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Copper |Oxide (Cu_2O) Sheet Based Solar Cell

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خلية شمسية من أكسيد النحاس غير المتجانسة (Cu_2O)

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ABSTRACT

Background:

Copper oxide Cu_2O is a potential material for the fabrication of low cost solar cells for terrestrial application. It is one of the earliest semiconductor materials investigated for solar cells in the early century. Copper oxide exists in forms of Cu_2O with a certain band gap, which is 2.3 eV at room temperature. A copper sheet has been used to create a solar cell that would use the sun's energy to produce electricity. The copper oxide is an ancient solar cell that converts sunlight into current in which a photon is turned into an electric signal, it is known as photovoltaic. Photovoltaic cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect.

Materials and Methods:

We conducted our experiment using pure water first, followed by salt water, and compared the outcomes. The salt (Nacl) solution was added to water, the solution acts as an electrolyte. We found that salt water was a superior electrolyte after analyzing the data.

Results:

As a result, we utilized a sodium chloride (Nacl) solution as the cell's salt water electrolyte. On the other hand, differing electrolyte concentrations and light intensity were significant considerations that both demonstrated their own roles in solar cell.

Conclusion:

This project's purpose was to produce alternate solar cells made from cheap materials and easiest designed that could serve as a model for a new solar cell. It consists of Copper Oxide along with salt water (Nacl) solution.

Key words: Copper oxide $Cu2O$, Solar cells, salt water (Nacl), electrolyte, photovoltaic

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INTRODUCTION

A considerable section of the world population is not reaping the benefits of technology energy consumption, while those who are consuming more fuel. Given that the current reliance on fossil fuels will eventually run out. Pollution and potential solutions to avoid it are one factor that must be taken into account in relation to future clean energy sources. Solar energy utilization will play a great role in solving the world's energy needs of the future and its spotless energy [1]. Solar energy includes producing electricity utilizing the sun's light energy through the photovoltaic effect (PV). PV cells can convert artificial light into electricity. Cuprous oxide is an inorganic compound that is denoted by Cu_2O . Among the earliest solar cells to be developed was copper oxide [2-5]. Clean sheet copper is an n-type semiconductor, whereas cuprous oxide is a p-type semiconductor with a specific band gap 1.2 eV (indirect) because to this, it might be used for solar energy. Because of its high optical absorption in the visible region and reasonably good electrical characteristics, cuprous oxide is a subject of considerable attention. Despite the fact that Cu_2O is among the first semiconducting substances that solid-state physicists are aware of [6-8].

Future global energy demands will be greatly reduced because of the use of solar clean energy. If feasible, affordable methods for direct conversion can be discovered, then using sunlight directly to generate power is likely to become a popular way in the future. There is no obstacle or complexity to a solar-cell system to achieve clean energy unlike solar thermal system other mechanism to produce electricity with more cost and more time. In a solar power system, concerns with fuel storage and transportation are avoided [9].

Solar power may be properly stored as electricity in batteries as well. The current price and manufacturing are barriers to the further development of solar cells, such as silicon. In our study, plastic was used as the cavity material, and water served as the salt solution (electrolyte). We first tested current, voltage, and power for copper oxide cleansed copper with pure water, then added salt Nacl to the water in various concentrations, and the findings showed that a substantial quantity of current and voltage were obtained with salt solution. [10], despite of the intensity of light which has massive role to increase energy of solar system. The objective of this study was to create alternative solar cells using low - cost materials and clean energy.

MATERIALS USED AND METHOD

Copper oxide and normal copper sheets employed easily, they have the same size roughly$12cm^2$, one of them burns for about 2 hours in order to produce copper oxide which has acted as a semiconductor (p-junction).This will warm the copper, giving it the energy it requires to respond rapidly with the air's levels of oxygen this is fast natural oxidation process second plates is a normal copper. To avoid oxidation, clean the sheets by removing any lubricants or dirt from your metal plate, also remove any scrub from the plates in order to works well also clean the plates of any scrape to ensure proper operation [11-13].

