

Use of the Solar Cell in Operation of Medical Device

Mohammed D. Salman ¹, Rafea Allawi Fayyadh ², Ahmed H. Ali ³,

Abstract

a study on the components of solar cells, their methods of work, defects and benefits from their use. She also studied how to take advantage of solar cells in medicine by supplying energy to medical devices. An emergency ambulance has been designed to operate on the solar energy, through solar panels placed over the vehicle. The cost has been calculated for the amount of electrical energy supplied by solar panels for two devices, the DC-Shock and the ECG.

Keywords : Solar Cell , Medical Device , emergency ambulance , solar panels .

1- Introduction:

In view of the great pollution that occurs in the last decades of the environment in most parts of the earth, and the serious effects of this pollution on human life on the surface of the earth and its natural environments, developed countries began to search for a long time for alternative sources of energy that are clean and environmentally friendly, so that they do not cause a negative impact Long-term on it. The harmful effects of fuel sources on the environment have become very widespread, which include diesel, gasoline and other oil derivatives, and this is what scientists called for using natural sources to produce energy in order to preserve the environment, and from these sources that are available throughout the solar hour, scientists have invented what is called B (solar cells) to produce electric energy depending on the sun's rays alone [1].

Its cost has witnessed a sharp decline since the eighties of the twentieth century, so that it became very low; in 1977 the cost of a single cell was more than a hundred times more than in 2013, which is one of the vast developments that made it a very popular source of energy in the recent period, [2] In the year 2015, the dependence of the world's population on solar energy reached 1% of all sources of energy production, which puts it at the forefront of the types of renewable energy currently (3).

^{1,3} Department of Medical Physics, College of Applied Science, University of Fallujah, Iraq

² Department of Ophthalmology, College of Medicine, University of Fallujah, Iraq

* Corresponding Author: dr.ahmedphysics@uofallujah.edu.iq

2- solar cell :

The solar cell is a machine whose function is to convert the energy present in the light rays into electrical energy that can be used to supply cities and industrial facilities with what they need. The vast majority of solar cells are now made of silicon, and the materials involved in their composition are constantly modified to increase their efficiency (their ability to produce energy relative to their area), as well as reduce the costs of their manufacture and distribution. Among the most important features that separate solar cells from others are energy stores, such as batteries and fossil fuel cells; they do not carry out any chemical reactions within them, and they do not need any amount of fuel to be able to produce electricity, which makes them very environmentally friendly, except Because of all this, it is distinguished from electric generators by not having any mechanical parts or to make noise [4].

3- The idea of working solar cell:

The principle of the work of the solar cells is to absorb the sun's rays and convert the solar energy into electrical energy that can be utilized through this process. In this case, the sun has played the role of the electric generators, amount of this energy reaches more than a thousand watts per square meter of open ground, and the solar panels attract this energy. Each solar energy panel contains a group of rows, and each row contains solar cells, and these panels are grouped into very large arrays to form the solar plants that supply cities and factories with energy in many parts of the world [5].

The solar cell is a semiconductor device with a simple structure, the function of which is to convert the photons in light rays into forms of energy that a person can benefit from, and the main way to do this conversion is to allow the solar cell to absorb photons and drop them onto a crystal surface consisting of a chemical component of one of the elements. The crystalline or crystalline property indicates that the atoms of this element are arranged at the molecular level in a very precise fixed pattern, and silicon is the most popular element for its use in this function because it has common properties between the minerals that conduct the electrolyte and the dielectric Cell formation [6].

When photons collide with the surface made of silicon, they lead to ionization of its atoms (an electrical charge is transferred to them), which leads to the release of some electrons from them, and therefore some crystal atoms remain with a positive charge, and the charge can transfer from the atom to the other atom of the atom The solar cell will produce it from light. This reaction can be simplified as it leads to the generation of electrical energy within the silicon once the sun's rays collide with it [7].

