الآيـــــــــــــــة

قـال تـعالـى:

بسم الـلـه الـرحمن الـرحيم

(قَالَ رَبِّ اشْرَحْ لِي صَدْرِي (25)
وَيَسِّرْ لِي أَمْرِي (26) وَاحْلُلْ
عُقْدَةً مِنْ لِسَانِي (27) يَفْقَهُوا
قَوْلِي (28))

صدق الـلـه الـعظيم

{ سورة طه }

DEDICATION

All praise to Allah, today we fold the days' tiredness and the errand summing up between the cover of this humble work.

To the utmost knowledge lighthouse, to our greatest and most honored prophet Mohamed - May peace and grace from Allah be upon him

To the spring that never stops giving, to my mother who weaves my happiness with strings from her merciful heart... to my mother

To whom he strives to bless comfort and welfare and never stints what he

owns to push me in the success way who taught me to promote life stairs wisely and patiently, to my dearest father

To whose love flows in my veins and my heart always remembers them, to my brothers, sisters and colleagues.

To those who taught us letters of gold and words of jewel of the utmost and sweetest sentences in the whole knowledge. Who reworded to us their knowledge simply and from their thoughts made a lighthouse guides us through the knowledge and success path, To our honored teachers and professors

Acknowledgement

Praise be to Allah.. Praise fill the heavens and the earth and their Praise be to Allah, praise be to Lord of the Worlds thank him, and gave the good creation of God our Lord and our Prophet Mohammed bin Abdullah and his family and companions peace and recognition of much good and I thank God that guided me and helped me to get that work done,and seeking to benefit from this study

My thanks to Dr. Rawia Abdelgani Did not skimp of what is bestowed by God from science.

And Praise be to Allah the Lord of the Worlds

ABSTRACT

The study the effect of laser light of helium-neon (He – Ne) on the electric characteristics and the performance of Si - solar cell. A He – Ne laser light of (λ = 632.8 nm) wavelength and (1.5mW) power has been used to irradiate the solar cells by continuous wave mode (cw) at different periods of time of irradiation. Measurements of I–V at experimental solar radiation intensity of (0.055W/cm2) have been made at room temperature. In these measurements the short circuit current (I_{sc}), the open circuit voltage (V_{oc}), and the fill factor (FF) have been studied, and then the efficiency of the solar cell has been found. The results have shown that the solar cells irradiation by the continuous laser light led to inconsistent increase in the values of cell performance parameters, i.e. The increase in the cell efficiency as the time of irradiation increases.

المستخلص

درس تأثير ضوء ليزر (هليوم – نيون) على الخواص الكهربائيه للخلايا الشمسيه السليكونيه وأدائها. حيث تم استخدام ضوء ليز ذو طول موجي (λ = 632.8 nm) وقدرة (1.5mW) لغرض تشعيع الخلايا الشمسيه بأستخدام أسلوب التشعيع المستمر وبأزمان مختلفه . وقد أجريت قياسات عند شدة اشعاع شمسي مختبري مقداره (0.055W/cm2) وعند درجة حرارة الغرفه (220 C) . ومن هذه القياسات تم دراسة كل من تيار الدائره القصيرة (Isc) وفولتية الدائرة المفتوحة (Voc) وعامل الملء (FF) ومن ثم إيجاد كفاءة الخلية الشمسية. وقد أوضحت النتائج إن تشعيع نماذج الخلايا الشمسية بضوء ليزر He – Ne بالأسلوب المستمر أدي إلى زيادة متغيرة في قيم معالم خرج الخلية , إذا أزدادت كفاءة الخلية الشمسية مع زيادة زمن التشعيع.

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Chapter One

1.1 Introduction

This study include the solar cell, a solar cell is an electronic device that produces electricity when light falls on it. The light is absorbed and the cell produces dc voltage and current. The device has a positive and a negative contact between which the voltage is generated and through which the current can flow. We connect these contacts to whatever it is you want to power. Solar cells have no moving parts. Effectively they take light energy and convert it into electrical energy in an electrical circuit, exploiting a physical process known as the photovoltaic effect. And include the history of solar cell , its applications ,its types , its components, its Operation and advantage and disadvantage of solar cells .

Laser light different from an ordinary light (the “white” light produced by an ordinary flashlight contains many different light rays of different wavelength that are out of step with one another (scientifically, that’s known as “incoherent”). But in a laser, all the light rays have the same wavelength and they are coherent (absolutely in step).

The effect of laser light of helium-neon (He – Ne) on the electric characteristics and the performance of Si - solar cell. A He – Ne laser light of (λ = 632.8 nm) wavelength and (1.5mW) power has been used to irradiate the solar cells by continuous wave mode (cw) at different periods of time of irradiation. Measurements of I–V at experimental solar radiation intensity of (0.055W/cm2) have been made at room temperature. In these measurements the short circuit current (Isc), the open circuit voltage (Voc), and the fill factor (FF) have been studied, and then the efficiency of the solar cell has been found. The results have shown that the solar cells irradiation by the continuous laser light led to inconsistent increase in the values 1 l performance parameters, i.e. The increase in the cell efficiency as the time of irradiation increases.

In this study we used silicon solar cell (ALROIYA TEADIMG) made in Germany, its efficient (η) is 12.55 %.and why we used silicon solar cell and laser helium-neon. Its gas laser, the device of laser was used in this study is from KANGXING LASER made in china. Emits light on the wavelength 632.8 and power is 1.5 mW and the laser work by continuous mode.