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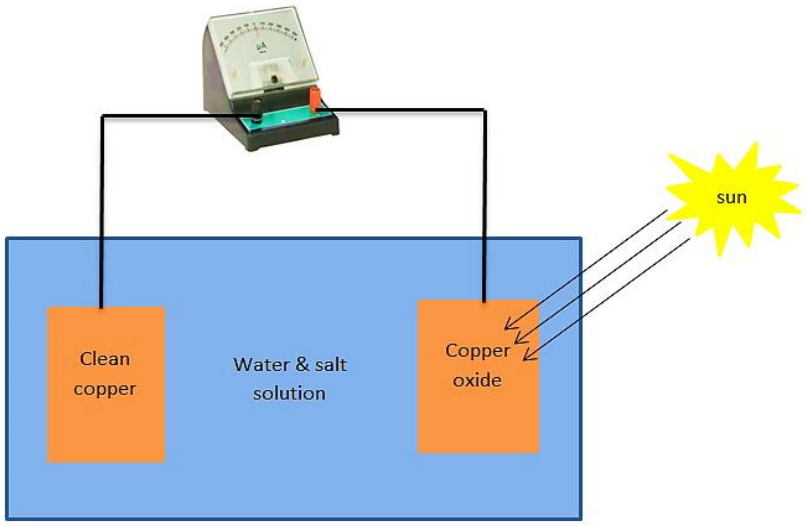

Figure 1: Experimental set up

Both plates insert in cavity with pure water and Na Cl solution. Plastic served as the cavity material in this study, while $2000\ cm^3$ of freshwater operated as the salt solution (electrolyte).we calculated current and volt for salt water with different concentration and water without electrolyte at constant luminous of light. Then analysis of pair parameter by changing intensity of the light for a certain concentration, the solution was employed at various concentrations, and the resulting outcomes were noted and monitored.

To get a salt water solution with various concentrations $5\%, 20\%, 30\%\ and\ 40\%$, the calculations shown below that were done [14]. A P-N junction was made possible by the oxide plate when combined with the metal itself. This situation produced a magnifier impact in the design and made it easier for electrons to move between the electrodes and through the electrolyte. To increase the metal's surface area exposed to light in the electrolyte and greater output power, the big area was selected as the electrode. The exterior light source was a 200W bulb used at a specific distance away from the cavity. Its wavelength is similar to that of the sun's light. The light directed to the cell then measured the current and voltage by galvanometer device. The mechanism to produce electric signal is the light which hits copper oxide plates, that make electron eject from the surface. The electrons move through the solution. Use the alligator clips to connect both parts to the plastic bottle's opposing edges. The clip connecting to the negative pole must be attached to cuprous oxide, while the clip leading to the positive pole might be connected to the clean copper sheet that illustrated in figure (1) [15].

RESULTS AND DISCUSSION

In our design, we built a solar cell that makes use of resources that are naturally available. It would make it unnecessary to use costly semiconductor materials, allowing us to decrease the price of our cell. We compared the results of pure water and salt water experiments. Salt water was found to be a better electrolyte than distilled water. To supply electrolytes to transmit current

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from the cuprous oxide layer to the spotless copper plate in the form of Na+ and Cl^- that are produced when salt is dissolved in water. This solution was applied at various concentrations, and related outcomes have been seen and observed. We found that in which concentration the power (current and voltage) reached the maximum value. To obtain salt water solutions of different concentrations, the following calculations were done.