After that, the electrons inside the solar cell begin to move as a result of the acquisition of the electric charge, forming an electric field, and the electrons are released

from the silicon crystal (or whatever type of material is used in the solar cell industry) and accumulates in the form of electric energy that the solar cell sends to the transformer device . At this stage, electricity is produced in the case of the direct current (DC); it is electricity that can be produced chemically, and the examples are the electricity of the batteries, but it cannot be used and it is in its current form in the daily life matters of the person, and therefore it is necessary to use a special transformer to convert this electricity From the state of the direct current (DC) to the alternating current (AC), then the electric energy becomes ready to run homes and human installations [8].

The amount of energy produced depends on the size of the solar panel and its solar cells. In normal solar panels, on average, the production capacity of one plate is approximately 250 watts. The output capacity of one plate can be found from the (DATA SHEET) sheet, which is supplied with the panels when purchased from a commercial company, as in Figure 1.

Kunstocom		
Serial No.	TSP1211901041	TSE-80P
Max. Power	(Pmax)	80.49W
Open circuit voltage	(Voc)	21.80 V
Short Circuit Current	(Isc)	4.95 A
Voltage at Max. Power	(Vmp)	4.62 A
Current at Max. Current	(Imp)	17.44 V
Series Fuse Rating		12 A
Application Class Rating		Class A
Fire Rating		Class C
All the electrical characteristics value of Pmax,Voc and Isc are within $\pm 5\%$ tolerance of given values at the Standard Test Condition (STC) i.e., 25°C Temperature, 1000w/m ² Irradiance & 1.5 A.M. Modules Complies with the standards of IEC-61215, 61730, 61701 & Safety Class II		
Caution: To avoid the hazard of electric shock and injury, cover the entire from surface of the V modules with a dense, opaque material such as a cardboard sheet, during installation and handling of the modules. Warning: Photovoltaic modules can generate electricity upon exposure to light. The voltage of a single module is less than 45VDC, but the shock hazard increases as modules are connected in parallel producing higher current. The shock hazard increases as modules are connected in series producing higher voltages.		
(MADE IN INDIA)		

Figure 1: The data sheet attached to the solar cell plate

This type of production of clean energy from renewable sources has taken a great turn and has gained great importance among organizations and governments interested in preserving the cleanliness of the environment. And its production, and it is possible to know the economic feasibility of installing this system by knowing the recovery period

for it during which it will return its costs, the less this period, the more meaningful the project will be materially (9).

4- Manufacture of solar cells from simple raw materials:

Materials

The following components can be used:

- 1-Flakes of a semiconducting element: one carries a positive charge and the other has a negative charge, here it is worth noting that semiconducting materials are chemically treated before use. Usually, the main material for building a solar panel is crystallized silicon wafers, or they are mono or crystalline
2. Charge controller
- 3- Wires to transfer the electric current
- 4- Electric load or batteries to store energy.
- 5- An electrical reflector (to convert the current from alternating to alternating current).
- 6- A glass case in order to protect it from the surrounding atmospheric and external factors, such as animals.
- 7- Two pieces of polished glass of the same size.
- 8- A pencil.
- 9-Avometer (instrument for measuring voltage and electric current).
- 10- Transparent adhesive.

Preparation method: The following steps can be taken to create a solar panel.

1. The solar panel is fixed by affixing the glass panels with silicon wafers, and this requires the use of special materials.
2. The inverter is connected to the battery with a set of wires, so that the negative wires are connected to the negative poles and the reverse
3. The charge controller is connected to the battery on one side and to the solar panel on the other, by a set of wires.
4. Extra wires can be extended to connect the battery to specific devices inside the house.
5. The solar panel is placed outside where there is plenty of sunlight available, so that it can start working.

5- Mechanism of operation of solar cells:

When the solar cells are exposed to the sun's rays, the photons work to load their energy into the electrons in the electrode that the silicon leads to ionization, i.e. the acquisition of their atoms to an electrical charge, and then the electrons - which leave the charged atoms - between the electrodes move, creating an electric current through a continuous wire To a light bulb (for example) and to operate it [10].

