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Preparation and Study of the Spectral and Structural Properties of Nano Composite Sensitize Photoelectrode

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Abstract--- *Nanocomposite (TiO_2 -SnO_2) has been prepared of raw materials chemically, addition, by Nd-YAG Laser (PLD for manufacturing sensitize photoelectrode for electrolysis cell to produce hydrogen, and studied spectral electrode using UV- VIS spectroscopy, Also, structured has been studied, through the analysis of (XRD). and (AFM) to identify the roughness of the prepared sample surface.*

Keywords--- *Composite Sensitize, XRD, AFM.*

I. INTRODUCTION

Hydrogen is one of the most important fuels in the future, as our global economy relies heavily on fossil fuels produce a large amount of pollution and thus possess human health and ecosystem. Dependence on fossil fuels has negative political, and social consequences [1,2]. Nanomaterials are the basic components for the development of functional materials, optoelectronics, catalysis, etc. Currently, there is an increasing demand for nanocomposites because of their purified support properties and also demonstrate their applicability to various applications. Moreover, the hybrid nanomaterials of the semiconductor or oxides are interconnected through the superconducting interfaces in highly structured configurations [3] Metal oxide semiconductors have sufficient band gap energy to increase, or stimulate a wide range of photochemical reactions of environmental importance [4]. TiO_2 is the most studied because of its many attractive properties, light absorption properties of TiO_2, [5] And chemical stability in aqueous media [6]. The heterogeneous formation of TiO_2 with minerals or semiconductors has been shown to enhance charge separation, and transport of optically generated electrons, and pairs of holes, thus improving H_2 optical generation[7]. SnO_2 and TiO_2 have been used as semiconductor oxides for a wide range of applications [8]. its TiO_2 and SnO_2 oxides have good thermal stability, easy setup, good acid resistance, high bandgap compared to conventional semiconductors (3-4 volts) [9,10], Aim of the research sensitize Photoelectrode is to develop electrodes with nanometer dimensions in the process of electrolysis of water for producing clean hydrogen cells..

II. EXPERIMENTAL DETAIL

2.1. Nanocompsite (TiO_2 -SnO_2) Preparation

The compound has prepared by taking 1:1 of nano (TiO_2 -SnO_2). in a flipping condition. Crystallization was carried out under hydrothermal conditions at three temperature as (at 100 ° C, at 150 ° C and 180 ° C) in continuous stirring conditions Upon completion of the thermal crystallization process, the compound was repeatedly washed

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with dionized water, filtered and dried to The fixed mass in the laboratory dryer at 120 ° C.As dhown Figure.1.

Figure 1: Nanocompsite (TiO_2 -SnO_2). Preparation

2.2. Preparation of Sensitize Photoelectrode

Nano TiO_2 doped SnO_2 have prepared by pulsed laser deposition using a device Nd-YAG Laser,, the distance between the laser and the nanocompsite (TiO_2 -SnO_2) is approximately 20 cm and pulse duration 8 sec,. TiO_2 and SnO_2 were composed of layers respectively. Finally, all samples were annealed at 400 K, 450 K, and 500 K for 1 h, as shown in Figure. 2

Figure 2: Nano (TiO_2 -SnO_2). Electrode

III. RESULT AND DISCUSSION

3.1. Results of an Spectral Properties

The optical properties of the deposited nano (TiO_2 -SnO_2 on glass substrate at room temperature with thickness 90 nm and annealing temperatures (400, 450 and 500) °K have been determined within the wavelength range (250-1100) nm. The absorbance, transmittance and reflectance spectrum have been studied. Also the energy gap and optical constants have been determined. Figure(3,4) shows a plot of transmission versus wavelength for nano (TiO_2 -SnO_2).prepared at room temperature and Annealed at different annealing temperatures (400,450 and 500) °K. In general, we can observe that the transmittance increases with increasing of annealing temperature, which means a decrease in the reflection and absorption that occurs due to increase of annealing temperature. The shifts of transmittance spectrum to the shorter wavelength (higher energies) compared to that of the annealed films may be attributed to the decreasing in the defects,Also, it is observed that below 532 nm there is a sharp Fall in the transmittance of the films for all annealing Temperatures, which is due to the strong observance of the films in this region while the structure tends to be more transparent in the long wavelength region a good optical transparency of about 98% in the visible region is observed for nano (TiO_2 -SnO_2) in the annealing temperature of 500K. This value of optical transmission is sufficiently high for, use these films as a transparent electrode in thin film.