Table 1: Different concentrations of Nacl with their dissolve in $2000cm^3$ of water

Concentration $NaCl$	**$NaCl\ gm$**	**Dissolve of $NaCl$ in 2000cm^3 of water**
0	0	0
5 %	2.9	58
20%	11.6	232
30%	17.4	348
40%	23.2	464

The P-N junction created by copper oxide and metal copper permitted an electron to travel from the first terminal to the second terminal. At first, the minimal amount of voltage produced between two plates using pure water and no light, since the electrodes operate as a capacitor. When 200W light bulbs fall on one of the electrodes as a consequence of the concentration of the ionic salt solution and the intensity of the light, a potential difference was generated. We observed the role of concentration of increasing voltage and current of our cell by constant light intensity, the investigation showed that until solution increased the current flow increase because the large number of Na^+ and Cl^-contributed to that process; they illustrated in figure 2. The current reaches 12.5 mA at 40% of the sodium chloride solution.

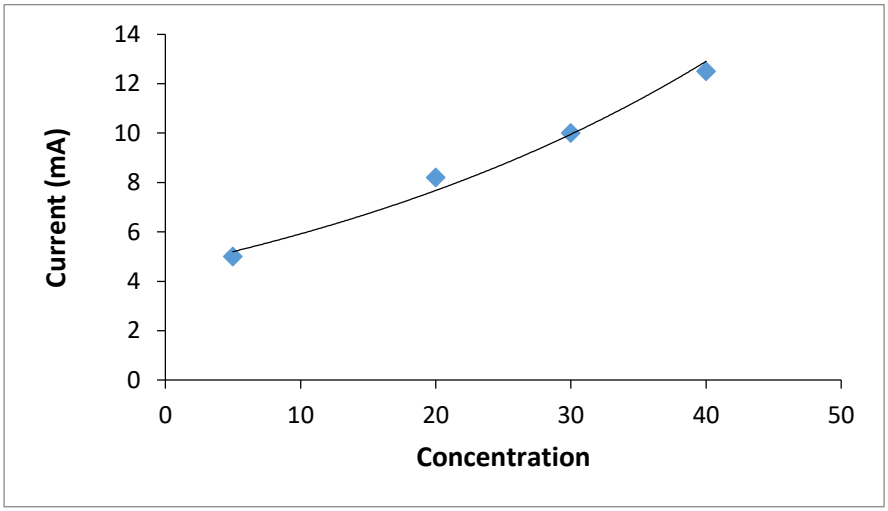

Figure 2: Graph of Current (mA) Vs. Nacl concentration

The investigation shows that the vast amount of Nacl solution raised that caused the voltage and power to grow; The differential potential increases because both plate poles produce a significant

number of carriers, voltage and power reached maximum at maximum concentration, they illustrated in figures 3,4

