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Microwave Assisted, Eco friendly - Biosynthesis and Characterization of Alumina Zinc Oxide (AZO) Nanoparticles using Myrobalan fruit extract

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Abstract – This article explore the preparation of Aluminium doped Zinc Oxide nanoparticles by biosynthesis method. It also known as greener synthesis method. This biosynthesis is Eco friendly, chemical free and nontoxic. In this synthesis, extract of Myrobalan fruit is used. Rich amount of Ascorbic acid is available in Myrobalan fruit may act as reducing and capping agents. It also acts as a good photo catalyst. The Structural, Morphological and Optical Characteristics are characterized by XRD, SEM and UV Visible Spectroscopy. The XRD analysis reveals that the particle size was 53 nm. The shape of the nanoparticles observed in wurzite format. The maximum peaks indexed as 100,002,101,102,110,103 and 200. The optical transmittance spectrum of AZO nanoparticle was about 85%. The SEM image indicates that the morphology has less aggmolaration.

Key words: Biosynthesis, Nanoparticle, Myrobalan fruit extract, AZO, XRD, SEM

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1.0 INTRODUCTION

ZnO is an N type semiconductor having direct energy band gap (3.37ev) and high binding energy (60 meV) (Khan, et. al., 2013). ZnO nanoparticle can be used in sensors, catalysis, water purification, antibacterial, nano electronics, solar energy, cosmetics, paints, synthetic textiles, food, packaging, medical care, health care, tooth paste, detergent and sun screen. At room temperature the electrical resistivity of the Zinc oxide was in the order of 0.75MΩ.the resistivity of the ZnO material can be reduced by doping with group – III materials. Zinc oxide materials can be easily doped with group – III material such as Ga, In, B and Al. In this work, aluminium is dopped with ZnO nanoparticle. AZO is an valuable alternative to ITO materials. It has increased optical transmittance and low electrical resistance (Selvakumari, et. al., 2016).

Synthesized AZO nanoparticle canbe prepared by sol gel, sprayprolysis, precipitation, hytrothermal method, chemical vapor deposition and microwave irradiation. Widly the microwave irradiation method is used to synthesize the AZO nanoparticles. Microwave irradiation method draws attention due to its homogeneous volumetic heating, simple and economical method (Krishnakumar, et. al., 2009. Kiruthiga and Krishnakumar, 2015). The prepared AZO material having peculiar optical property. so that it is involved in preparation of electric transducer, solar cells (Varghese and George, 2015).

2.0 EXPERIMENTAL SECTION:

Myrobalan fruit is also known as gooshberry, amla. Myrobalan is highly nutritious and is the richest source of vitamin C. (Lakshmi, et. al., 2016). It also has minerals and amino acid. All the parts of it plants such as leaves, stem, vegetation, seeds and roots are used to prepare the AZO nanoparticle (Vennila and Jesurani, 2017). It can be used for improve the eyesight, control the diabetes, cooling agent, enhances oral health, prevents cancer, improves bone health, treats wounds and is an powerful antioxidant. It also used for hair benefits such as strengthen hair, prevents premature graying, treats the dandruff, and improves pigmentation and conditions for hair.

2.1 Preparation of myrobalan fruit extract:

The freshly ripened myrobalan fruit has been purchased from local market at Coimbatore. Then it was washed with running water in the tap to remove the dust on it. Again it was washed with double distilled water. 50 gms of myrobalan fruit was chopped in to very small pieces. The chopped myrobalan fruits were crushed in to paste by using

mortar and pestle. Paste of myrobalan fruit was mixed with 100ml of distilled water and was boiled for 10 minutes at 100°c. The boiled water allowed cooling at room temperature. Pale yellow colored myrobalan fruit extract was filtered using whatman filter 1 paper with 0.4 micron thickness.

