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RESEARCH ARTICLE

SYNTHESIS AND STRUCTURAL PROPERTIES OF ZnO NANOPARTICLES BY ALTERNANTHERA SESSILE LEAVES EXTRACT.

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Abstract

Green synthesis is environmentally friendly technique for synthesis of metal Oxide nanoparticles.In this present work, synthesis of ZnO nanoparticles were prepared by Green Synthesis method. Here Leaf extract of Alternanthera Sessile can be used as reducing and capping agent for synthesis of stabilized ZnO nanoparticles .ZnO nanoparticles were characterized by X- ray diffraction (XRD), Scanning Electron Microscope (SEM), Energy dispersive analysis of X-rays (EDAX)and Fourier transform infrared spectroscopy (FTIR).From X-ray diffraction studies it is observed that (101) phase obtained at 36.68^0 2theta value.The size of the nanoparticle is 22nm at this peak.It was observed that the shape of the ZnO particles is agglomerated spherical by SEM attached with EDS analysis. From FTIR analysis ,it was observed that Alkenes and Nitriles functional groups in this leaf extract used as reducing agent for synthesis of ZnO nanoparticles. It was proved by peaks were obtained at wave numbers $809cm^{-1}$,$909cm^{-1}$,$2331cm^{-1}$ and $2361cm^{-1}$.

Introduction:-

ZnO is one of the most promising materials for analyse optical and electrical properties. The superiority of ZnO photocatalytic activity and semiconductor property because it is direct band gap semiconductor of, bandgap of 3.37 eV.ZnO has a wide range of applications in optoelectronic devices such as light-emitting diodes, photodetectors, and p-n homojunctions lasers. ZnO has higher luminescence efficiency of the emitted light even at room temperature. Many techniques including chemical vapor deposition, pulsed laser deposition, molecular beam epitaxy, sputtering, hydrothermal synthesis, and oxidation of metallic zinc powder have been used to prepare ZnO in different forms and structures for various applications. Nanoparticulate form enhances the catalytic activity due to its large surface area and the presence of vacancies and uncoordinated atoms at corners and edges. The photocatalytic activity is also improved by bandgap engineering, as a result of the quantum confinement effect. A well-controlled synthesis process at room temperature is needed for the economical use of ZnO in catalytic applications such as water treatment and other environmental applications. Plant crude contains novel secondary metabolites such as phenolic acid,flavonoids,alkaloids and terpenoids in which these compounds are mainly responsible for the reduction of ionic into bulk Metallic nanoparticles formation.Plant metabolites involved in the bioreduction i.e Amine,Nitrile,Carboxyl and Alkene group in the Leaf extract of Alternanthera Sessile which one responsible for reducing ionic compounds into Metal oxide nanoparticles.Nano particles synthesised by green synthesis method, can be used for Anti oxidant

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and antimicrobial activity.From biological approach using leaf extract of Alternanthera Sessile has been used for the first time as a reducing material as well as surface stabilizing agent for the synthesis of spherical-shaped ZnO-NPs. The structure, phase, and morphology of synthesized product were investigated by the standard characterization techniques.

Experimental:-

Synthesis of ZnO-NPs:-

Zinc acetate dihydrate and glassware was purchased from Indian scientific company, tirupati. All glassware was washed with sterile distilled water and dried in an oven before use.

ZnO NPs can be synthesized by using the leaves extract of plant Alternanthera sessile. In this procedure, 600 ml of distilled water is taken and aqueous zinc acetate dihydrate is added into it under constant stirring and make it 0.1M solution.Then after 10 min stirring the aqueous leaf extract of Alternanthera sessile is introduced into the above solution. 2M NaOH is also added to make pH 12 resulting in a pale white aqueous solution.It is then placed in a magnetic stirrer for 2 hrs. After stirring, pale white precipitate is centrifuged and washed many times with distilled water followed by ethanol to make it free from impurities.Then after drying in vacuum oven overnight, a pale white powder of ZnO nanoparticles will be obtained at 100^{o}C temperature.