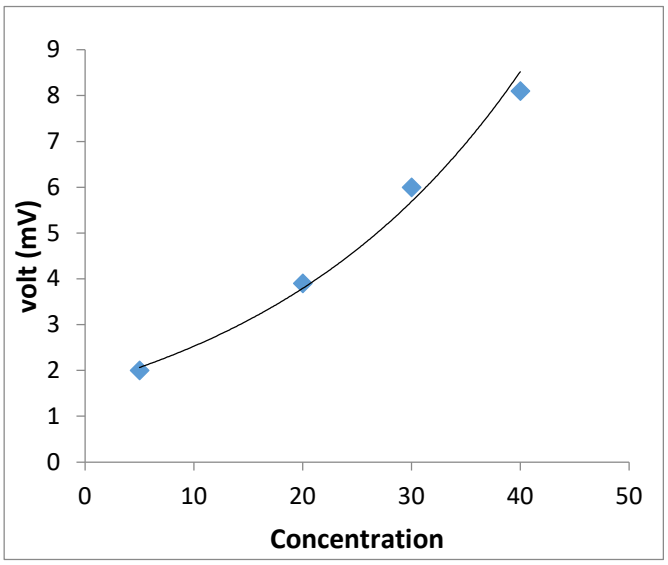

Figure 3: Graph of voltage Vs. Nacl concentration

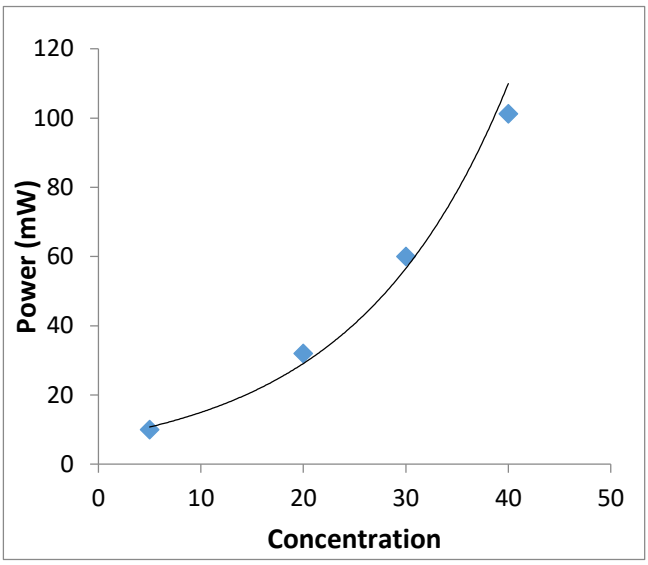

Figure 4: Graph of power Vs. Nacl concentration

On the other hand, the cuprous oxide plate of the solar cell should be exposing the most direct sunlight in order to release electrons onto the copper plate, which then sends the electrons to the cables [14-15]. Using a Lux meter to monitor the luminance of a 200 W light bulb, the impact of light intensity on current, voltage and power were examined. The positive and negative ions working as charge carriers in solution and the water operating as a dielectric caused the voltage and current to be created before the light, these are seen in figure 5, 6 respectively. *At* 90 *KLux* of light, the highest current and voltage values are 12.5 mA and 8.1 mV.

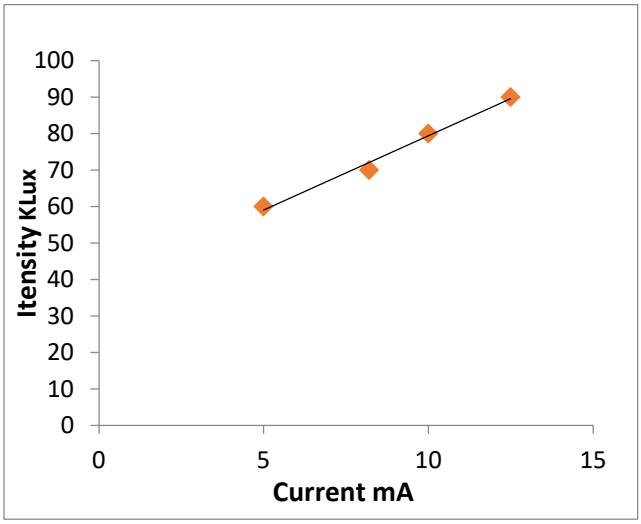

Figure 5: Relation between current rises (mA) vs. Light intensity (Klux)

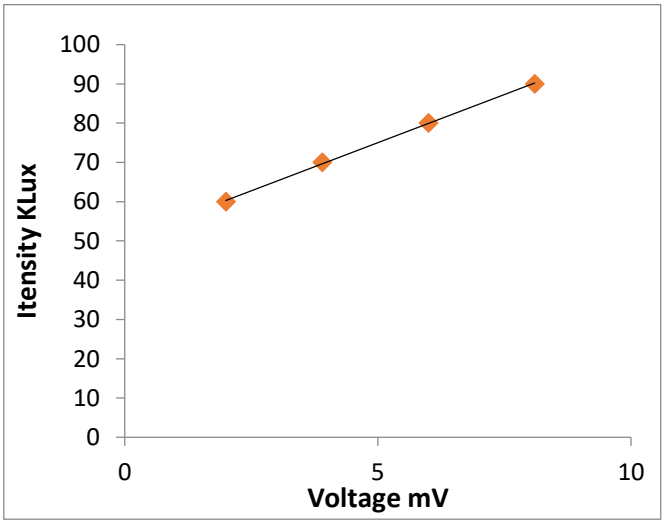

Figure 6: Relation between volts rise (mv) vs. Light intensity (Klux)

