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PREPARATION AND STUDY OF THE OPTICAL AND STRUCTURAL PROPERTIES NANOMEMBRANE

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Abstract

The adoption of nanotechnology to work within a field of sustainable energy within the preparation and manufacture of nano membrane (CO3O4, TiO) for fuel cell, which has prepared chemically. addition, using modern technology spraying ultrasound, to improve the structural, studied nano membrane have annealed in a vacuum and different temperature. studied optical properties membrane using UV- VIS spectroscopy, results of structural properties X-ray diffraction (XRD) showed that nanoparticles have polycrystalline also grain size decreased, composite nano membrane , Morphological studies using Scanning electron microscopy (SEM).
Keywords: Nano Membrane (CO3O4, Tio), UV- VIS Spectroscopy; X-Ray Diffraction; Optical Properties.

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Introduction

Many scientists and workers in field scientific research have recently paid attention to the production and development of environmentally friendly energy sources [1], the main barriers in fuel cells are the high-cost materials used in the manufacturing of these. researchers have focused on using nanotechnology to reduce costs by improving cell efficiency [2].The introduction of nanotechnology, which contributes considerably to sustainable economic growth, has broad applications in advanced technologies because of its characteristic properties [3]. As well as which are high conductivity and electric porosity, to allow high reaction flow, high surface area, and acceptable stability [4]. So they had to prepare materials with new specifications. And one of those materials that received attention is titanium dioxide.[1,5]. More membranes, materials used in electrodes for fuel cells are platinum (Pt) because of its excellent properties in high catalytic oxidation activity. But the cost is a major obstacle put on the commercialization of fuel cell technology [6], either CO3O4 has expanded rapidly over the past few years, this material exhibits strong photoactivity compared to other materials, due to its chemical stability and stability, high sensitivity [4]. Aim. Nafion membrane due to its high cost and limited availability. Cobalt oxide and titanium oxide were used instead because of their membranes ability, because of the different oxidation states, chemical stability, and low cost. It has studied the Optical and Structural Properties.

2Experimental

2.1NanomembranePreparation

The TiO supported Co3O4 nanoparticles has prepared as follows: 8 mM of precursors have prepare in the mixed solvent of deionized water 1, 1: 1 respectively; the prepared precursor solution after stirring at 30 temperature, the products have aged for 6 hours also the resulting precipitates have centrifuged, The mixed these materials by SonicatorsQsonica. LLC followed dried at 60 ◦C in an oven. As shown in Figure 1. In addition, the samples were then pressed with a special press to form a nanomembrane for a fuel cell.

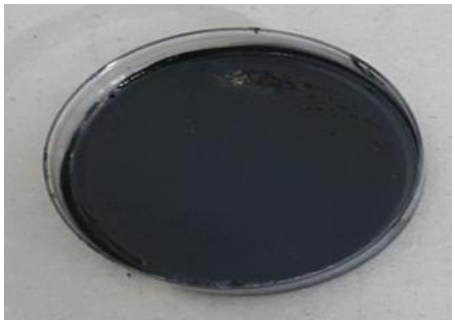

Figure.1. After mixing with the Sonica sonicators device

3.Results and discussion

3.1 Optical Properties Of nanostructure nano membrane (CO3O4, TiO):

The optical properties of nanostructure nanomembrane CO3O4:TiO deposited on a glass substrate have been investigated. The absorption and transmittance spectra have been studied at different thicknesses as a function of wavelength in the rang (450-1200), as shown in Figure 3.It can be observed that when the thickness of the nanomembrane increases. The absorption value has also increased because, in the state of thicker nanomembrane, more atoms are present in the nanomembrane more states will be available for the photons to be absorbed. In the visible light region, as agree with [7]. the strong photo-absorption has presented in the wavelength 460 nm and for all thick, as shown in Figure 4.

