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SYNTHESIS OF NANO PHOTOCATALYSTS (SNO2-ZNO) FOR HYDROGEN PRODUCTION

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Abstract

It has been prepared synthesis nano (SnO_2-ZnO) powders, through Chemical method,the prepared samples were analyzed by XRD, AFM, and FTIR, XRD results revealed that the crystalline structure of nano photocatalysts was formed. nano photocatalysts (SnO_2-ZnO) showed higher photoactivity for hydrogen production. The high activity of the nano photocatalysts was attributed to the presence of heterojunctions between the two oxides, as well as The photocatalytic activities of prepared samples increased with the increased intensity of radiation.

Keywords: Nano, Hydrogen, Synthesis.

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1. Introduction

Hydrogen has been considered a source of green energy and a promising environment, an alternative to fossil fuels, and many research efforts have been made and have received attention and focus on photocatalysts [1]. A photocatalyst delegation wide attention in semiconductor development due to its high activities for environmental applications. Photocatalysis relies on the generation of punctured electron pairs by the radiation bandgap that has been lead to oxidation and reduction reactions with adsorbed species on the surface of photocatalysts [2.3]. Recently, among the nanoparticles is the use of metal oxides, due to its properties of high chemical stability [4], and the value of the bandgap for different oxides with semiconductor behaviors has played an important role, in determining the photocatalytic properties of unusual magnetic, chemical, electronic, optical and mechanical properties, Such oxides are zinc oxide, SnO_2, TiO_2, and In_2O_3 [5]. Combining some semiconductors with different band gaps, heterogeneous connections in optical stimulation systems have become essential through combining some semiconductors with different band gaps, and researchers have focused on this process, to obtain unique properties not found in individual nanomaterials. Among these are SnO_2: ZnO [6,7].The aim, improved The functional properties for producing hydrogen, it used hybrid nanomaterials, consisting of zinc oxide and tin oxide acting as multiple components, also have a wide gap, it has used to increase storage capacity, photocatalytic activity

2. Experimental

2.1. Preparation of nano photocatalysts (SnO_2-ZnO).

The 2: 2 ratio of ZnO and SnO_2 have mixed with adding 0.4 mol / L of zinc acetate in ethanol. It is mixed by Sonicators Qsonica.LLC, which is a device for mixing nanomaterials. Then, the mixture is placed in a water bath at a constant temperature of 80 ° C for 3 hours. After drying at room temperature, a heterogeneous composite was obtained from SnO_2-ZnO powder. As shown in Fig. 1..

Figure 1. *nano* **photocatalysts** *(SnO_2-ZnO)*

2.2. Preparation of hydrogen gas unit

Photocatalytic water splitting. The photocatalytic reactions were conducted in a quartz cylindrical reaction cell of 50 mL in volume.so that it is able to absorb accidental radiation and enhance photocatalytic reactions with minimal optical losses. Moreover, optical reactors can separate H_2 and O_2 .Typically, 4.213 mg of photocatalyst, 9 mL deionized water and 1 mL methanol were mixed and Before the light was turned on, A magnetic stirrer was used to guarantee the homogeneity of the reacting mixture for 45 min to form a homogeneous suspension. illumination with the UV- lamp. As shown in Fig. 2.

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Figure 2, The electrolysis cell

3.Results and discussion

3.1. XRD Measurement

The structure of nano photocatalysts (SnO2-ZnO), were examined by X-ray diffraction (XRD) technique with the monochromatic Cu Kα radiation. The peaks of the XRD have observed room temperature. Fig.3. illustrate the XRD patterns of (SnO2-ZnO) shows the polycrystalline, that obtained three peaks corresponding to (110), (100), and (101) directions of the cubic (SnO2-ZnO) crystal structure which is corresponding to the positions 2θ = 25.2 o, 27.4 o, and 31.2 o respectively. Also, the XRD measurements revealed that the intensity of peak (101) orientation is predominant which.

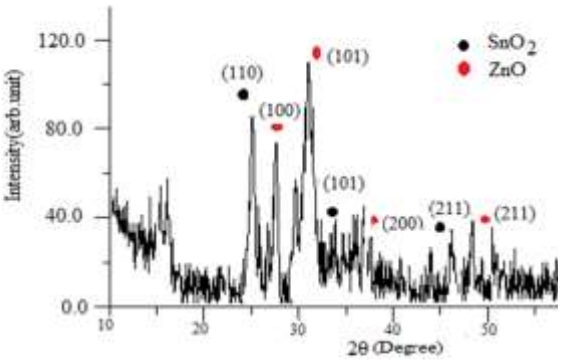

Figure 3.X-ray diffraction analysis of

(SnO_2-ZnO)

3.2. AFM Measurement

Atomic Force Microscopy (AFM) studies focus entirely on the nanoscale characterization of the (SnO2-ZnO). Fig. 4a,b. AFM picture it has taken on (SnO2-ZnO)Surface morphology of the catalytic layers revealed the presence of a sponge-like structure when the current density increases, where nano crystalline can be seen and distributed throughout the entire surface, . The surface analysis mode with tapping mode AFM shows the smoothness surface. The usual rough surface structure, characterized by several nano-sized (SnO2-

ZnO).which exhibited a smaller grain size. It was found that the average grain size was 45 nm.

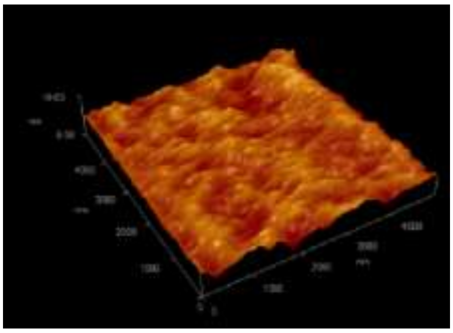

Figure 4a, Surface morphology of . nano **photocatalysts** *(*SnO_2-ZnO*)*.