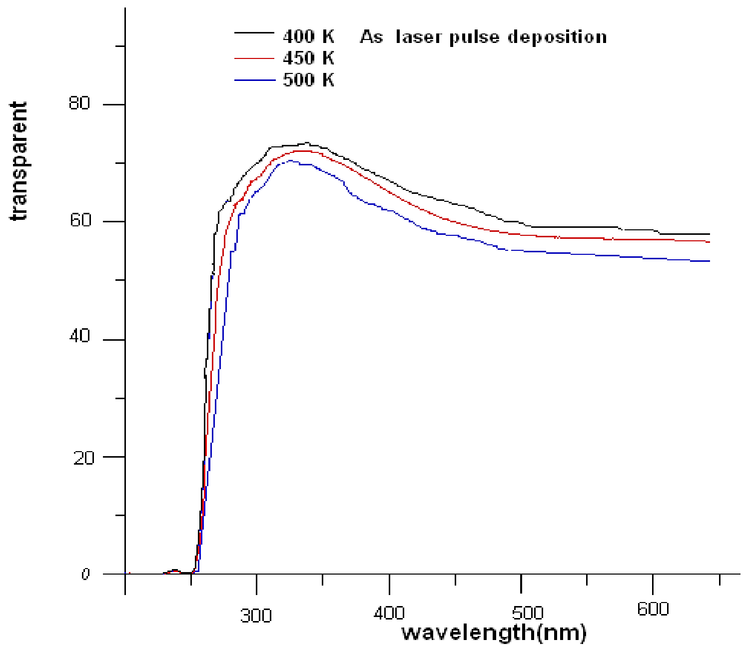

Figure 3: The spectrum of Transitions Electrodes

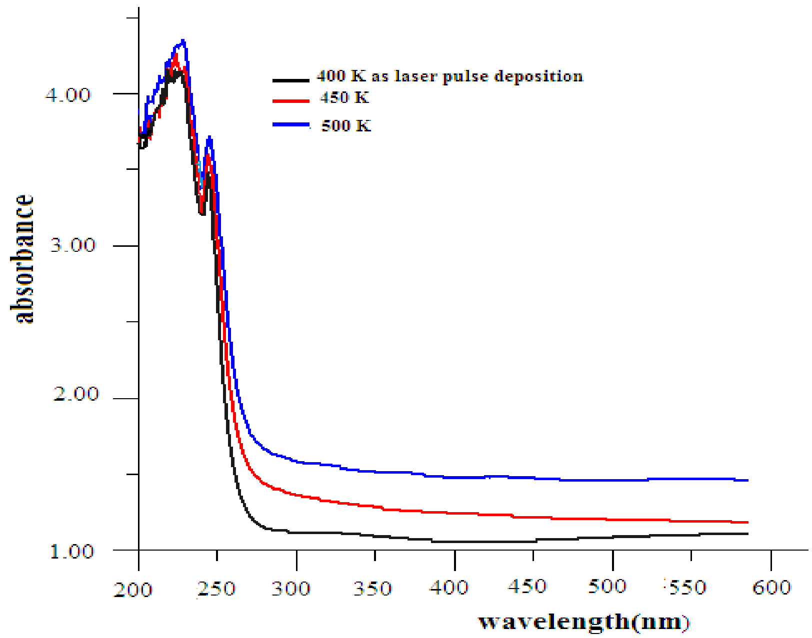

Figure 4: The Amount of Change in the Absorption Coefficientof the Electrode with the Wavelength

3.2. Results of the Energy Gap

The optical energy gap in the prepared nano (TiO_2 -SnO_2). is estimated to be in (3.41 - 3.89) eV. The energy gap is found to increase with increasing annealing temperature as shown in Table (1). The optical energy gap value is calculated for an allowed direct transition of nano (TiO_2 -SnO_2) before and after annealing by applying equation (1):

$$\alpha h\nu = A\,(h\nu - Eg)^r \quad (1)$$

Where A: Constant depends on the nature of the material, Eg : energy gap In allowed direct transition r = 2.A plot drawn between $(\alpha h\nu)^2$ versus hν.Is shown in Figure 5.