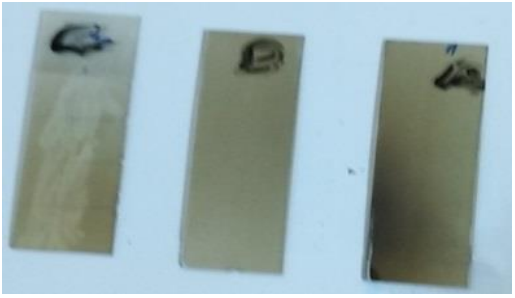

Figure 3nanomembrane CO3O4:TiO deposited on a glass substrate at different thicknesses

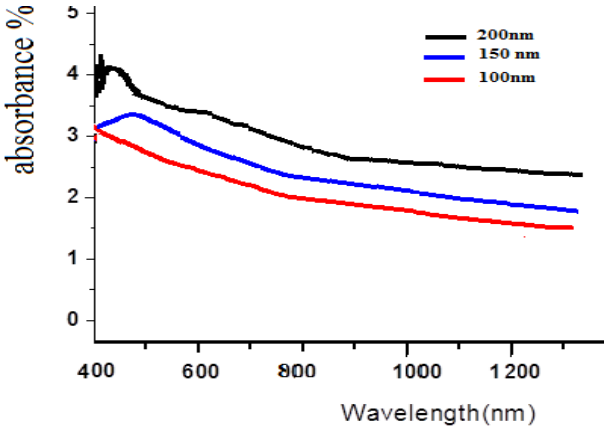

Figure 4: Absorbance spectra of nano membrane (CO3O4, TiO) at different thicknesses

Nanomembranes are not highly transparent in the visible range of the electromagnetic spectrum with a maximum value of about (49.5%) was recorded with nanomembrane with a lower thickness of (100 nm), transmittance decreases slightly with the increase of nanomembrane thickness. This behavior has attributed to the increased in the number of atoms with the thick that leads to the increased of the number of collisions between incident atoms, which in turn, leads to the increase of absorption and decreasing transmittance,as agree with [8]. As shown in figure 5.

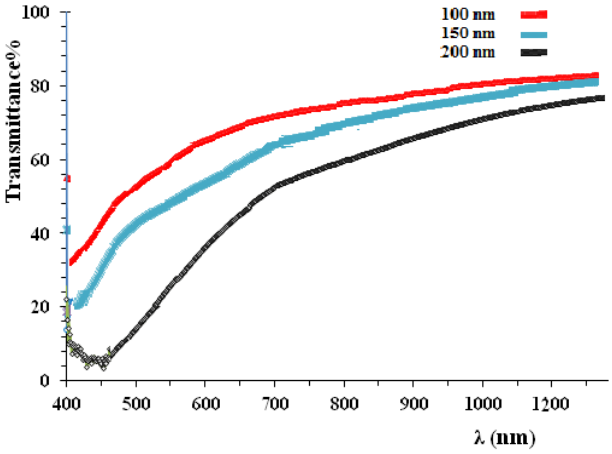

Figure 5: Transmittance spectra of nanomembrane

CO3O4: TiOat different thicknesses

3.2X-Ray diffraction

The structural analysis of nanomembrane CO3O4: TiO deposited on the glass substrate, at different thicknesses of different temperatures of substrates, has been analyzed by using X-Ray diffraction Figure 6. Shows the XRD patterns of various nanomembranes CO3O4, TiO deposited on a substrate. It is clear that the three diffraction shows a preferred, and the intensity of the peaks increases with the time deposition of nanomembranes,t his effect can be related to the

increase of both, thickness and grain size of the nanomembranes with time, as agree with [9,10], as well as It was seen from the XRD patterns that the nanomembrane has polycrystalline.

