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Manufacturing HHO cell and study the effect of Nano Photocatalyst to produce hydrogen

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Abstract

This paper reports the investigation of Manufacturing HHO cell consists of two canisters, we designed this cell of glass Pyrex and cylinder hydrogen holes one to enter the thermometer and the other for the exit of the gas, as well as containing a quartz lens to enter the optical beam , the process of photo electrochemical where they are to prepare aluminum are used as substrates. to deposition of SnO2 electrodes under the influence of light source of the type N-type for the Liberation of hydrogen presence of photocatalytic and P-type for the Liberation of oxygen , The study of the volume of gas output, time with change voltages and current, we have the results were almost identical and structured characteristics were studied through the analysis of X-ray diffraction (XRD). Also, The he morphological characterizations of photocatalytic (nano Znic oxide), were carried out using the Atomic Force Microscope (AFM).

Keywords: HHO cell; photocatalytic (nano Znic oxide) ; aluminum; X-ray diffraction (XRD).

Introduction

The metal oxides for beneficial many application not only because of its high mobility for better charge transport, but also due to its various nanostructures applied for the order heterojunction, which can efficiently improve the exciton dissociation. Therefore the performance of device can be improved significantly with the application of metal oxides [1] . Zinc oxide (ZnO) nanoparticles as a cheap nontoxic semiconductor with a wide direct band gap (3.37 eV) are a promising material for different applications such as photocatalysts, photodetectors, gas sensors, piezoelectric sensors and ultraviolet lasers[2] as well as Nano-sized ZnO particles have been intensively studied for their wide applications as light-emitting diode, varistors, photoluminescence devices and catalyst [3]. ZnO, with a lower cost, absorbs over a larger fraction of UV spectrum and absorbs more light quanta than TiO2 [4,5]. When an appropriate light source illuminates ZnO, electron/hole pairs will be produced with electrons absorbing the light energy, transitioning to the conduction band and leaving positive holes in the valence band [4,6]. Hydrogen is considered the best clean energy carrier, due to its light weight, high energy density and zero pollution [7]. It is widely recognized that hydrogen is one of the most promising energy carriers for the future. The low polluting emissions of the hydrogen combustion make it a very attractive fuel in particular for transportation applications. In the past years, the application of hydrogen fuel cell was mainly employed in spacecraft, while recently the interest in both mobile and stationary power generation has grown due to its advantages in terms of environmental impact [8]. Aim of the research: Manufacturing HHO cell as well as study the effect of Nano Photocatalyst on the hydrogen production.

Material and Methods

Manufacturing cell

HHO cell consists of two canisters, we designed this cell of glass Pyrex and cylinder hydrogen holes one to enter the thermometer and the other for the exit of the gas, as well as containing a quartz lens to enter the optical beam ,shown Figure 1. There are different materials could be used as an electrode (aluminum are used as substrates. to deposition of SnO_2). But each one has its own merits and demerits. designed as P-N-P-N-P-N. For the connectivity among positive electrodes and negative electrodes, they are arranged not to make any shot circuit at any condition and mechanically should be strong to withstand the electrolyte corrosions.

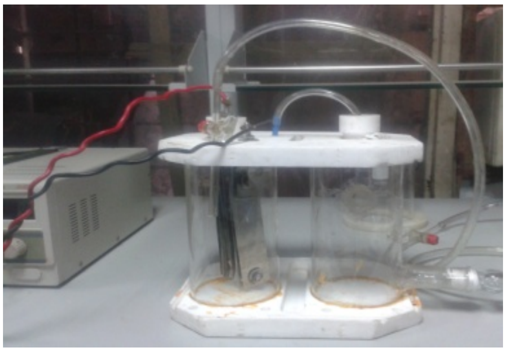

***Figure 1**. Shown the photo electrochemical cell*

prepared Photocatalytic (ZnO nanoparticles):

0.1M of zinc acetate was dissolved in 50ml of ethanol at 80 ° C under vigorous stirring for 30min, then obtained solution was cooled down to 0 ° C. 0.14M of lithium monohydroxide was dissolved in 50ml of ethanol at room temperature using an ultrasonic bath for 30min. Lithium hydroxide solution was added drop-wise to zinc acetate solution at 0° C under vigorous stirring for 30min. The molar ratio of Zn^{+2}/Li^{+1} was 1:1.4 to get on adjust reaction stoichiometry. When the solution is allowed to age at room temperature, The present synthesis procedure is simple and permits a very fast nucleation with minimum aggregation of the nanocrystalline ZnO at room temperature .as Shown Figure 2.

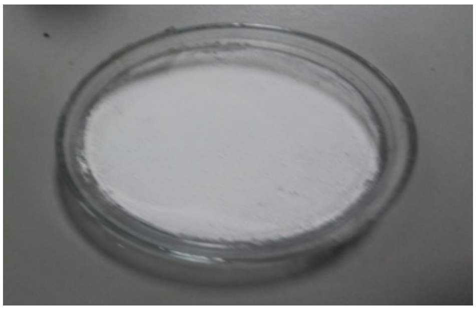

***Figure 2**. Shown the prepared nano ZnO*

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Results and Discussion

X-ray diffraction Results

(XRD-6000 Shimadzu Japan) was used for the purpose of measuring this of crystalline structures formed in the samples. Where the target was CuKα radiation (λ=1.54oA) in the range of 2θ=10-60^o, We used the Barak law to calculate the distance (d) between the atomic levels.

$n\lambda=2d\sin\Theta$

Where: n : diffraction rank equal to (1).

Θ : of diffraction.

λ : wavelength of X-rays. [9].