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Table 2: Summary of our experimental results at a constant intensity of light

Concentration of Nacl	Current analysis	Voltage analysis	Power analysis
	maximum current(mA)	maximum voltage(mV)	maximum power(mW)
5%	5	2	10
15%	6.25	3.2	20.16
25%	8.88	4.6	40.71
35%	11.3	7	79.1
45%	12.6	8.9	112

CONCLUSION

We verified that the solar system's voltage and current were greater with solution than without solution (pure water). Our experiments demonstrated that they produced outcomes that were better than those of most experiments were done. The purpose of this project was to develop affordable materials to make alternative solar cells. It is made up of an ionic salt water (Nacl) solution and a copper and copper oxide PN junction, $Cu\ 2O$ was present in the oxide. In this investigation, concentration played a significant influence in increasing solar power, which resulted in 101.3mW at 40% concentration. We discovered that as the concentration increased from 5% to 40%, current and voltage increased by (5.12 mA and 2.81 mV, respectively). Intensity was the second critical factor, and it has been noted that as intensity increased, voltage and current also increased at constant concentration, the voltage and current were 8.1 mV and 12.5 mA at 90 Klux respectively.

Conflict of interests.

There are non-conflicts of interest.

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الخلاصة

مقدمة:

أكسيد النحاس Cu_2O هي مادة محتملة لتصنيع الخلايا الشمسية منخفضة التكلفة للتطبيقات الأرضية. إنها واحدة من أقدم مواد أشباه الموصلات التي تم فحصها للخلايا الشمسية في أوائل القرن. يوجد أكسيد النحاس في أشكال Cu_2O مع فجوة نطاق معينة ، والتي تبلغ 2.3 فولت في درجة حرارة الغرفة. تم استخدام لوح نحاسي لإنشاء خلية شمسية تستخدم طاقة الشمس لإنتاج الكهرباء. أكسيد النحاس هو خلية شمسية قديمة تحول ضوء الشمس إلى تيار يتحول فيه الفوتون إلى إشارة كهربائية ، ويعرف باسم الخلايا الكهروضوئية. الخلية الكهروضوئية هو جهاز كهربائي يحول طاقة الضوء مباشرة إلى كهرباء عن طريق التأثير الكهروضوئي

طرق العمل:

لقد أجرينا تجربتنا باستخدام الماء النقي أولاً، متبوعًا بالماء المالح ، وقارننا النتائج. يضاف محلول الملح (Nacl)إلى الماء ، ويعمل المحلول كإلكتروليت أجرينا تجربتنا باستخدام الماء. وجدنا أن الماء المالح كان إلكتروليتًا متفوقًا بعد تحليل البيانات

النتائج:

نستنتج من ذلك ، استخدمنا محلول كلوريد الصوديوم (Nacl)كمحلول بالكهرباء في الماء المالح للخلية. من ناحية أخرى ، كانت تركيزات الإلكتروليت المختلفة وشدة الضوء اعتبارات مهمة أظهر كلاهما دورهما في الخلية الشمسية.

الاستنتاجات:

كان الغرض من هذا المشروع هو إنتاج خلايا شمسية بديلة مصنوعة من مواد رخيصة وأسهل تصميمًا يمكن أن تكون بمثابة نموذج لخلية شمسية جديدة. يتكون من أكسيد النحاس مع محلول الماء المالح(Nacl) .

الكلمات المفتاحية: أكسيد النحاس Cu_2O ، الخلايا الشمسية ، المياه المالحة (Nacl) ، المنحل بالكهرباء ، الكهروضوئية

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