1.2 Objectives of the Study

To study the voltage and current of the cell irradiation by He-Ne laser.

Calculation the efficiency of the cell when irradiation by He-Ne laser .

Knowing the ratio of the filling factor of the cell.

1.3 Thesis Lay Out

This thesis contains five chapters: the first chapter is Introduction and second Chapter includes solar cell the third chapter contains the laser light fourth chapter is Experimental work and five chapter is result and discussion.

Chapter Two

2

Solar Cells

2.1 Introduction

A solar cell, or photovoltaic cell, is a semiconductor device consisting of a large-area p-n junction diode, which, in the presence of sunlight is capable of generating usable electrical energy. This conversion is called the photovoltaic effect. The field of research related to solar cells is known as photovoltaic [1].

The discovery of the photovoltaic effect is credited to the French physicist, Edmond Becquerel, in 1839. He found that by concentrating the sun's light on one side of a battery the output current of the battery could be increased. This revolutionary discovery triggered the idea that one could produce energy from light by an artificial process. In 1883 an American inventor produced a solar cell from a material called selenium, but it was very inefficient. Selenium became used in light-exposure meters for cameras, but not for power production.

It was not until the 1950s that practical solar cells were developed. In 1948 the transistor was invented, at Bell Laboratories in the United States, and it was found that the same high quality silicon wafers used for making transistors could be used to make solar cells. This work was published in 1954. From 1958 onwards the cells were employed in the space race. Solar cells are still the only sensible source of electrical power for space satellites, because they are in effect batteries that never run out [2].

2.2 Applications Of Solar Cells

Solar cells have many applications. They are particularly well suited to, and historically used in situations where electrical power from the grid is unavailable, such as in remote area p 3 ystems, Earth orbiting satellites, handheld calculators, remote radiotelephones, water pumping applications [1].

2.3 The Type of Solar Cells

The following are the different types of solar cells.

- Amorphous Silicon solar cell (a-Si)
- Biohybrid solar cell
- Buried contact solar cell
- Cadmium telluride solar cell (CdTe)
- Concentrated PV cell (CVP and HCVP)
- Copper indium gallium selenide solar cells (CI(G)S)
- Crystalline silicon solar cell (c-Si)
- Dye-sensitized solar cell (DSSC)
- Gallium arsenide germanium solar cell (GaAs)
- Hybrid solar cell
- Luminescent solar concentrator cell (LSC)
- Micro morph (tandem-cell using a-Si/μc-Si)
- Monocrystalline solar cell (mono-Si)
- Multi-junction solar cell (MJ)

- Nanocrystal solar cell
- Organic solar cell (OPV)
- Perovskite solar cell
- Photoelectrochemical cell (PEC)
- Plasmatic solar cell
- Plastic solar cell
- Polycrystalline solar cell (multi-Si)
- Polymer solar cell
- Quantum dot solar cell 4
- Solid-state solar cell
- Thin-film solar cell (TFSC)
- Wafer solar cell, or wafer-based solar cell (synonym for crystalline silicon solar cell [3].

2.4 Components to Photovoltaic Cells

1) Photovoltaic Effect: PV cells are able to create electricity at the atomic level using the photovoltaic effect. Often the photovoltaic effect is confused with the photoelectric effect. One is related to the other as both begin with the basic understanding that the universe is created of two core entities: matter and energy. Matter is anything that has mass and takes up space. In physics energy is defined as a source providing the ability to do work (e.g. light, heat, sound, electricity). In the photoelectric effect, there are two components: photons (energy) and electrons (matter). Photons are light “packets”. Each one carries a specific quantity (quanta) of energy revealed in different frequencies of light (higher energy photons are found in higher frequencies of light waves). Using the correct light frequency (photons) focused on a material (usually metal), it is possible to knock off or release electrons. So, the photoelectric effect uses light to eject electrons. Similarly, in the photovoltaic effect photons are used to

eject the electrons, but these electrons are harnessed to produce an electric current or electricity.

2) Semi-Conductor: The flow of electrons or an electric current is possible within the photovoltaic effect if a conductor is present. Electricity is conducted through a material by moving electrons through orbitals at varying energy levels in atoms. Electrons move from lower energy levels (valance band) to higher energy levels (conduction band). The energy difference between these levels is known as the band gap. Semi-conductors have an intermediate band gap. Meaning they require more energy to move electrons than a conductor, but less than an insulator. Once electrons are moved they create electron "holes" or unoccupied orbitals in the valance band and easily released electrons in the conduction band. In PV cells, semi-conductors are often used because they can regulate conduction band electrons and electron "holes" more readily, especially if the semi-conductor is "doped" or impurities are added.

3) P-N Junction (Photodiode): The photovoltaic effect within a PV cell is able to produce an electric current by using a P-N junction. The P-N Junction is made of two kinds of semi-conductors. The N-type (N for Negative or electron-rich) is doped to have a high density of electrons and few holes, while the P-type (P for Positive or electron-poor) is doped to be the opposite. Electrons flow from areas of high to low concentration. The difference between these concentrated areas is known as voltage. A P-N junction regulates the voltage, so current only flows in one direction resulting in an electric current [3].