Figure 3. demonstrate the XRD profile of the prepared ZnO nanocrystals; The highest peak observed at 2θ = 15.22° ,2θ = 24.83° 2θ = 28.02°, 2θ = 31.72° and 2θ = 37.91°can be attributed to the (111) plane of the hexagonal (ZnO). the obtained diffraction peaks at planes(110) , (101), (102), (111) and (100) indicate that all the precursors have been completely decomposed and no other complex products were formed. These diffraction peaks and their relative spectra all coincide with hexagonal phase, The result is in agreement with the literature of American Standard of Testing Materials (ASTM),

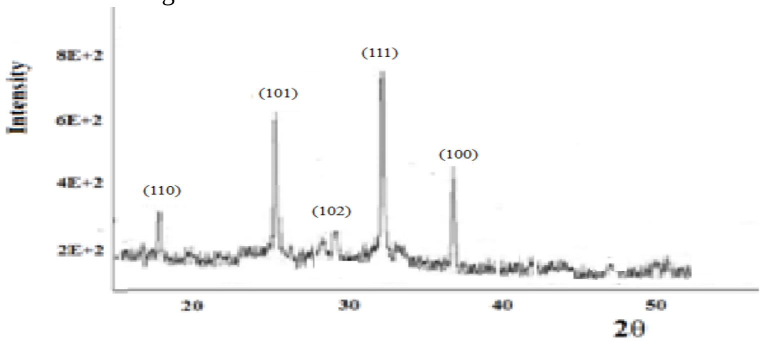

***Figure 3**. X-ray diffraction analysis.*

Morphology Analysis

The surface morphology of the ZnO nanoparticals was investigated using atomic force microscopy (AFM). It can be noticed that the average grain size and roughness increase with increasing of number . of pulse because of increasing the thickness of the film and this is can be explain to create the localized state in the structure of the film. the distribution of granules is homogonous as in Figure 4.

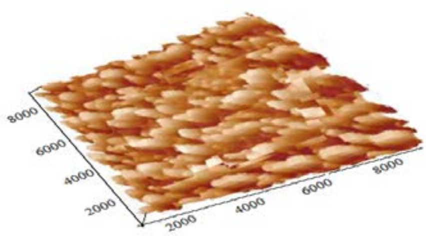

***Figure 4**. Atomic force microscope at nano ZnO*

After the preparation and study of nano ZnO characteristics structural .As has been the use of these Photocatalysts and without Photocatalysts and study the effect of Nano Photocatalysts on the hydrogen production , photocatalytic water-splitting reaction, they act as reducing agent and oxidizing agent to produce H2 and O2, respectively. A schematic representation of the principle of the photocatalytic system for water is depicted in Figure 5. Water splitting into H2 and O2 is an uphill reaction. It needs the standard Gibbs free energy change Δ*G*0 of 237 kJ/mol or 1.23 eV, as shown in Eq.(2).

$H_2O \rightarrow 1/2O_2 + H_2$ $\Delta G = +237$ kJ/mol (2)

Therefore, the band gap energy (*E*g) of the photocatalyst should be □1.23 eV (□1000 nm) to achieve water splitting. However, to use visible light, it should be □3.0 eV (□400 nm).

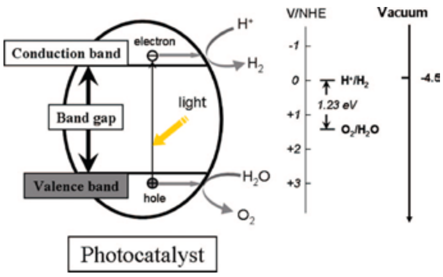

Figure 5*. principle of the photocatalytic system for water*

To facilitate both the reduction and oxidation of H2O by photoexcited electrons and holes, the match of the band gap and the potentials of the conduction and valence bands are important. Both the reduction and oxidation potentials of water should lie within the band gap of the photocatalyst. The bottom level of the conduction band has to be more negative than the reduction potential of H+/H2 (0 V vs normal hydrogen electrode, whereas the top level of the valence band has to be more positive than the oxidation potential of O2/H2O (1.23 V)[10].

As shown of Table (1) the existence of hydrogen production increases With Photocatalysts little more compared with increase Without Photocatalysts change voltages ,current and time to 1min, Add photocatylist for process of interaction in the electrolytic cell is aimed at energy saving (by increasing the production of chemical reactions) as well as the best product the quality of the resulting material control and the speed of their formation. And pure output Reduce the composition of spin-offs of the interactions and reduce pollution, where the addition of Photocatalysts speeds of interaction process that are due to the large surface area in contact with the substrates. This allows more number of photons hit the catalyst and large adsorption capacity results.

Table (1) Determination of photo electrochemical cell characteristic

Volume H_2 (ml)		Time (min)	Voltage (Volts)	Current (Amp)
Without Photocatalysts	With Photocatalysts			
3	5.7	1	5.2	2.1
3.9	8.4	1	6.1	3.7
7.2	12.9	1	7.5	4.8
15.6	18.6	1	8.9	5.1
20.5	25.8	1	10.4	5.9
25.4	33.7	1	12	6.1

Conclusions

the development of scientific knowledge and Photocatalysts need to understand the mechanical work is a key objective of the various interactions those related to the production of hydrogen, which is the fuel of the future because of its significant role in the provision of adequate clean energy to the environment, the most important. , which is currently the focus of attention of researchers. Most of the of Photocatalysts used to produce hydrogen are heterogeneous catalysts, Notes the increase in the volume of gas with Photocatalysts is more efficient It can be observed that the gas production increases sharply with voltage .

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