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Green Fabrication And Characterization Of In_2O_3-Sno_2 Nanocomposite From Acacia Gum

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Abstract

This study demonstrate the green synthesis of In_2O_3-SnO_2 Nanocomposite using acacia gum as capping agent. The precursors used were Indium (III) acetylacetonate, Tin(IV) Bis (acetylacetonate) dichloride and acacia gum. The particles thereby obtained were characterized by X-ray diffraction (XRD)to calculate average particle size and analyzed the calcinations temperature by TGDTA.The morphological analysis and chemical composition were bring off by scanning electron microscopy(SEM/EDX).Fourier Transform Infrared (FTIR)spectroscopy is used for analyzing the functional groups which is involved in the reaction, Zeta potential to know the stability. Optical properties were carried by UV-Visible spectroscopy (UV-Vis) to analyze the absorption patterns and energy gap.

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Keywords: In2O3-SnO2 Nanocomposite; Acacia gum; Green synthesis;characterization

1. Introduction

In recent times generation of nanoparticles by green synthesis has developed into more attractive. The utility of green synthesis is eco-friendly, simple, economic, non – toxic and preferable to other techniques. Green chemistry and biosynthesis are interrelated with Nanoscience and technology [1]. Nanoparticles are generated by various approaches like chemical, physical and biological methods. The Fabrication of Nanoparticles by physical and chemical methods incorporate with laser ablation, chemical, physical vapour deposition, pyrolysis,or, sol-gel, and lithography electro-deposition utmost of them have toxic effects on human health, which restrict their extensive

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application [2]. Fabrication of nanoparticles by biological method is considered as a better choice as a clean, compared to other physical and chemical methods. Plant extract may act as both reducing and capping agent. Biopolymers like derivative of chitosan, derivative of cellulose, dextran or tree gums, are often used as reducing and stabilising agents for metal and metal oxide NP synthesis As Natural gums are natural polymers, lower toxic, nature friendly they have numerous properties and are preferred over comparable synthetic polymers due to their availability, lower-toxicity Natural polymers and plant extracts are very attractive for this purpose as they are environment friendly and abundant. [3].As plant derived biopolymer available economical, this method could be executed for the large scale production of highly stable nanoparticles.

As Metal oxide nanostructure have large surface area to volume ratio, dimensions, size, specify morphology would show a great impact on device properties.[4,6].Among many metal oxide, Indium tin oxide is unique and recent used in commercial applications such as displays, solar cell, and photovoltaic devices because of excellent electrical conductivity, optical transparency and thermal stability [5,7]

In the present study we have report the facile synthesis of Indium Tin oxide Nano composite using Indium acetylacetonate and Tin Bis acetylacetonate dichloride by plant Extract Such as Gum acacia.

Using Gum acacia as a cheap precursor for the current simple method provides high yield nanosized material with well crystal structure and better optical properties. The metal oxide nanoparticles formation has been characterized by a various physical techniques such as TGDTA, SEM-EDAX, UV-vis spectroscopy, XRD and FT-IR and zeta potential.

2. Materials and Methods

2.1 *Chemicals*

In the present investigation for Indium Tin oxide(ITO) Nanocomposite ,the chemical material used were Indium (III)acetylacetonate,Tin(IV)Bis(acetylacetonate)dichloride(99.99% purity,) was procured from (Sigma Aldrich India) and Gum Acacia from local market.

2.2 *Synthesis of Indium Tin Oxide NCs*

The Gum acacia (0.1gm), Indium (III)acetylacetonate(0.6gm) and Tin(IV)Bis(acetylacetonate) dichloride (0.2gm) were mixed and powdered into fine powder using motor and pestle .The precursors was characterized by thermogravimetric-Diffrential thermal analysis (TG-DTA) to determine thermal stability, weight loss during heat treatment .The prepared composite was evaluated by TG-DTA from room temperature to 600ºC at a scan rate 10ºc/min in air and crystallization temperature was found to be 400ºC.The dried precursors is sequentially calcined in box at 500ºc and 600ºc for 2hrs in air. The sample were cooled to obtain a pale yellow colored powder, which was confirmed by XRD to be In_2O_3-SnO_2 Nanocomposite

The prepared sample was analyzed with X-Ray diffraction (XRD) using monochromatic CuKα radiation ($\lambda = 0.154cm$) running at 40kv and 30mA and crystalline size was calculated by applying debay scherrer equation .Scanning Electron Microscope (SEM), EDX analysis was done to understand the morphology and composition of synthesized ITO Nps, and to verify the existence of Indium, Tin and oxygen in the particle moreover to notice any other component if present.