2.5 Operation of Photovoltaic Cells (Solar Cells)

PV Cells are able to convert light into electricity by first allowing radiant energy from the sun to pass through a transparent layer (glass). A small portion of the light frequencies (10 – 17% with technology commercially available in 2011) (photons) are absorbed ejecting electrons from the doped N-type semiconductor layer. The amount depends on intensity and angle of light sent and the continuing development of the manufacturing technology. These electrons are passed to a conductor, which completes a circuit back to the P-type semiconducting layer. After transporting electrical energy utilized by electrical devices or stored in batteries, the electrons will fill “holes” in the P-type semiconducting layer. Due to electrons being deposited in P-type semiconductor layer the voltage increases forcing the electrons to move across the junction into the N-type semiconductor allowing the process to repeat itself. As technology advances, improvements in conversion efficiencies demonstrated in the laboratory (some approaching 40%) ma become commercially available, subsequently lowering costs.

2.6 Advantages

- Electricity produced by solar cells is clean and silent. Because they do not use fuel other than sunshine, PV systems do not release any harmful air or water pollution into the environment, deplete natural resources, or endanger animal or human health.
- Photovoltaic systems are quiet and visually unobtrusive.
- Small-scale solar plants can take advantage of unused space on rooftops of existing buildings.
- PV cells were originally developed for use in space, where repair is extremely expensive, if not impossible. PV still powers nearly every satellite circling the earth because it operates reliably for long periods of time with virtually no maintenance.
- Solar energy is a locally available renewable resource. It does not need to be imported from other regions of the country or across the world. This reduces environmental impacts associated with transportation and also reduces our dependence on imported oil. And, unlike fuels that are mined

and harvested, when we use solar energy to produce electricity we do not deplete or alter the resource.

- A PV system can be constructed to any size based on energy requirements. Furthermore, the owner of a PV system can enlarge or move it if his or her energy needs change. For instance, homeowners can add modules every few years as their energy usage and financial resources grow. Ranchers can use mobile trailer-mounted pumping systems to water cattle as the cattle are rotated to different fields [4].

2.7 Disadvantages

- Some toxic chemicals, like cadmium and arsenic, are used in the PV production process. These environmental impacts are minor and can be easily controlled through recycling and proper disposal.
- Solar energy is somewhat more expensive to produce than conventional sources of energy due in part to the cost of manufacturing PV devices and in part to the conversion efficiencies of the equipment. As the conversion efficiencies continue to increase and the manufacturing costs continue to come down, PV will become increasingly cost competitive with conventional fuels.
- Solar power is a variable energy source, with energy production dependent on the sun. Solar facilities may produce no power at all some of the time, which could lead to an energy shortage if too much of a region's power comes from solar power [4].

2.8 Crystalline Silicon Solar Cells

Crystalline silicon solar cells have dominated the photovoltaic market since the very beginning in the 1950"s. Silicon is non-toxic and abundantly available in the earth crust, silicon PV modules have shown their long –term stability over decades in practice. The price reduction of silicon modules in the last 30 years can be described very well by a learning factor of 20%. i.e. doubling the cumulated module capacity results in a reduction of module prices by 20%, Production has exploded in the last years, reaching a new record value of more than 20 GWp in 2010. To extend the success story of this photovoltaic working horse, it is important to further bring down the costs.

The cost distribution of a crystalline silicon PV module is clearly dominated by material costs, especially by the cost of the silicon wafer therefore besides improved production technology, the 8 ency of the cells and modules is the main leverage to bring down the costs even more. This chapter describes the state-of –the –art process for silicon solar cells and gives insight into advanced processes and designs.

Crystalline silicon solar cells and modules have dominated photovoltaic (PV) technology from the beginning. They constitute more than 85% of the PV market today, and although their decline in favor of other technologies has been announced a number of times, they presumably will retain their leading role for a time, at least for the next decade. One of the reasons for crystalline silicon to be dominant in photovoltaics is the fact that microelectronics has developed silicon technology greatly. On the one hand, not only has the PV community benefited from the accumulated knowledge but also silicon feedstock and second-hand equipment have been acquired at reasonable prices. On the other hand, Microelectronics has taken advantage of some innovations and developments proposed in Photovoltaic. For several decades, the terrestrial PV market has been dominated by p-type Czo chralski silicon substrates. Continuous improvements in performance, yields and reliability have allowed an important cost reduction and the subsequent expansion of the PV market. Because of the lower cost of mc-Si wafers, multi crystalline (MC) silicon cells emerged in the 1980s as an alternative to single-crystal ones. However, their lower quality precluded the achievement of similar efficiencies to those of Cz, so that the figure of merit $ W−1 has been quite similar for both technologies over a long time.

Deeper understanding of the physics and optics of the mc-Si material led to improved device design, which allowed a wider spread of the technology. A combination [5].

2.9 Properties Of Crystalline Silicon

Crystalline silicon has a fundamental indirect band gap EG = 1.17 eV and a direct gap above 3 eV at ambient temperature. These characteristics determine the variation of optical properties of Si with wavelength, including the low absorption coefficient for carrier generation for near band gap photons]. At short ultraviolet (UV) wavelengths in the solar spectrum, the generation of two electron–hole pairs by one photon seems possible, though quantitatively this is a small effect; at the other extreme of the spectrum parasitic free-carrier absorption competes with band-to-band generation. The intrinsic concentration is another important parameter related to the band structure; it links carrier disequilibrium with voltage.

At high carrier densities, doping- or excitation-induced, the band structure is altered leading to an increase in the effective intrinsic concentration: this is one of the so-called heavy doping effects that degrade the PV quality of highly doped regions [5].

Chapter There

Laser light

3.1 Introduction

A laser is adevice that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. A laser differs from other sources of light in that it emits light coherently. Spatial coherence allows a laser to be focused to a tight spot, enabling applications such as laser cutting and lithography. Spatial coherence also allows a laser beam to stay narrow over great distances (collimation), enabling applications such as laser pointers. Lasers can also have high temporal, which allows them to emit light with a very narrow spectrum, i.e., they can emit a single color of light. Temporal coherence can be used to produce pulses of light as short as a femtosecond.