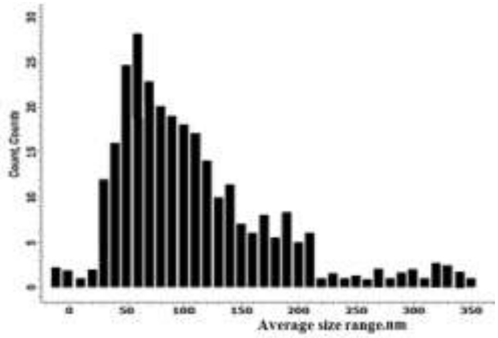

Figure 4b, granularity normal distribution of . nano **photocatalysts** *(*SnO_2-ZnO*)*

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3.3 . FTIR spectra of SnO2-ZnO

To confirm the presence of functional groups on the ocular SnO2-ZnO surface, an immediate infrared analysis (FTIR) was performed. Fig. 5 ,shows the FTIR spectra of SnO2 nanoparticles. Infrared spectra indicate that absorption at 3310 cm-1 is clearly related to the presence of hydroxyl groups of water molecules. Also the absorption range at 623 cm-1 can also be attributed to O-Sn-O, which corresponds to the results obtained by Chetri et al[8].

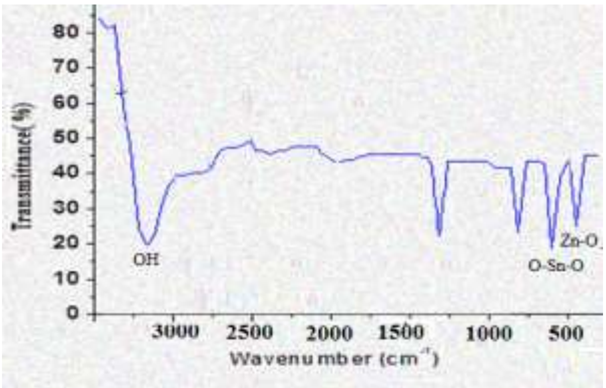

Figure 5. FTIR spectra of SnO2-ZnO

3.4 The Effect of the intensity of radiation to the volume of hydrogen gas:

photocatalysts have been studied on the water splitting for hydrogen production. Hydrogen production from the photocatalysis process by dissociation of water into, hydrogen and oxygen, only optical energy (photons), water, and catalyst are needed with either artificial or natural light. It is clear that when the variation of the volume with increasing time for constant light, addition, the increase in the nano photocatalysts (SnO2-ZnO) leads to an increase in the number of energy carriers, which in turn increases the hydrogen production, as shown in table 1, and Fig. 6, which correspond to the data for these papers

Table 1. Show the relationship between the volume of gas with Time

Time (min)	Voltage (V)	Volume of H (ml)
20	5	0.4
25	5	1.5
30	5	2.6
35	5	4.5
40	5	7.7
45	5	10.5
50	5	13.8

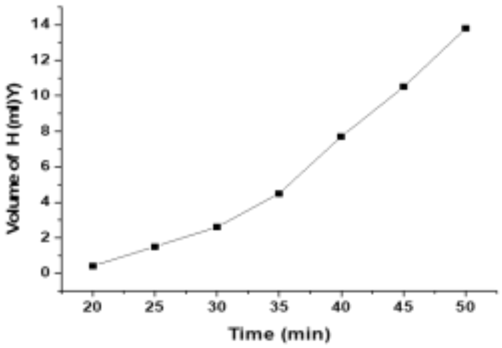

Figure 6.The relationship between Volume of hydrogen and Time

When UV radiation is applied to the SnO2-ZnO catalyst, the electrons can transfer from the more ZnO cathode conduction band to the more SnO2 anode conduction band. Alternatively, transfer of holes from the valence bar from SnO2 to the valence band of ZnO can occur. Effective charging separation can increase the life of the charging carriers and enhance the efficient transportation of the intermediate charges of the adsorbing substrates. In photocatalyst, a major factor is the intensity of radiation. The results of this part of the study demonstrated that in the increase of photosynthesis, due to increased radiation intensity, this increases the catalytic efficiency[10] ,as shown in Fig.7, the stability of photocatalysts is crucial for their practical application [11]. the photocatalysts can be reused without or with few loss in their activities [12].

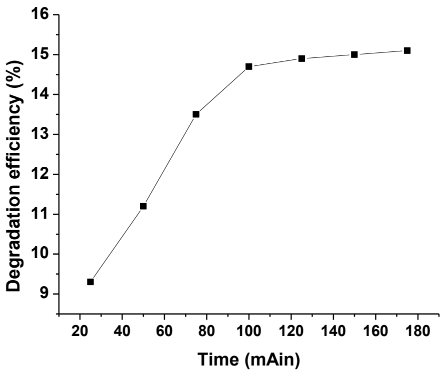

Figure 7.The relationship between nano photocatalytic degradation and time

Conclusions

1. 1-Use active photocatalytic semiconductor optical stimuli to improve the visible light response to the photocatalyst
2. 2- That photocatalytic hydrogen generation will be an important path to obtaining clean energy in the future.
3. 3-The design of a low-cost, high-efficiency photoelectric reactor has an important impact on the rate of hydrogen generation

NOT : The preparation of nano SnO_2, as well as nano ZnO , have not been presented because they have been published in a previous paper.

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