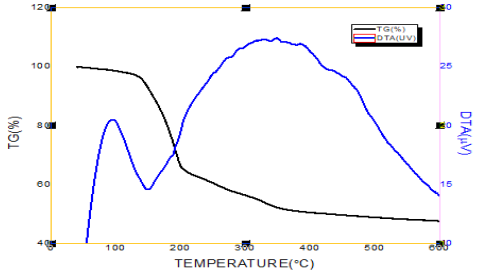


Fig1. TG-DTA curves of thermal stability of the synthesized In_2O_3-SnO_2 Precursors at a scan rate of 10ºC/min in static air

3 Results and discussions

3.1 *TG-DTA Analysis*

Thermal decomposition of synthesized In_2O_3-SnO_2 Nanocomposite was analyzed by Thermo gravimetric-Differential analysis shown in Fig 1.The TG curve in the representative thermo gram(Fig1) shows first weight loss at 150ºC which correspond to the removal of water. The second weight loss from 150ºC to about 400ºC indicated that decomposition starts at this temperature due to fragmentation of hydroxyl (OH) and CO groups. The loss in weight continues up to 500ºC and above this temperature the weight of the sample stays constant.DTA thermo gram (Fig1) shows the endotherms at 350ºC due to burning of organic species in the precursor powder from the amorphous component.

3.2 *XRD Analysis*

A yellow coloured In_2O_3-SnO_2 Nanocomposite displays the XRD pattern and the difractogram (222),(400),(440),(622) coincide with cubic bixbyte structure of indium oxide(10.0996Aº) which is well consistent with the standard data file (JCPDS 06-0416) without any identification of crystalline Sno_2 as an additional phase. By using Debye Scherrer equation $d = \frac{k\lambda}{\beta\cos\theta}$, where d is particle size, λ is X-ray wavelength and k is constant(0.89), β is full width half maximum(FWHM=0.63380,0.46980) at 500ºC,600ºC the estimated average particle size of synthesized In_2O_3-SnO_2 Ncs calculated and found to be 12nm and 16nm as shown in below Fig 2 and Table 1.

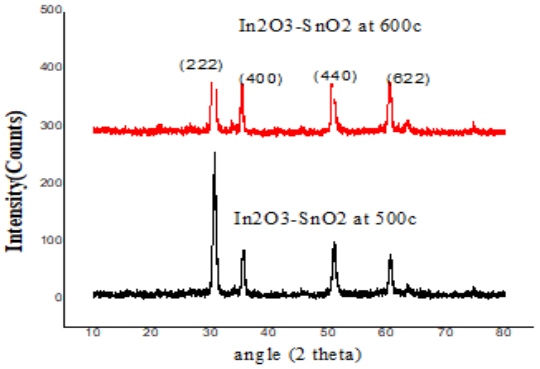


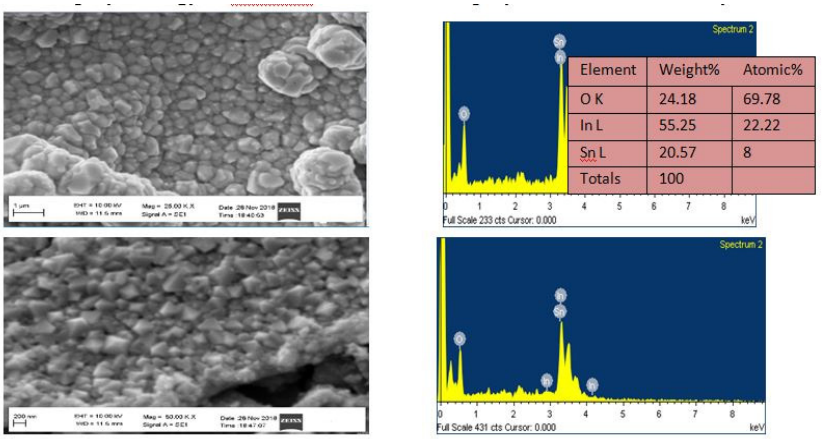
Fig 2 XRD Pattern of In_2O_3-SnO_2 Nanocomposite calcined in air for 2 hours 500ºcand 600ºc

Table 1. In_2O_3-SnO_2 Nanocomposite from different characterization

	Average Particle size from XRD(nm)	Cubic lattice Parameter a (nm)	Morphology from SEM
500ºC	12nm	1.0099nm	Spherical
600ºC	16nm	1.0162nm	Cubical

3.3 *SEM&EDAX Analysis*

The morphology of the gum acacia mediated In_2O_3 and SnO_2 was studied by Scanning Electron Microscopy (SEM) Fig. 3 which shows evidently and clear image of Synthesized nanoparticles having spherical shapes at 500ºc and cubical at 600ºc.The presence of elemental composition of oxygen, Indium and tin were confirmed by the analysis through EADX spectrometers. The horizontal axis displays energy in KeVand vertical axis displays the number of X-ray counts .



(a) (b)

Fig 3SEM/EDAX images of of In_2O_3-SnO_2Nanocomposite calcined in air using acacia gum at (a) 500°C,(b) 600°C

3.4 FTIR Analysis

The FTIR spectra of In_2O_3-SnO_2 stabilized with acacia gum typically shows stretching 3443.05, 2922.25, 2359.02, 1647.26, and 1159.26 cm-1are identified. The presence of the very intense band at 3443.05, 2359.02 cm-1 and the moderate 1159.26 band at cm-1 confirms presence of O-H and C-O stretching's from Acetylacetonate species.