Among their many applications, lasers are used in optical disk drives, laser printers, and barcode scanners, DNA sequencing instruments, fiberoptic and free-space optical communication; laser surgery and skin treatments, cutting and welding materials, military and law enforcement devices for marking targets and measuring range and speed, and laser lighting displays in entertainment [6].

3.2 History of Laser

- In 1957, Charles Hard Townes and Arthur Leonard Schawlow, then at Bell Labs, began a serious study of the infrared laser. As ideas developed, they abandoned infrared radiation to instead concentrate upon visible light. The concept originally was called an "optical maser". In 1958, Bell Labs filed a patent application for th 11 oposed optical maser; and Schawlow and Townes submitted a manuscript of their theoretical calculations to the Physical Review, published that year in Volume 112.
- Gordon Gould coined the LASER acronym, and described the elements for constructing the device.

  Simultaneously, at Columbia University, graduate student Gordon Gould was working on a doctoral thesis about the energy levels of excited thallium. When Gould and Townes met, they spoke of radiation emission, as a general subject, afterwards, in November 1957, Gould noted his ideas for a "laser", including using an open resonator (later an essential laser-device component). Moreover, in 1958, Prokhorov independently proposed using an open resonator, the first published appearance (in the USSR) of this idea. Elsewhere, in the U.S., Schawlow and Townes had agreed to an open-resonator laser design – apparently unaware of Prokhorov's publications and Gould's unpublished laser work.

- At a conference in 1959, Gordon Gould published the term LASER in the paper The LASER, Light Amplification by Stimulated Emission of

Radiation.[1][6] Gould's linguistic intention was using the "-aser" word particle as a suffix – to accurately denote the spectrum of the light emitted by the LASER device; thus x-rays: xaser, ultraviolet: uvaser, et cetera; none established itself as a discrete term, although "raser" was briefly popular for denoting radio-frequency-emitting devices.

- Gould's notes included possible applications for a laser, such as spectrometry, interferometry, radar, and nuclear fusion. He continued developing the idea, and filed a patent application in April 1959. The U.S. Patent Office denied his application, and awarded a patent to Bell Labs, in 1960. That provoked a twenty-eight-year lawsuit, featuring scientific prestige and money as the sta 12 Gould won his first minor patent in 1977, yet it was not until 1987 that he won the first significant patent lawsuit victory, when a Federal judge ordered the U.S. Patent Office to issue patents to Gould for the optically pumped and the gas discharge laser devices. The question of just how to assign credit for inventing the laser remains unresolved by historians.
- On May 16, 1960, Theodore H. Maiman operated the first functioning laser at Hughes Research Laboratories, Malibu, California, ahead of several research teams, including those of Townes, at Columbia University, Arthur Schawlow, at Bell Labs, and Gould, at the TRG (Technical Research Group) company. Maiman's functional laser used a solid-state flashlamp-pumped synthetic ruby crystal to produce red laser light, at 694 nanometers wavelength; however, the device only was capable of pulsed operation, because of its three-level pumping design scheme. Later that year, the Iranian physicist Ali Javan, and William R. Bennett, and Donald Herriott, constructed the first gas laser, using helium and neon that was capable of continuous operation in the infrared (U.S. Patent 3,149,290); later, Javan received the Albert Einstein Award in

1993. Basov and Javan proposed the semiconductor laser diode concept. In 1962, Robert N. Hall demonstrated the first laser diode device, made of gallium arsenide and emitted at 850 nm the near-infrared band of the spectrum. Later that year, Nick Holonyak, Jr. demonstrated the first semiconductor laser with a visible emission. This first semiconductor laser could only be used in pulsed-beam operation, and when cooled to liquid nitrogen temperatures (77 K). In 1970, Zhores Alferov, in the USSR, and Izuo Hayashi and Morton Panish of Bell Telephone Laboratories also independently developed room-temperature, continual-operation diode lasers, using the heterojunction structure .

3.3 Recent Innovations

Since the early period of laser history, laser research has produced a variety of improved and specialized laser types, optimized for different performance goals, including:

- new wavelength bands
- maximum average output power
- maximum peak pulse energy
- maximum peak pulse power
- minimum output pulse duration
- maximum power efficiency
- minimum cost

And this research continues to this day.

was discovered in 1992 in sodium gas and again in 1995 in rubidium gas by various international teams. This was accomplished by using an external maser to induce "optical transparency" in the medium by introducing and destructively interfering the ground electron transitions between two paths, so that the likelihood for the ground electrons to absorb any energy has been cancelled [7].

3.4 The Types Of Laser

There are many types of lasers available for research, medical, industrial, and commercial uses. Lasers are often described by the kind of lasing medium they use - solid state, gas, excimer, dye, or semiconductor

- ✓ **Solid state** lasers have lasing material distributed in a solid matrix, e.g., the ruby or neodymium-YAG (yttrium aluminum garnet) lasers. The neodymium-YAG laser emits infrared light at 1.064 micrometers.

- ✓ **Gas** lasers (helium and helium 14 , He-Ne, are the most common gas lasers) have a primary output of a visible red light. CO2 lasers emit energy in the far-infrared, 10.6 micrometers, and are used for cutting hard materials.

