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A Case Studying of Nature Light Source with Hydrogen Quantity Used in Small-Sized Regenerative Fuel Cell

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Abstract

This paper presents a case studying of nature light source with hydrogen quantity used in small-sized regenerative fuel cell, by studied the natural sunlight in the second time period between 08.30 to 12.00 am, and 13.30 to 17.00 pm, with artificial light source which was conducted in room drapes. The light energy to the polycrystalline silicon solar cell with size 2.5 volt 11 watt panel, that acts of voltage to electrolyzer which water is separated, into hydrogen and oxygen to keep the barrel to collect feedback into the fuel cell to generate electricity. The study found that natural sunlight the performance to split water with electricity is a better at the time of maximum light intensity, an increasing proportion of the size of the light intensity in the range of the 1 to 3 times the amount of hydrogen.

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Keywords: Regenerative Fuel Cell; Electrolyzer

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1. Introduction

Nowadays, Global climate change is a serious threat faced by the contemporary world. There are two major causes of climate change. They are, burning of fossil fuels and deforestation. Burning of fossil fuels contribute significantly as they are used in many places like transport, industries, power generation, etc., [1]. The combustion of fossil fuels results into the inducement of various gases like SO_x, NO_x, CO_x, etc., these gases are also known as green house gases which greatly contribute in the phenomena called as the green house effect [2]. Therefore, many countries around the world are focusing on renewable energy issues, such as solar, wind, ocean tidal and geothermal energy to reduce fossil fuel use. Presently, fuel cell (FCs) is one of the most promising sustainable and renewable power sources because of its very low emission and high power density. Fuel cell another source of energy that is being developed and widely used today. Fuel cells are devices that convert the chemical energy of a fuel such as hydrogen, methane, methanol, natural gas or coal gas, to be electric by electrochemical process, fuel must flow into the system at all times. The results of electrochemical processes derived from certain fuel cells, such as molten carbonate fuel cell (MCFC) or solid oxide fuel cell (SOFC) can be generated in addition to generating electricity, already it can also bring a lot of heat produced. Used to produce steam or hot water through gas turbines or other technologies to reuse heat, this is the process of increasing the efficiency of the power generation system [3], [4]. Fuel cells is considered as a clean power source for various applications such as stationary power system, mobile power supply, transportation and space application [5], [6].

Currently, researchers around the world have developed systems and applications of fuel cells, in various fields in order to replace the energy resources that are going to be exhausted in the future. This paper approach of nature light source with hydrogen quantity used in small-sized regenerative fuel cell, by studied the natural sunlight in the second time period between 08.30 to 12.00 am, and 13.30 to 17.00 pm, with artificial light source which was conducted in room drapes. The light energy to the polycrystalline silicon solar cell with size 2.5 volt 11 watt panel, that acts of voltage to electrolyzer which water is separated, into hydrogen and oxygen to keep the barrel to collect feedback into the fuel cell to generate electricity. The study found that natural sunlight the performance to split water with electricity is a better at the time of maximum light intensity, an increasing proportion of the size of the light intensity in the range of the 1 to 3 times the amount of hydrogen.

2. Objective

To study the amount of hydrogen quantities, compared to a natural light source in the time of day with artificial light source used in small-sized regenerative fuel cell system. Used as an energy source in conjunction with solar cells, in an electrolyzer system with the proper performance.

3. Methodology

3.1. Principle of fuel cell

The significant components of the fuel cell are the electrodes, includes cathode and anode, these electrodes are separated by an electrolyte plate. The operation of the fuel cell occurs when the fuel is refueled by feeding hydrogen into the anode, and feed oxygen from the air into cathode. Operating of fuel cell as show in Fig. 1. The hydrogen atoms (H_2) flow in the fuel cell, it is oxidized reaction ionized to protons (H^+), and is chemically reaction emerge electrons (e^-), the hydrogen atoms are in an ionizations which the protons move through the electrolyte to the cathode. While electrons move through the electrical circuits outside of the cell to the cathode to reduce oxygen to oxide ion (O^{2-}), the electrical energy come out. Proton moves from anode passing to the electrolyte, an aggregation with oxide ion in the cathode, producing pure water and heating is producing. Normally, one fuel cell can generate is a small electrical voltage about 1 volt or 1.16 volts. For practical applications need several series of cells must be connected, such as if the fuel cell is serialized (Fuel Cell Stack) 12 cells will get 12 volts, or increase the number of cells to achieve the desired voltage level. This sequence will continue as long as the fuel and oxidizer are fed into the fuel cell and the electrical power is continuously supplied. The operation of the fuel cell is similar to that of the battery, be different fuel cells can not store energy as batteries.

Fuel cells can be classified into several basic of fuel cells, such as temperature, fuel type and electrolytes. According to the different electrolytes, fuel cells can be divided into several types, such as Alkaline fuel cell (AFC), Phosphoric Acid fuel cell (PAFC), Molten Carbonate fuel cell (MCFC), Solid oxide fuel cell (SOFC), and Proton exchange membrane fuel cell (PEMFC), Direct methanol fuel cell (DMFC). Apart from the identification of the types of fuel cells in the form of the six types of different electrolytes described above. There is another form of fuel cell that has developed a closed-loop reaction process, call this fuel cell Regenerative Fuel Cell (RFC) [7].