6- Advantages and disadvantages of solar cells:

(The advantages):

- 1-The technologies used in this type of renewable energy are relatively simple when compared to the technologies used in other energy sources such as wind.
- 2- Solar energy is considered an environmentally safe source, as it is an environmentally friendly energy that does not create any form of air pollution, and that makes it conservative on the environment and environmental life in general.
- 3- It is considered a permanent source of energy, so it can only be destroyed when the world is destroyed.
- 4- It is not necessary to produce this energy using any type of fuel, which makes it a low-cost source.
- 5- This energy often does not need a lot of moving parts to produce it, as in Figure 2.



Figure 2. Solar cell in the medical physics laboratory

(The disadvantages) :

- 1-The efficiency of solar cells is only about 20%, and despite this, scientific studies and research and development processes on cells are still in place to raise the efficiency rate.
- 2- The high prices of the batteries used to store solar energy, and it is difficult to store this energy without losing large amounts of it.
- 3- The cost of building a solar system is almost expensive, but over long periods it is profitable to use this energy.
- 4- The lack of solar energy throughout the day, and the presence or absence of it changes with the change of seasons of the year, which makes this source unstable for many.
- 5- The high cost of the equipment that converts the thermal energy generated from the sun to electrical or electromagnetic energy, which makes it difficult for many to have such equipment.

7- 3D Solar cells:

3D solar cells that capture almost all the light that falls on them and can enhance the efficiency of PV systems while reducing their size, weight and mechanical sophistication. The new three-dimensional solar cells, created at the Georgia Institute of Technology Research, rely on capturing photons from sunlight using a set of miniature "constellations" structures that resemble tall buildings in the city street network. 3D Solar Cell plans to market these 3D cells, but the technology is currently patent pending as shown in Figure 3.



Figure 3. The 3D solar cell

8- Solar cells implanted under the skin can power pacemakers:

Solar technology is tested to see how effective it is when used in medical agriculture. The idea of these cells is to allow self-charging of the battery operated pacemaker device, and to avoid the risk of battery failure and the need for invasive electrical alternatives. This concept of this idea implies the use of solar cells placed under the skin to continuously recharge the implanted electronic medical devices [11] as shown in Figure 4.

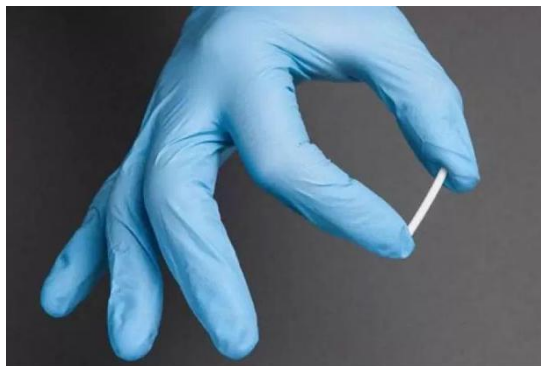


Figure 4. A solar cell implanted under the skin. [11]

And according to the pacemaker's need for electrical energy, we need a solar cell with an area of 3.6 square centimeters sufficient to generate electrical energy during all seasons of the year, to operate the standard Pacemaker pacemaker. In addition to pacemakers, there are devices designed to stimulate deeply through the brain. Deep brain stimulation is a neurosurgery procedure that involves implanting a medical device called Neurostimulator, aimed at sending electrical impulses to specific targets in the brain (brain nuclei) to treat movement disorders.

The main goal of this technology is to protect patients. Here, the idea of wearing solar cells generating energy under the skin will avoid the risk for patients undergoing invasive battery replacement procedures.

Most medical implants are a solar powered battery. The size of the battery depends on the size of the device, its function and the expected life of its work. Without these implants, and when the battery is drained, patients need to undergo implant replacement procedures [12].

The use of solar cells overcomes the need for replaceable batteries, with cells converting sunlight into usable energy. This process requires sunlight to penetrate the surface of the skin and the efficiency and amount of electrical energy generated depends on the amount of solar radiation penetrated into the skin and fall onto the surface of the solar chip implanted beneath it and found that regardless of the annual season, small cells can generate between 5 to 10 microns of energy, It is enough to charge the pacemaker [13].