- ✓ **Excimer** lasers (the name is derived from the terms excited and dimers) use reactive gases such as chlorine and fluorine mixed with inert gases such as argon, krypton, or xenon. When electrically stimulated, a pseudomolecule or dimer is produced and when lased, produces light in the ultraviolet range.

- ✓ **Dye** lasers use complex organic dyes like rhodamine 6G in liquid solutions or suspension as lasing media. They are tunable over a broad range of wavelengths.

- ✓ **Semiconductor** lasers, sometimes called diode lasers, are not solid-state lasers. These electronic devices are generally very small and use low power. They may be built into larger arrays, e.g., the writing source in some laser printers or compact disk players [6].

The acronym LASER stands for "Light Amplification through Stimulated Emission of Radiation". It has also become standard to refer to the device itself as a laser. The light emitted by a laser has very special properties which distinguish it from the light given off by an ordinary source of electromagnetic radiation, such as a light -bulb. These special properties make it possible to use lasers for very unusual purposes for which ordinary, even nearly - monochromatic light is not suitable.

3.5 Proprties of Laser Light [15]

A. The light is extremely monochromatic with wavelength l= 632.8 nm

B. Consequently, the light has high "temporal coherence", meaning as you travel Along the direction of propagation, the components of the electric field continue to oscillate like a sine-wave with a single wavelength, amplitude, and phase. Of course, no light source generates perfect plane-waves. Real wave-trains have finite length. The distance over which the waveform remains similar to a sine-wave is called the coherence-length of the beam, Lc, and it is typically about 10-30 cm for commercial He-Ne lasers.

C. The light is unidirectional and aligned so as to be parallel to the body of the laser.

D. The light is "spatially coherent". The phase of radiation is nearly constant throughout the cross-sectional width of the beam. This property is a consequence of property C, and is entirely independent of temporal coherence (property B).

E. A Brewster-window is often inserted in the laser by the manufacturer to produce light with a definite state of linear polarization.

3.6 Helium-Neon lasers

Helium-Neon laser is a type of gas laser in which a mixture of helium and neon gas is used as a gain medium. Helium-Neon laser is also known as He-Ne laser.A gas laser is a type of laser in which a mixture of gas is used as the active medium or laser medium. Gas lasers are the most widely used lasers.Gas lasers range from the low power helium-neon lasers to the very high power carbon dioxide lasers. The helium-neon lasers are most commonly used in college laboratories whereas the carbon 16 ide lasers are used in industrial applications.The main advantage of gas lasers (eg: He-Ne lasers) over solid state lasers is that they are less prone to damage by overheating so they can be run continuously.

At room temperature, a ruby laser will only emit short bursts of laser light, each laser pulse occurring after a flash of the pumping light. It would be better to have a laser that emits light continuously. Such a laser is called a continuous wave (CW) laser.

The helium-neon laser was the first continuous wave (CW) laser ever constructed. It was built in 1961 by Ali Javan, Bennett, and Herriott at Bell Telephone Laboratories.

Helium-neon lasers are the most widely used gas lasers. These lasers have many industrial and scientific uses and are often used in laboratory demonstrations of optics.

In He-Ne lasers, the optical pumping method are not used instead an electrical pumping method is used. The excitation of electrons in the He-Ne gas active medium is achieved by passing an electric current through the gas.

The helium-neon laser operates at a wavelength of 632.8 nanometers (nm), in the red portion of the visible spectrum.

3.7 Helium-Neon Laser Construction

The helium-neon laser consists of three essential components:

- Pump source (high voltage power supply)
- Gain medium (laser glass tube or discharge glass tube)
- Resonating cavity [8].

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3.8 The Lasing Mechanism

A He-Ne laser consists of a hollow tube filled with 90 percent He and 10 Percent Ne gases and fitted with inward -facing mirrors at the ends of the cavity. The combined pressure of the two gases is approximately 1 Torr (1/760 Atmospheres).

And He-Ne laser works by exciting Neon atoms in the gas. The 632.8 nm Optical light emitted by the laser is generated in the process when the Neon atoms decay from an excited state to an ordinary state.

Chapter fourth

Experimental work

4.1 Introduction

To procedure scientific measurement to study Electrical properties of solar cell we need lab solar light from tungsten light source fixed in vertical shape in intensity (0.055 $W.cm^2$) . On certain distance placed the solar cell and connect to electrical circuit to study properties of solar cell that shown in figure (1)

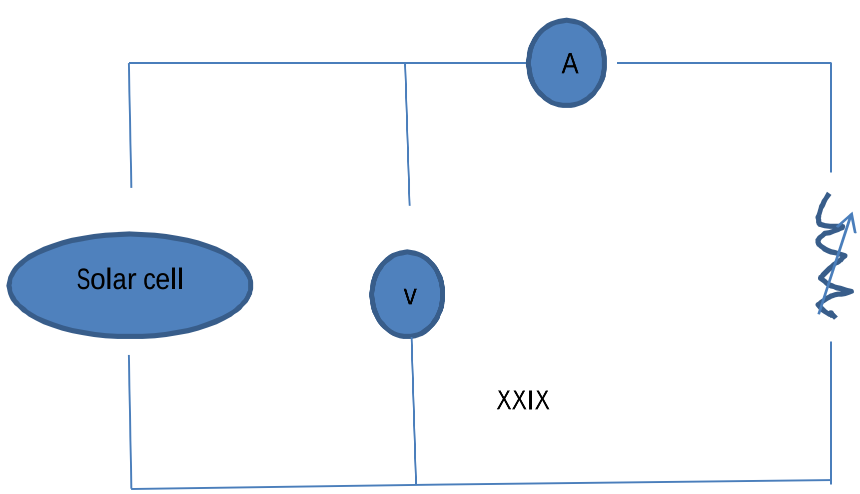

Figure (4.1) Electrical circuit to study properties of the current –voltage for solar cell of sort silicon

The ammeter was used in this study from KEITHLEY Company (642 electrometer) and the voltmeter from KEITHLEY company also (177 micro voltmeter).