Table 1: The Values of the Energy Gap

Sample	T (K)	Eg(eV)
Co_3O_4	400	3.41
	450	3.52
	500	3.89

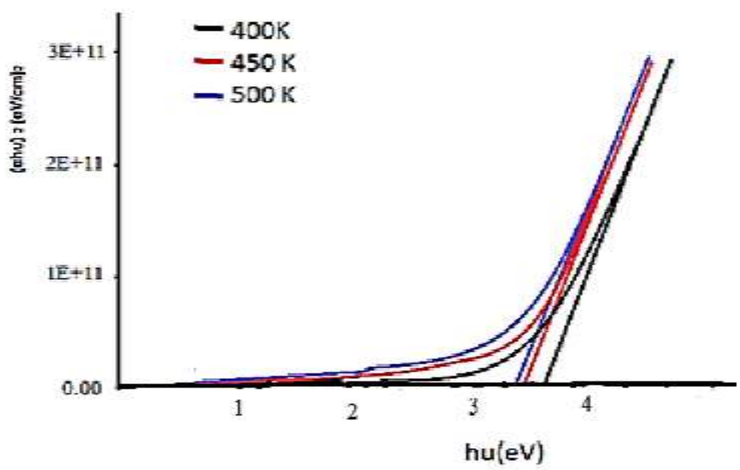

Figure 5: The Energy Band Gap of the Nano (TiO_2 -SnO_2)

3.3. Results of the X-Ray Diffraction

We used the Barak lawto calculate the distance(d)between theatomiclevels.

$$n\lambda=2d\sin\Theta \qquad (2)$$

Where:- n diffractionrankequal to(2).

Θ angle ofdiffraction.

λ :wavelength fX-rays[11].

Stageswere identifiedby comparingthe values ofthe spaces formed between thelevels afterX-ray diffraction standard tables (ASTM).Figure 6. demonstrates the XRD profile of the preparation nano (TiO_2 -SnO_2), nano crystals; the obtained diffraction peaks at planes (001), (111), (110), (211), and (102), indicates that all the precursors have been completely decomposed and no other complex products were formed.The X-ray diffraction patterns of nano ((TiO_2 -SnO_2).) which were as-deposited at 400 °K temperature and annealed at 450 – 500 °K temperatures with a fixedannealing. It was found that all the films were polycrystalline.. It was observed that the intensities of the peaks of few nano (TiO_2 -SnO_2). planes increased slightly with the increase of annealing temperature[12].

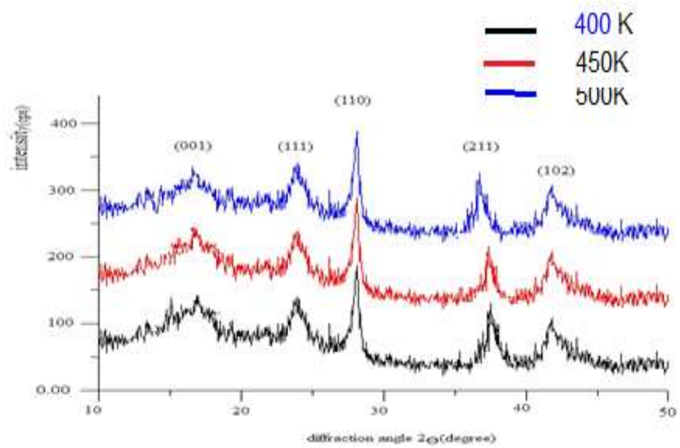

Figure 6: XRD Patterns of Nano (TiO_2 -SnO_2). Deposited

3.4. Results of an Atomic Force Microscope

Annealing has a pronounced positive effect on the prepared thin film oxide, as shown. In Figure 7a, 7b, and 7c. Changes in structural composition, surface formation, and properties of nano (TiO_2 -SnO_2). Resulting from precipitation time are affected by the large number, it is the best case when applying laser treatment due to increased Flue electrodes regularly and regulate the distribution of granules, the homogeneity of the laser-treatment thin films increased and the particle distribution was homogeneous

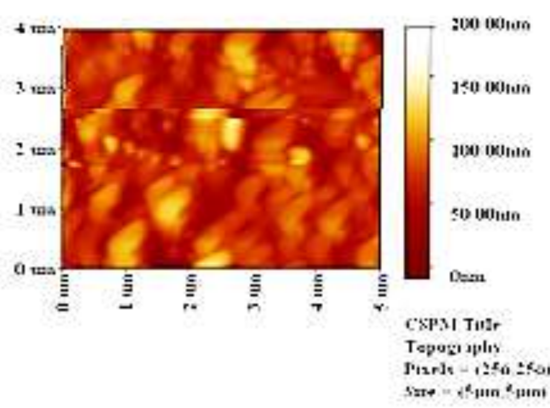

Figure (7a): AFM Image of Nano ((TiO_2 -SnO_2). Deposited at 400°K

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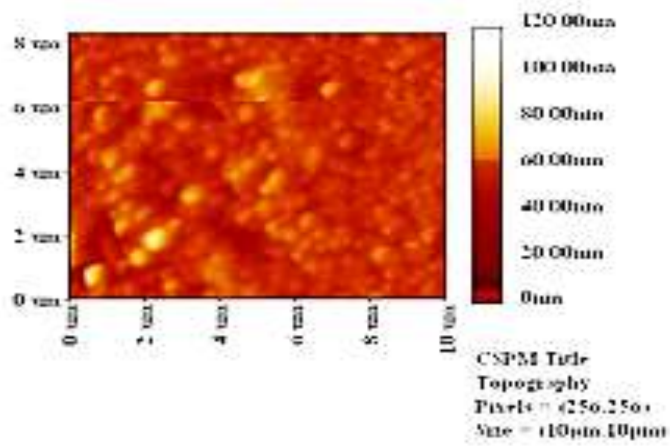