Chemical reaction formula:-

1. $Zn(CH_3COOH)_2.2H_2O + NaOH + \text{leaf extract} \rightarrow Zn(OH)_2\downarrow + 2CH_3COOH + NaOH$
2. $Zn(OH)_2 \rightarrow ZnO + H_2O\uparrow$

Result and Discussions:-

From X-Ray Diffraction (XRD) Analysis of The ZnONp powdered sample was examined by a CuKa1- X Ray Diffractometer for confirming the presence of ZnO and its structure. Main peaks corresponding to 2θ values of 32.14°, 34.83°, 36.68°,47.98^{o} ,56.91^{o} ,63.32^{o}, 68.38^{o},69.58^{o},77.40^{o},90.07^{o} and 95.86^{o} in the multi-plot have observed from the graph as shown in Fig . The observed peaks of the graph are in good agreement with the JCPDS data card no:36-1451,proved that ZnO NPs has Wurzite structure. Peaks was compared to standard literature values and the presence of zinc oxide particles was confirmed. The average size of the particles was calculated as 22nm using Debye-Scherrer's formula:

$$D = \frac{k \times \lambda}{\beta_{hkl} \times cos\theta}$$

where k is Scherer constant=0.9.

the wave length of the source λ = 15.406nm.

Lattice parameters are calculated from the following equations $a = \frac{\lambda}{\sqrt{3}\sin\theta_{100}}$

$$c = \frac{\lambda}{\sin\theta_{002}}$$

$$V = \frac{\sqrt{3}a^2c}{2}$$

Interplanar spacing $d_{hkl} = \frac{1}{\sqrt{\frac{4\left(\frac{h^2+k^2+hk}{a^2}\right)}{3} + \frac{l^2}{c^2}}}$

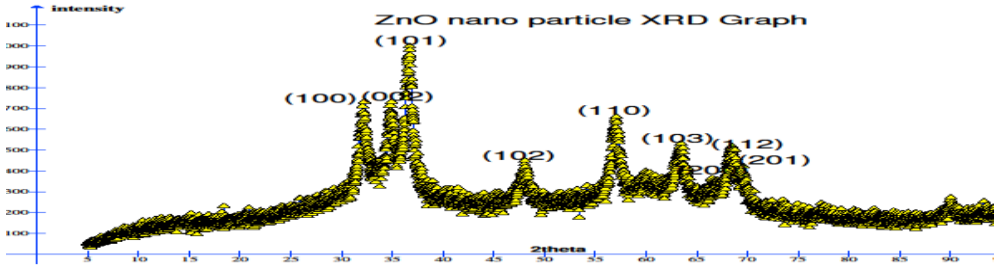

Fig 1:- XRD graph of Alternanthera Sessile leaves ZnO nanoparticles

Table 1:- The structural parameters of Alternanthera Sessile leaves ZnO nanoparticles

data	2θ	hkl	d_{hkl} (Å)	Structure	Lattice parameters(Å)	V (Å^3)
sample	32.14 34.83	(100) (002)	2.783 2.582	Hexagonal	a=3.213 c=5.152 c/a=1.6035	46.05
Jcpds(36-1451)	31.770 34.422	(100) (002)	2.814 2.603	Hexagonal	a =3.250 c =5.207 c/a =1.6021	47.63

SEM &EDAX analysis:

From the SEM analysis observed that ZnO nanoparticles were agglomerated spherical in shape.In reported journal they have stated that agglomerated spherical Shape ZnO nanoparticles formed by Green synthesis method.The particle size roughly estimated as 15-30nm from SEM analysis.