4.2 Equipment Used

The solar cell put in front of the packet of light laser on suitable distance (10 cm). The irradiation for different time (10, 20, 30, 40, and 50) minutes respectively on temperature (22˚c).

4.3 Theory

We know the efficiency of solar cell is the ratio of large power that outsides from the cell to the total power for light enter the cell. To calculate this efficiency record measurement of the current and the voltage, from this measurement we will study three variables that outsides from solar cell to study it performance. These variables are short current circuit (Isc) which is the outside current from cell and the second variable is open circuit voltage (V_{OC}) which is the outside voltage from cell. The third variable is full factor (FF) knows by equation (1)

$$FF = I_{max} * V_{max} \;/\; I_{SC} * V_{OC} \qquad (4\text{-}1)$$

Where that:

$P = V\,I$ (4-2)

P: That is the large outside power from the solar cell.

But the efficiency of transform power (η) given by the low:

$\eta = J_{SC} * FF * V_{OC} / P_{in}$ (4-3)

Where:

P_{in} : is the total power that enter the cell and equal 0.055W/cm2

And:

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$J_{SC} = I_{SC} / A$ (4-4)

J_{SC}: is density of current

Where (A) area of solar cell is equal 256cm

Chap 21 Five

5.1 Result and Discussion

For the purpose of knowing the true performance of the solar cell was used we took the measurements of current and voltage before irradiation He –Ne laser shown in figure (2) These measurements were taken from the resistance change. And from figure (2) can found variables upon which the performance of the solar cell and that is determine by short current circuit (I_{SC}) and open circuit voltage (V_{OC}) and full factor (FF) and from these can calculate efficiency of transform power to the cell, we have found the scientific value of the I_{SC} =14.73mA and V_{OC} =0.126V for this model. When we use the equation (1) we obtained the value of the fulling factor and the amount of FF = 0.93, the efficiency of the cell calculated from equation (3) it was found that the amount of (η=12.55) when the intensity of the radiation within the (0.055).

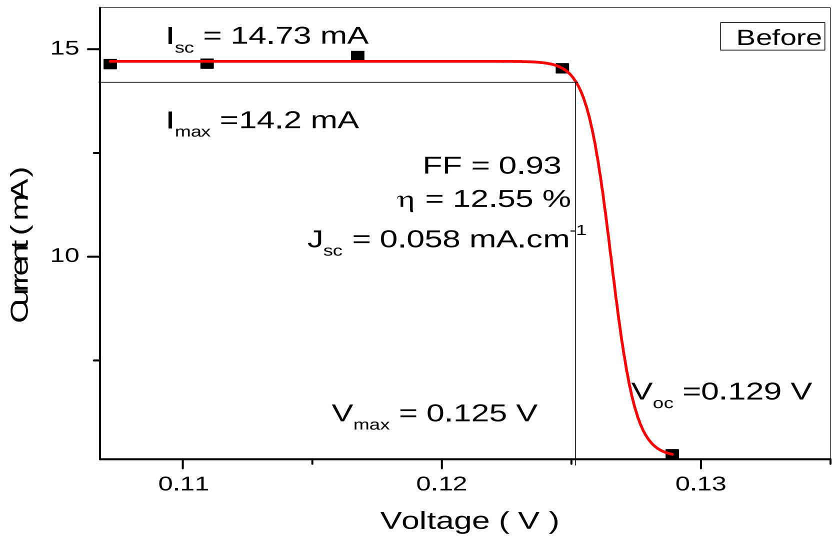


Figure (5.1) Current - Voltage properties of the solar cell before laser light irradiation

From study the properties of the curı 22 nd voltage of the solar cell after the irradiated by He-Ne laser by continuous mode for different periods of time (10, 20, 30, 40 and 50) minutes respectively shown in figure (3, 4, 5, 6 and 7) and table (1) we have noticed that there are increasing in the value of the cell parameters came out with increased irradiation time. The value of efficiency of the cell was increasing from 12.55% before the irradiate to 12.79% after passing 10 minutes from irradiation by light of laser. While we found that with increasing irradiation time to 50 minutes, the value of efficiency of the cell increase to 14.05%, we also note an increase in the value of the fulling factor from 0.93 to 0.97 before irradiation after 50 minutes passed from the time of irradiation.