Figure 7b: AFM image of nano ((TiO_2 -SnO_2).)at 450°K

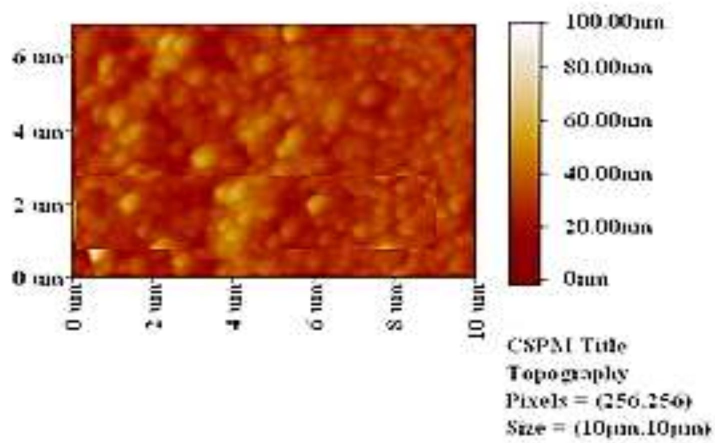

Figure 7c): AFM image of nano (TiO_2 -SnO_2). at 500°K

After studying the Spectral and we used this electrode as a node of the electrolysis cell. that the process of corrosion that occurs in the electrodes of the cell as a result of the impact of exchange between the materials and the surrounding medium by the water, the basic ways to adjust corrosion, a change in the structure of matter, technique was used nanotechnology to prevent corrosion and rust on the outer surfaces of the electrode

IV. CONCLUSION

The study of the optical properties of sight great importance from both theoretical and show how the possibility of using these materials nanometric in many applications such as electrodes nanometer, where cause these effects phasic shifts in the article, and sometimes for heating occurs without any material shift phasic, The band gap 3.89 eV which was decreased to. 3.41eV after annealing. This has been attributed to the decrease in defect levels, The AFM results show slower growth of crystalline sizes for the as-grown films and annealed films from 400 to 500 °K.

The transmittance decreased with increasing annealing temperature.

REFERENCES

[1] A. Fujishima, X. Zhang and D. A. Tryk, Surf. 2008, *Sci. Rep.*,, 63, 515-582.
[2] M. Ni, M. K. H. Leung, D. Y. C. Leung and K. Sumathy. 2007, *Renew. Sustainable Energy Rev.*, 11, 401-425.
[3] Raffaella Buonsanti, Fabia Gozzo, Vincenzo Grillo, Mar Garcia-Hernandez, Elvio Carlino, Miguel Angel Garcia and P. Davide Cozzoli, Cinzia Giannini, Roberto Cingolani. 2010, *J. Am. Chem. Soc.*, 132, 2437–2464.
[4] Arun Kumar Sinha, Mukul Pradhan, Sougata Sarkar, and Tarasankar Pal. 2013, *Environ. Sci. Technol.*, 47, 2339-2345.
[5] H. Tada, Q. Jin, A. Iwaszuk and M. Nolan, *J. Phys. Chem. C*, 2014, 118, 12077-12086
[6] H. Zazoua, A. Boudjemaa, R. Chebout and K. Bachari. 2014, *Int. J. Energy Res.*
[7] Wang, H., Zhang, L., Chen, Z., Hu, J., Li, S., Wang, Z., Liu, J., and Wang, X. 2014, *Chem. Soc. Rev.* 43, 5234–5244.
[8] Paulo Roberto Bueno*, José Arana Varela, 2006, Materials Research, Vol. 9, No. 3, 293-300,
[9] Cai X F, Zhang P and Wei S H.2019, *Journal of Semiconductors* 40 092101
[10] Shinde D R., Tambade P S and Chaskar M G. 2017, Drink. *Water Eng. Sci* 10 109
[11] James, F.S. Hackel, 2000."Materials Science for engineers", *Fifth edition, by prentice Hill Inc.*
[12] D. Lee, K. Nam, D.Lee, K. Nam, 2000. Thin Solid Films 375, 142.