology to become the main source of energy, particularly the Middle East and Central and North Africa.

Cost is an important factor in the success of solar technology.

Efficiency is a measure of the ability of a certain area of the solar cell (by be square meter) coming from the sun and convert it into electrical energy absorption of energy, and there are several types of efficiencies with different features of solar cells.

Properties of materials differ greatly when reduced to Nano scale size of the physical and chemical locality.

The advances potential in nanotechnology could open the door to the production of cheaper and more efficient solar cells, which helps in providing rural electricity or Third World regions.

Nanotechnology may be able to increase the efficiency of solar cells, but the most promising application of nanotechnology is to reduce the manufacturing cost.

Possibility of nanotechnology improve performance of solar cells dependent on semiconductors to become dependences and suitable for the generation of electrical energy from the sun's rays with high efficiency conversion.

Replacement of Nano-materials technology semiconductor solar cells from organic materials are cheap and with the highest efficiency.

Nano-materials energy saves about 220 Watt, the highest value of conventional solar cells.

Solar cell hybrids (combination of materials / polymer organic, blended with semiconducting inorganic materials) one of the alternative technologies to harness of solar energy into electrical energy to overcome the high cost of conventional solar cells.

Application of nanotechnology in solar cell hybrids has opened the door for the manufacture of a new class of high-performance devices.

adjustments could be made to the structure of the solar cell is also improvement of radiation rigidity, low mass, and improve the structural flexibilities for future devices, this nanotechnology could lead to the development of conformal, efficiency to more than 30%.

The Nano-rods could be synthesized or tuned to absorb a variety of wavelengths of light, this can

significantly increases the efficiency of the solar cell because it can be taken advantage more of the incident light.

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