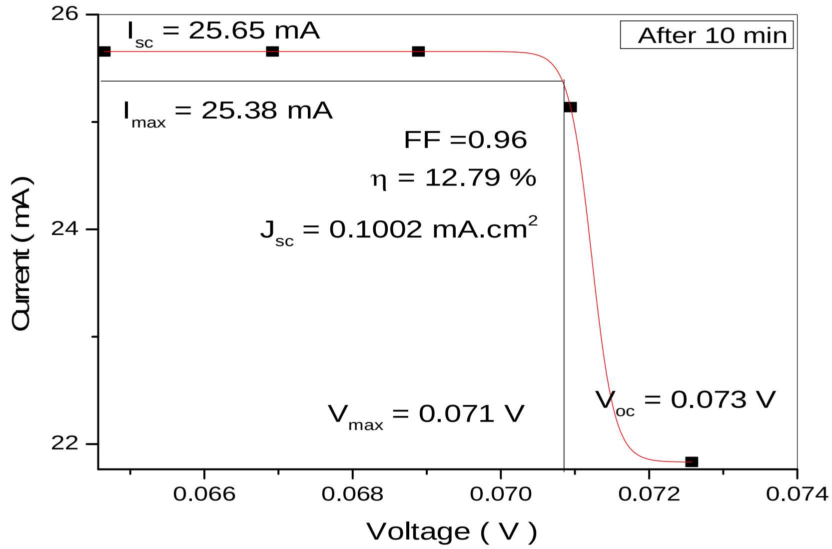
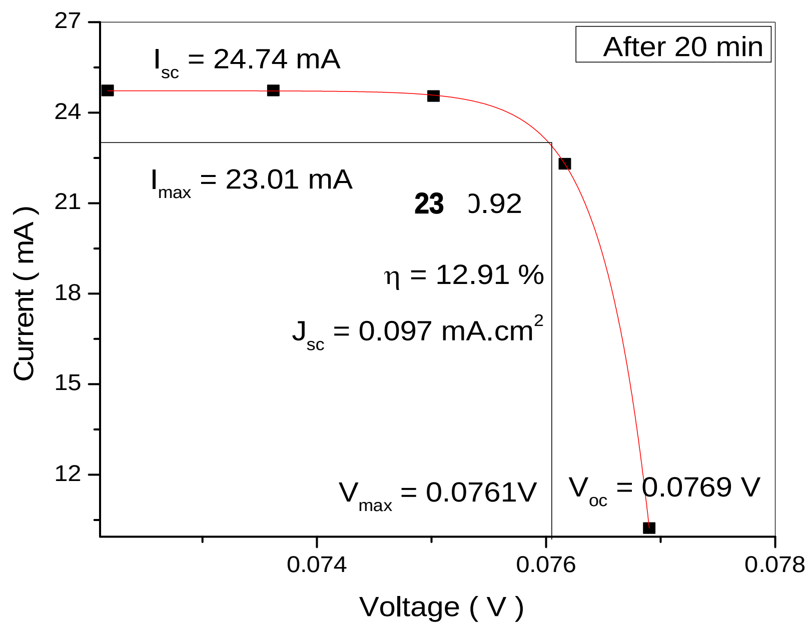
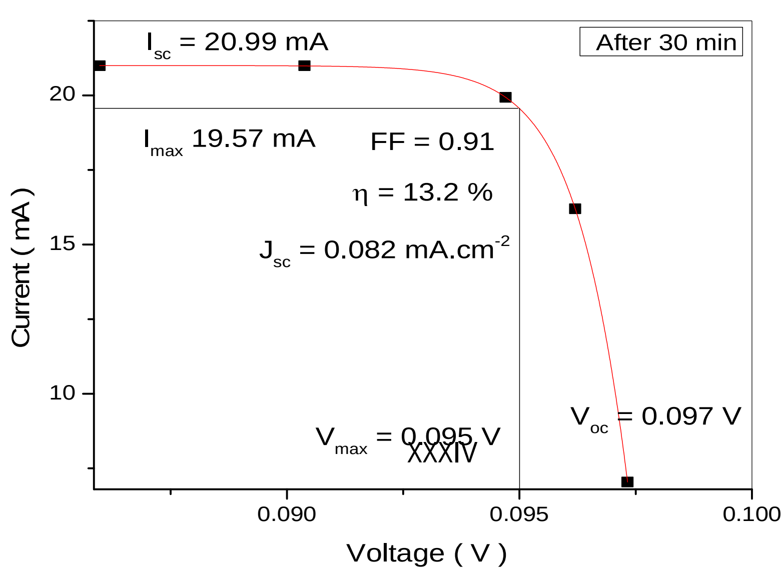


Figure (5.2)Properties of current – voltage for solar cell after 10(minutes) for irradiated by laser light He – Ne by continuous modes





Figure

(5.3)Properties of current – voltage for solar cell after 20(minutes) for irradiated by laser light He – Ne by continuous modes

Figure (5.4)Properties of current – voltage for solar cell after 30(minutes) for irradiated by laser light He – Ne by continuous modes

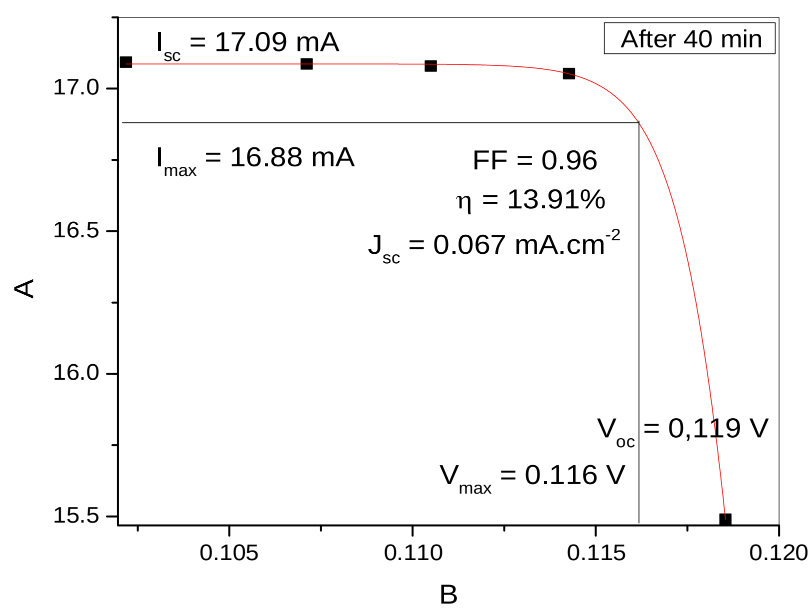


Figure (5.5)Properties of current – voltage for solar cell after 40(minutes) for irradiated by laser light He – Ne by continuous modes