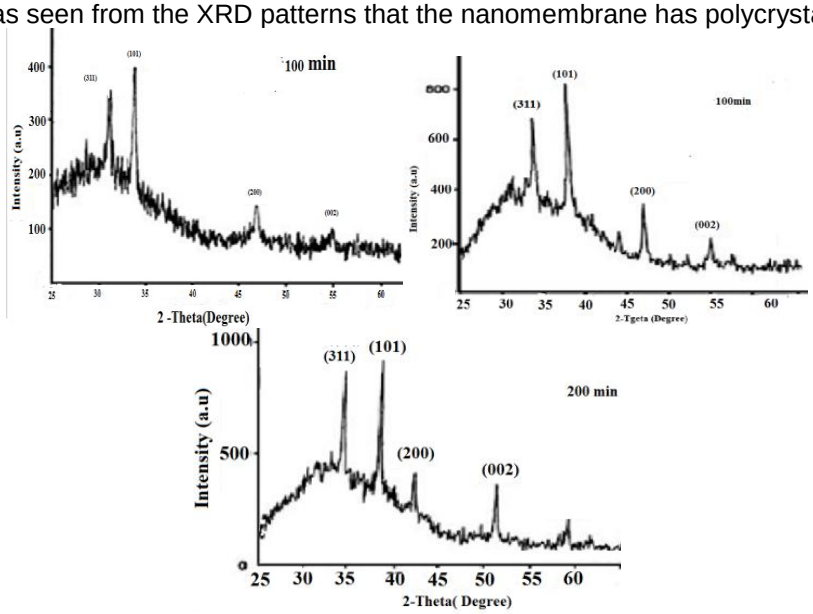

Figure 6: X-Ray diffraction of nanomembrane CO3O4: TiO at different thicknesses

3.3. BScanning electron microscope (SEM)

Thenanomembrane has spatially only one degree of freedom, in which they can grow, namely vertically aligned to the surface. The distribution of the nanomembrane diameters is a broader range (20 –100 nm). The density of nanomembranes could be further increase if all clusters would be nucleation centers. The growth rate mainly depends on the diffusion rate of material . In the case of nano remembrance, we observe in Figure 7. That the growth is vertically aligned and curly shaped

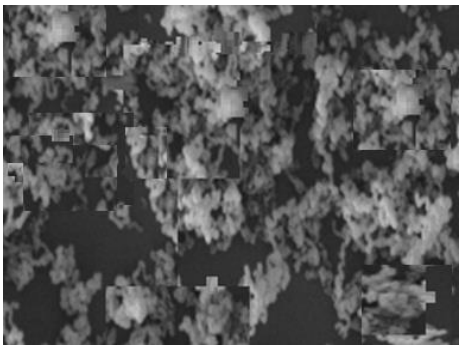

Figure 7: SEM of nanomembrane CO3O4: TiO

After studying the optical and structural properties and achieving special tests for the nano-membrane, it is used as a supper for a fuel cell. The fuel cell is manufactured using nanotechnology, by adopting a low-cost technology path, as shown in Figure 8.

Figure 8.Laboratory workshowshydrogen production on nano electrode

4. Conclusions

1- Preparation and fabrication of nano-membrane (CO3O4: TiO) by adopting nanotechnology
2- Through this study found that the thickness of the nanoparticle increases. Absorption value also increased
3- Transmittance decreases slightly with the increase of nanomembrane thickness
4- The grain size of the composite nanomembrane is decreased

Note that the details of the fuel cell cell and its work were not mentioned, and that was published in a previous paper

Reference

Xioobo , C. and S.S. "Titanium dioxide nanomaterials synthesis , Properties Modifications and application " Chem Rev , 107 : 2891 – 2906 .Mao ,2007

Akira Fujishim , Xintong Zhang, Donald. A. Tryk, "Heterogeneous photocatalysis: From water photolysis to applications in environmental cleanup", International Journal of Hydrogen Energy 32,2664–2672, 2007.

N. Ćirović, P. Spasojević, L. Ribić-Zelenović, P. Mašković, M. Spasojević " Synthesis, structure and properties of nickel-iron-tungsten alloy electrodeposits part I: Effect of synthesis parameters on chemical Composition, Microstructure and Morphology" Science of Sintering, 47 ,347-365.2015.

Elena Serrano , Guillermo Rus , Javier Garcı, Martı´nez, " Nanotechnology for sustainable energy " Renewable and Sustainable Energy Reviews 13 ,2373–2384. 2009/

Diebold , V, , " The Surface Science of titanium dioxide " Surf Sci . Rep, 28 : 53-229,2003l

Shangfeng Du and Bruno G " Applications of NanomaterialsinFuel Cells" author profiles for Chapter 7 • June 2014.

SuryakantMishraOrcid, Priyanka Yogi, P. R. SagdeoOrcid, and Rajesh Kumar, " TiO2–Co3O4 Core–Shell Nanorods: Bifunctional Role in Better Energy Storage and Electrochromism", ACS Appl. Energy Mater. 2018, 1, 2, 790–798

2# Yan Song, Yunfeng Li, YuePeng, Chengwei Zhang, Fuxing Yin , " Co3O4@3D ordered macro-/mesoporous TiO2 as an excellent cathode catalyst for rechargeable Li–O2 batteries, Microporous and MesoporousMateria Volume 314, February 2021

V. Ramakrishnan, H. Kim, J. Park and B. Yang," Cobalt oxide nanoparticles on TiO2 nanorod/FTO as a photoanode with enhanced visible light sensitization", RSC Adv., 2016, 6, 9789 .

ThorbenMuddemann, Dennis Haupt , Bolong Jiang, Michael Sievers and Ulrich Kunz " 1Investigation and Improvement of Scalable Oxygen Reducing Cathodes for Microbial Fuel Cells bySpray Coating",Processes 2020, 8, 11;