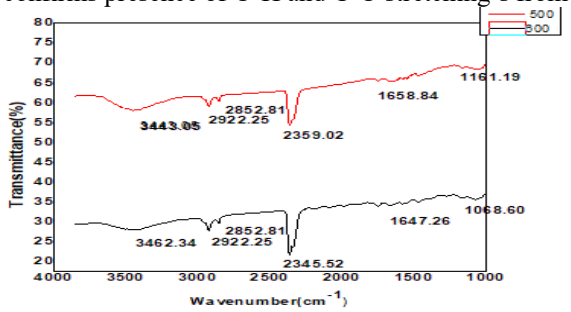


Fig 4:FTIR spectra of In_2O_3-SnO_2 Nanocomposite calcined in air using acacia gum

3.5 UV-Vis Absorbance and Zeta potential

The light absorption property of In_2O_3-SnO_2 investigated by uv –Vis spectroscopy shows strong characteristic peaks at 332nm spectra of Fig 4 and energy gap show 3.8ev .The zeta potential value of In_2O_3-SnO_2 Nanocomposite is -69.1mv and . -93.6 mv at 500°C and 600°C (Fig 5) and this assures excellent stability .As the temperature increases more is the stabilization as shown in below Fig 6.

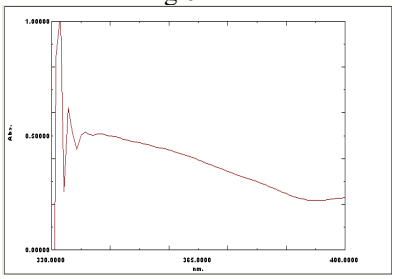


Fig5:UV-Vis Spectroscopy of In_2O_3-SnO_2 Nanocomposite with acacia gum

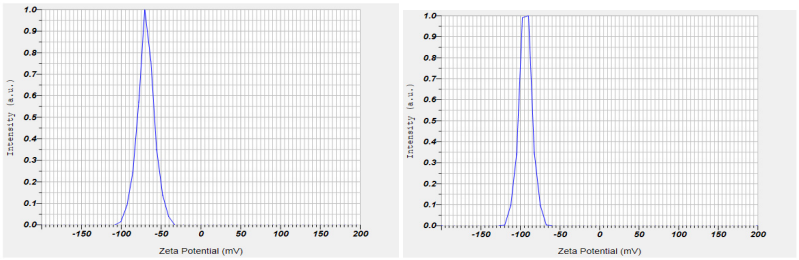


Fig6: Zetapotential of In_2O_3-SnO_2 Nanocomposite with acacia gum at 500ºC& 600ºC

Conclusion:

The synthesized In_2O_3-SnO_2 Nanocomposite with acacia gum were prepared by Green synthesis results shows that crystalline size is around 12nm and 16nm when studied from XRD and forming spherical and cubical structure by SEM analysis when calcined at 500ºC& 600ºC.The band gap is 3.8ev by indirect optical transmission from UV-Vis spectroscopy which is good agreement with theoretical value.

References

1. P. Karpagavinayagam, C. Vedhi, “Green synthesis of iron oxide nanoparticles using Avicennia marina flower extract”, *Vacuum*, Volume 160,2019,Pages 286-292,ISSN 0042-207X.
2. .Shani Raj, Suresh Chand Mali, Rohini Trivedi,”Green synthesis and characterization of silver nanoparticles using Enicostemma axillare (Lam.) leaf extract”, Biochemical and Biophysical Research Communications, Volume 503, Issue 4,2018,Pages 2814-2819,ISSN 0006-291X.
3. Vinod Vellore Thekkae PADIL1, Stanislaw WACŁAWEK1 and Miroslav černík1* “green synthesis: nanoparticles and nanofibres based on tree gums for environmental applications” ecol chem eng s. 2016;23(4):533-557.
4. Ramireddy Boppella: Advance in synthesis of nanostructure metal oxide for chemical sensor. Chemical sensors 2014,4:19
5. Melvin David Kumar,Yun Chang Park,Joondon Kin “Impact of thin metal layer on the optical and Electrical properties of Indium Doped Tin oxide and aluminum dopedZinc Oxide Layers” Super lattices And Microstructure 82,2015,Pages 499-506
6. Kolekar, T.V., Bandgar, S.S., Shirguppikar, S.S., Ganachari, V.S., 2013. Synthesis and characterization of ZnO nanoparticles for efficient gas sensors. Arch. Appl. Sci. Res. 5 (6), 20–28.
7. Study of Indium Tin Oxide Nanomaterials Obtained from Vapor Phase by Electron Microscopy -Marcelo Ornaghi Orlandi 1, Alexandre José Castro Lanfredi2 and Elson Longo1