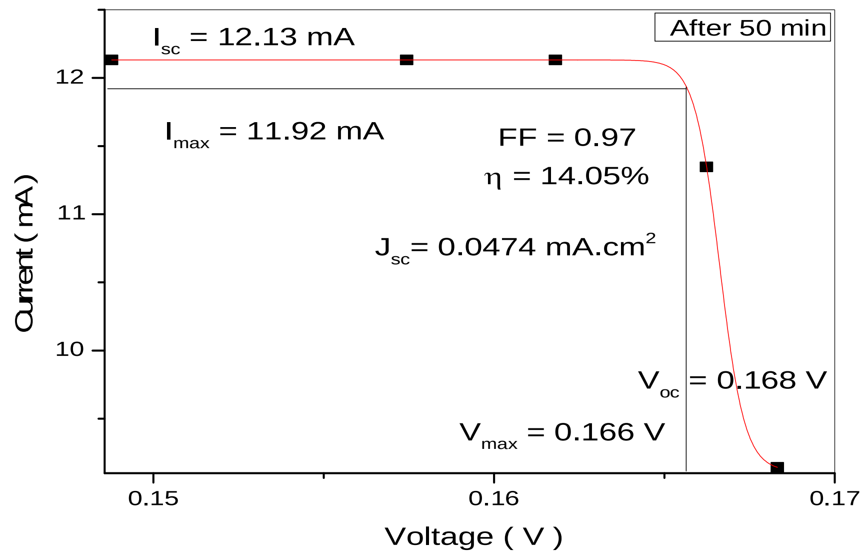


Figure (5.6)Properties of current – voltage for solar cell after 50(minutes) for irradiated by laser light He – Ne by continuous modes

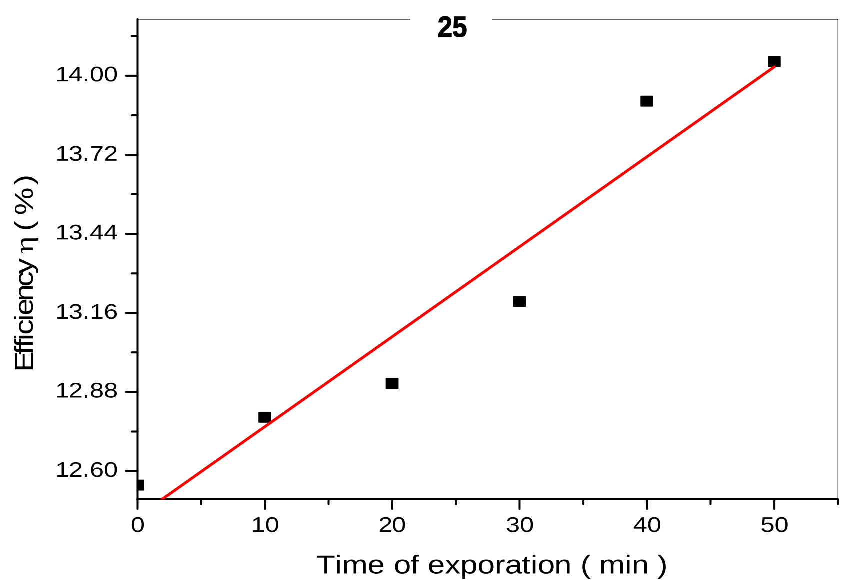


Figure (5.7)Efficiency (η) after irradiated by He-Ne laser by different time

The irradiation of solar cell light laser continuous mode means that there is an increase in the degree of cell temperature, and this temperature has an effect on the energy gap [9]. The increase in the degree of cell temperature leads to a decrease in the energy gap width increases light absorption, this heat effects on voltage open circuit and fulling factor with increasing irradiation time to 50 minute

Table (5.1): The value of current and voltage of solar cell irradiated laser light by continuous mode:

η (%)	**FF (unit less)**	**V_{OC} (volt)**	**I_{SC} (Am)**	**Time**
12.55	0.93	0.129	14.73	**Before**
12.79	0.96	0.073	25.65	**10**
12.91	0.92	0.0769	24.74	**20**
13.2	0.91	0.097	20.99	**30**
13.91	0.96	0.119	17.09	**40**

14.05	0.97	0.168	12.13	**50**

From figure (8) and table (1) found that the Efficiency is increasing with increase the time of irradiate by change rate equal 0.032%.

5.2 Conclusions

It observed improvement in the solar cell and efficiency of its performance when it irradiate by light laser and that improvement cause the depth of penetration of laser beams from surface of the cell which leads to the possibility of generating electron –a gap in the vicinity of the link region pairs which lead to increase the number of pregnant minority and reduce the losses and thus will increase the efficiency of cell.

When a solar cell irradiate by light laser with continuous mode we found that there is an increase in the value of the filling factor (FF)and the circuit voltage (VOC) and these properties is desirable in the production of solar cells.

5.3 Recommendation:

1\ Irradiation the solar cell to the laser for time more than 50 minutes.

2\ Make compare between continuous wave mode and discontinuous wave mode.

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