2.2. Preparation of AZO nanoparticles:

Figure 1 shows the synthesized producer of AZO nanoparticles.In this synthesized method the aqueous solution of Zinc actate dehytrate ($Zn(CH_3COO)2H_20$) is an precursor and Aluminium nano nitrate ($AL(NO_3)9H_20$) was a source of aluminium. 1.0M of Zinc acetate dehytrate was dissolved in 100 ml of double distilled water by using hot plate magnetic stirrer. 1 at % of aluminium nitrate was mixed with this dissolved solution. Liquid ammonia also added into it in dropwise to adjust the PH value to 8.0. 10ml of freshly extract of myrobalan fruit added in dropwise in it. The liquid ammonia converts the solution in gelation format. It was stirred vigorously for 40 minutes at 80ºc.The prepared solution was allowed to get cool at room temperature. At last pale yellow colored AZO precipitate formed at the bottom of the beaker.

The prepared precipitate solution was filtered using whatman filter paper and was washed for four times using double distilled water. The washed precipitatewere dried at 60°c temperature to evaporate water molecules. The dried precipitate kept in microwave oven. The microwave irradiation was performed for 15 minutes at 160°c. Moreover it is placed in muffle furnace for 4 hours at 150°c to dry the particle again. The dried synthesized particle has been powered using mortar and pestle.

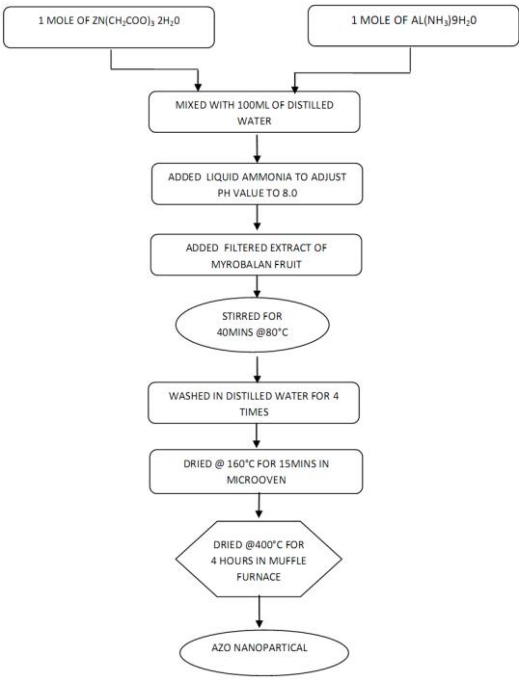

Fig 1:Flow chart of AZO nanoparticles synthesis

3.0. RESULTS AND DISCUSSION:

3.1. X-RD:

The synthesized AZO-Goose berry extract nanoparticles are examined in X-RD for 2^{θ°. In ranging from 10 to 80 using Cuk^{α} relation at =1.5406 A°. The average size of the synthesized nanoparticle is calculated by scherrer formula. The synthesized AZO nanoparticles are in-wurzite structure and we found the maximum peaks at 100,002,101,102,110,103 and 200 which were matched with JCPDS 36-1451 of AZO material. Synthesized ZnO nanoparticle crystallite size was 53nm.

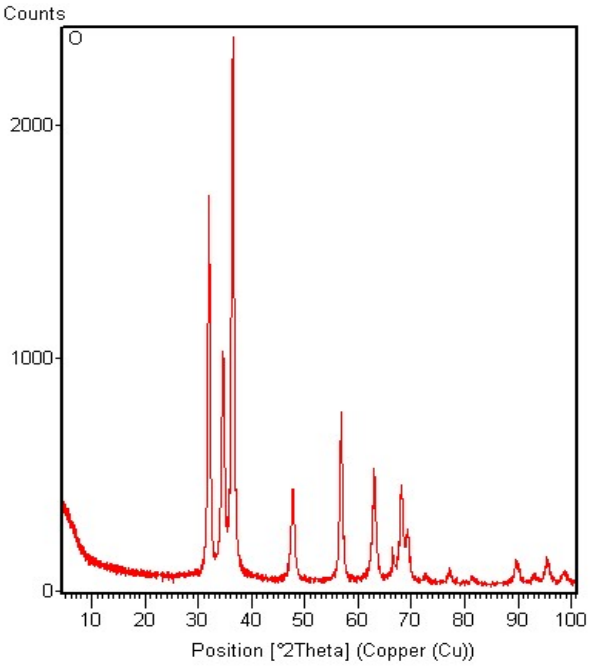

Figure 2: X-RD Pattern of AZO nanoparticle using Biosynthesis method

$D=K\lambda\beta\cos\theta$

Where D is the crystalline size of AZO nano particle λ represent the wavelength of x-ray source 0.1541 nm used in XRD β is the full width at half maximum of the diffraction peaks K is the Scherrer constant with a value from 0.9 to 1 and θ is the Bragg angle

