ALMOND SHELL ACTIVATED CARBON-PERFORMANCE OF PEROVSKITE SOLAR CELLS

Abstract

Activated carbon made from almond shells can be used as a material in perovskite solar cells to improve the efficiency and stability of the cells. The performance of the perovskite solar cells can be improved using almond shell activated carbon by adsorbing the impurities present in the precursor solutions which may otherwise lead to defects in the perovskite film, thus increasing the lifespan of the solar cell. The actual lifespan of the solar cell is dependent on various factors such as the environment, temperature, and the quality of the perovskite materials used. Halide perovskite is a family of materials that has the potential to produce solar cells with high performance and low cost. Gold (Au), a costly element, is used as the counter electrode (Ce) in perovskite for the best conversion of light energy into electricity. The best replacement materials often consist of almond shell, comparing the work function testing with the materials of almond shell and gold comes close. Consequently, the impacts of particle size and lifetime of an electrode made of almond shell on perovskite performance will be examined in this study. Almond shell activated carbon is a low-cost alternative to the traditional activated carbon made from coconut shells and coal. It has a high adsorption capacity for pollutants such as volatile organic compounds (VOCs), pesticides, and other harmful chemicals. It can be used in various applications such as air and water purification, food and beverage processing, and industrial chemical processing.

Keywords: Solar cells, Photo voltaic cell, Activated carbon, Almond shell, Renewable energy sources, Charging battery.

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I. INTRODUCTION

Halide perovskite is an interesting and potentially breakthrough application in solar power generation technology. Perovskite with a distinctive crystalline and crystallographic structure that resulted from the creation of dye-sensitised solar cell development. It is based upon a hybrid organic -inorganic based material typically makes more effective at converting light energy into electricity. Perovskite is the name discovered in Russia 1839 by Gustav Rose. Many varieties of Perovskite Solar Cells (PSC) exist, but the most interesting of these for the photovoltaic industry are crystals connected to atoms of lead or tin. PSC offers flexibility, semi-transparency, lightweight and more comfort[1].

Normally, Researchers and scientist are certain that such characteristics will allow many more applications for solar cells. Furthermore, it has the ability for the low-power consumption and the radiance sparkling in the solar industries for the additional growth. Perovskite has certain problems by using a high-cost expensive material to achieve maximum PCE. The most common electrode material, counter electrode of perovskite solar cells are gold (Ac) and silver (Ag)[1]. The method through which gold (Au) and Silver (Ag) gas counter electrode of Perovskite Solar Cells produce high-power use and a high-cost material. So, here we tend to use of carbon. i.e., Activated carbon, also named as activated charcoal. Activated carbon made from almond shell, which is a form of carbon that has processed to increase its surface area and absorption properties[6].

From the Activated Carbon, the carbonaceous source materials are classified, they are bamboo, coconut husk, willow peat, wood and such more[4] are easy to manufacture due to its good electrical conductivity, stability against the counter electrode, reasonable price[6]. Consequently, the impact of particle size and prepared by chemical activation technique are investigated with their CE potentials has more economic. Generally, the experiment is tested for the required carbon allotropes is 5.0ev. Since the value is nearest to the gold (Au) which is 5.1ev[1]. Almost with the knowledge and interest to do research about using of almond shell from the classification of Ac, it will be used as counter electrode of PSC'S[4]. However, activated carbon almond shell is non-toxic and best for all the commercial photovoltaic industry sector in future. The chemical activation of zinc chloride and under a nitrogen atmosphere, the activated carbon is developed with porous structure and include high surface area were prepared from the almond shell[5].

According to the above prospectus, activated carbon almond shell-based CE is the best development of PSC'S[6]. This investigation led to find the particle size and lifespan of activated carbon among the performance of PSC'S and also this research motively achieves for the better efficiency in the development of improved PSC'S as the best results in solar cells[9].

II. METHOD OF FABRICATION

This section contains the fabrication procedure in detail.