9- Solar ambulance:

It is a vehicle equipped with solar panels on its surface that receive sunlight and convert it into electrical energy. This energy passes through circuits that control and regulate the electrical current in a way that suits the medical electrical devices inside the vehicle (these devices are necessary and important, some of which are used to save the lives of people who suffer from sudden cardiac arrest, "cardiac arrest") These devices meet very quickly the electric shock that restores the heart's activity and work. Regular) This device is called DC SHOCK.

There are many other devices that are required in this ambulance, including the ECG (electrocardiogram). To design the structure of the vehicle, it is necessary to search for lightweight, easy-to-shape and highly durable materials. The best of these materials are aluminum, fiberglass and light electronics and are very precisely tuned and work is under way to build them. Among the devices used in it are:

1-Dc shock:

It is a medical device used in the treatment of serious irregular heart rhythm disorders such as ventricular fibrillation and ventricular tachycardia and non-dangerous ones such as atrial flutter and atrial fibrillation by giving an electric shock that ends the disturbance in the transmission of the electrical badge in the heart

Defibrillator works to end the disturbances of the transmission of the electric emblem through the heart, by directing an electrical current higher than the current generated in the heart as shown in the electrocardiogram resulting from the action potential group generated in the cells of the heart muscle, so that it works to stop All random electrical badges in the heart, so that the heart returns electrically to the zero point, and the heart beats begin to emanate from the primitive pacemaker in the heart at best [14]. The device needs a power to operate 110 watts i.e. 240 volts volts and a current of 0.46 amps and the capacity (energy) coming out of the device 90 watts and constant voltage 18 volts and TIA 5 ampere as shown in Figure 5



Figure 5. DC shock device board

A glass panel was purchased at a cost of \$ 100 and its (its) capacity was 80 watts \pm 5 with a battery and adapter as in Figure 1 and 2. It has been operated and its efficiency is lower due to the power of the plate 80 watts, while the power of the device is 110 watts so we need the second plate to raise the power.

2- ECG (Electrocardiogram):

The ECG is used to measure the action potential of the heart. The ECG needs 48-45 watts of energy to operate, i.e. 240 volts and 0.2 amperes. As in Figure 6 and 7.



Figure 6. The ECG board



Figure 7. ECG device

conclusion:

A study on the work of the solar panel, its benefits and defects in its use, as it is a simple way to make a solar panel. In our research, we worked on an emergency ambulance containing solar powered devices. In this work the devices were the flickering device and the ECG. We need two solar panels to operate the two devices together with good capacity, i.e. the estimated cost of \$ 200.

References:

- 1- About solar energy technologies, Greenpeace International, Retrieved 29-10-2016.
- 2- Solar Power -- About Solar Power", Clean Technica, Retrieved 29-10-2016.
- 3-Solar Cell Electronics · S. Ashok Raymond T. Fonash Stephen Joseph Fonash
Retrieved 29-10-2016. ·Britannica
- 4-Solar Cell Electronics · S. Ashok Raymond T. Fonash Stephen Joseph Fonash-
Retrieved 29-10-2016. ·Britannica
- 5-JESSIKA TOOTHMAN & SCOTT ALDOUS , "How Solar Cells Work"
HowStuffWorks, Retrieved 29-10-2016.
- 6- How do solar cells work?, Physics.org, Retrieved 29-10-2016.
- 7-· Chemistry Explained·Solar Cells
- 8-How do solar cells work?, Physics.org, Retrieved 29-10-2016.
- 9- DIY: How to Make Your Own Solar Power Generator! Inhabitant,27-12-
2016Retrieved 11-11-2016.
- 10- 3D Solar Cells Boost Efficiency While Reducing Size, Weight and Complexity of
Photovoltaic Arrays (Press release). Georgia Institute of Technology. 2007-04-11.
.Retrieved 2010-11-26
- 11-A Sunny Past and Future: Georgia Tech Advances Solar Energy Research. Georgia
Tech Research Institute. Retrieved 2010-11-26
- 12-Here comes the sun. Georgia Tech Research
Institute. Retrieved 2010-11-26
- 13-Worlds first 3D solar cell is surprisingly efficient. Retrieved 2014-12-
- 17.External link in |publisher.
- 14- According to the recommendations of the European Rescue Council