3.2 SEM:

The size and shape of the nanoparticle are depends upon nature of the reducing agent. Ascorbic acid present in the Myrobalan fruit extract may act as a reducing and stabilizing agent. The SEM image of AZO prepared by using Myrobalan fruit extract ie., Biosynthesis method shows the morphology and structure. Myrobalan extract used as an bio template which prevented the particle to form more

agglomeration and reduced its size. The morphology has only small amount of agglomeration.

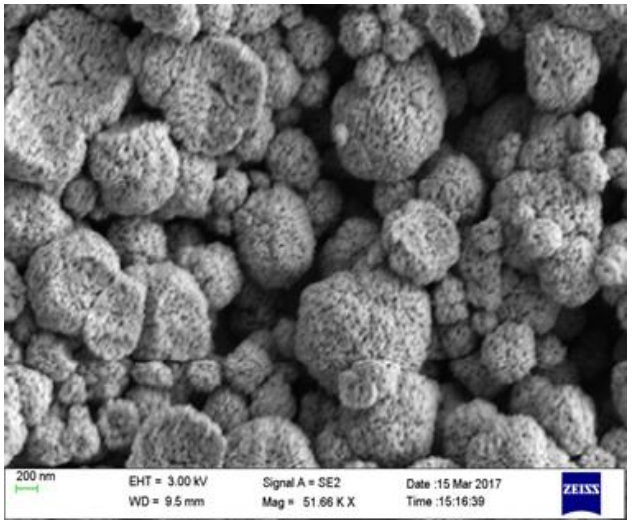

Figure 3:SEM image of 1 at.% of AZO prepared by BioSynthesis method

3.3 U-V absorption technique:

The optical transmittance spectra of Aluminium doped ZnO- myrobalan fruit extract nanoparticles were prepared at room teprature in the wavelength of 200-600nm. The optical transmittance spectra of AZO was about 85%. It shows that ZnO nanoparticle having photocatalytic degradation ability.s

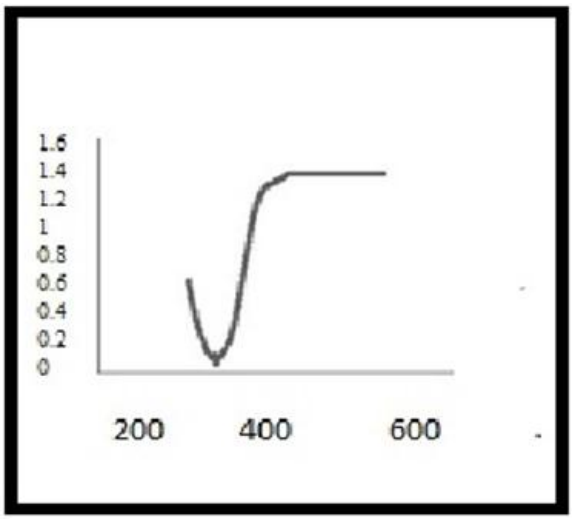

Fig 4: UV-visible spectra of AZO nanoparticle using greener method

CONCLUSION:

AZO nanoparticles can be prepared by greener method ie., using myrobalan fruit extract. The prepared nanoparticles were analysed by XRD, SEM and UV method. The synthesized nanoparticles characterized by XRD analysis shows that the synthesized particles are wurzite shape and size is 53nm. The SEM analysis shows that morphology of AZO using myrobalan fruit extract method having less agglomeration. The UV-V study also shows that transmittance spectra was about 85% at 400nm. This study confirmed the synthesized nanoparticle having photocatalytic degradative ability.

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