1. **Device Design:** The materials, which are used to design the PSC, are TiO_2-based Electron Transport Layer (ETL), a layer of perovskite and an activated carbon-based electrode layer, which mean the activated carbon provide as both the HTL and the electrode in the finite structure, and the hole transport layer (HTL) is not used[3].

The performance of the PSC with activated carbon-based electrode By using HTL of PSC through the Copper Silicate, is decreased. Each layer should be adjusted to its needed responsibility along with the energy content, for providing outstanding electron and hole mobility[8].

The complete energy level of the material could be moulded in a band schematic diagram for look into the charge flow for the perovskite. When the perovskite is sufficiently exposed to sunlight, both holes and electrons are removed into the conduction and valence bands, respectively[10]. Electrons flows ETL, which band frequencies of Ti-02is -4.1 eV and -7.3 eV. Furthermore, as the TiO_2-based top ETL is responsible for preventing hole flow, which reduces the possibility of charge recombination. In terms of intensity, TiO_2 material maximum have a wide range of (bandgap Ex = 4.8 eV), resulting for the approximate output[5]. FTO glass randomly use as a base for the deposition of TiO_2 and make alternation based on carbon electrodes and explores the outstanding clarity in transmitting light[1].

2. **ETL Preparation by applying TiO2**: FTO substrates made of glass thickness approximately reach 2.2 cm to 5.5 cm were moulded in substrates for five minutes with distilled water, acetone, and ethanol using an ultrasonic treatment cleaner[5].

   Then FTO glass substrates were dried on a hot slide plate at 60°C. Titanium benzene 90% was dilute in 2mL of methanol and then mixed with 0.1 mL of HCl as a buffer to create a TiO_2 precursor solution[7]. An electromagnetic stirrer has been employed to agitate the liquid for 20 minutes at the ambient temperature. FTO glass substrates were covered with a tape with a touch area masking measurement of 20.25 cm prior to the deposition procedure[8]. Again by spin-coating in accurate rpm for about minimum 30 seconds and annealing over fifteen minutes at 390^{o} approximately, titanium dioxide antecedent is applied to the surface of FTO glass[4].

3. **Making the Perovskite Layer:** To create the perovskite precursor, maximum 100mg of Lead Chloride (powder 90% Aldrich, Methylammonium chloride were mixed and placed in Dimethyl (Chemical Solution). Using a magnetic stirrer, the mixture was heated to 80°C and swirled for 60 minutes. Spin-coating at 1000 rpm for maximum seconds, followed by 18 minutes of soften at 120°C, was the procedure used to deposit perovskite precursor on top of a TiO^2 layer[1].

4. **Preparation of Activated Carbon:** In order to reduce the moisture content, almond shell should take time to wash and then make dry at 105°C for 24 hours. A Size of 1-2 mm, the dry samples were crushed and sieved[7]. The following materials those are the raw shell carbonization along with the activation of the charcoal are produced in a vertical stainless-steel reactor that was housed in electric furnace. During the carbonization procedure nearly 15gm of raw material have to be prepare for the charcoal[9]. From the moment of carbonization process initiated, the reactor where filled with nitrogen-based gas in a flow rate of 100 cm3.Then furnace's temperature raised gradually from ambient to 450° C and maintained there for one hour[6]. The impacts of modified temperature, duration and carbon dioxide flow rate to be researched for the activation process in order to find the ideal parameters[4].

III. CONCLUSION

From the results, it is observed that the electrode for PSCs might be made from activated carbon, which is manufactured from almonds shell charcoal. It can also be concluded that the physical activated method using co_2 and almond shell have to be proven effective with a variety of textural, surface, and porosity characteristics. Investigating the impact of particle size can be done by applying Activated carbon, a material that has a powdered structure. High-surface area activated carbon electrodes performed better with smaller particles. The efficiency of PSCs was further improved by the electrodes' longer lifespan. Hence the Perovskite shows the lifespan of particle size for the best performance with the PCE of good efficiency.

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