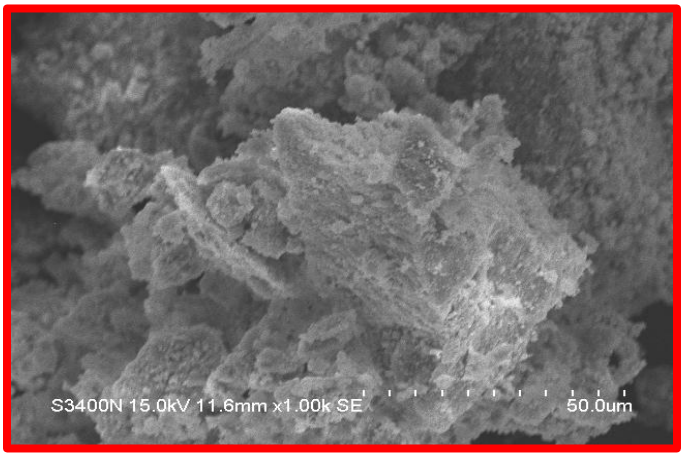

Fig 2:- SEM image of Alternanthera Sessile leaves-ZnO nanoparticles

EDAX: The sample contains only Zinc and Oxygen and no other impurity are present in the sample. This was conformed by the EDAX study.

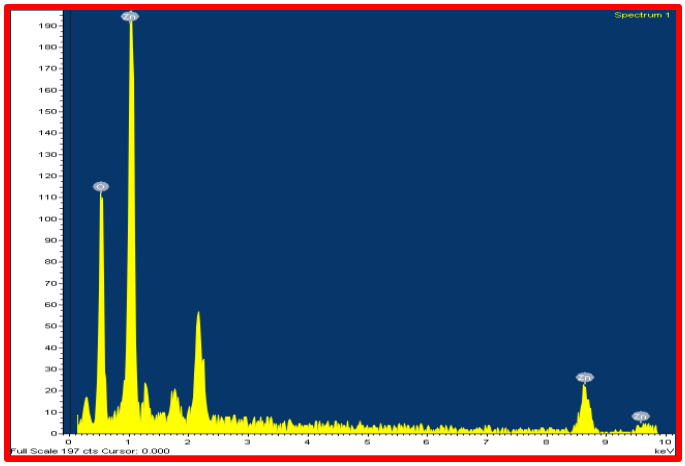

Fig 3:- EDAX graph of ZnO nanoparticles of Alternanthera Sessile leaves

Table-2: AtomicWeight percentage of Alternanthera Sessile leaves ZnO nanoparticles from EDAX graph

tnemelE	**egatnecrep thgieW**	**egatnecrep cimotA**
K O	35.76	69.46
K nZ	64.24	30.54
Total	100	100

Fourier Transform Infrared Spectroscopy (FTIR):-

The FTIR spectrum of ZnO nanoparticles is shown in Figure . For the IR spectra of unannealed samples (Fig-4), a series of transmission peaks from 500 to 4000cm-1 can be found, corresponding to the carboxylate and hydroxyl impurities in materials. The O-H stretching mode of hydroxyl group has confirmed by peaks observing at 3501 and 1206 cm-1wave numbers due to water adsorption by ZnO nanoparticles. The peaks assigned at 1630 and 1384 cm-1 are due to the asymmetrical and symmetrical stretching of the zinc carboxylate, respectively. As the size of the nanoparticles increases, the content of the carboxylate (COO-) and hy-droxyl (-OH) groups in the samples decreased. The hygroscopic nature of ZnO causes to form zinc carboxylate and zinc hy-droxyde .

The fundamental mode of vibration at 1647cm-1which correspond to the C=O stretching vibration, 3396 cm-1 which correspond to the N-H bend, 1556 cm-1which corresponds to N=O stretching vibration were confirmed Amide group present in Alternanthera Sessile leaves. Peaks at 909 and 809cm-1 which correspond to O-H bend,2331 and 2361cm-1 which correspond to C≡N stretch were conformed that carboxylic acid ,Alkenes and Nitriles present in the Alternanthera Sessile leaves. Amides , carboxylic acid, Alkenes and Nitriles groups in this leaves serves as the reducing agents for minimal of particle size becomes few nano meters.

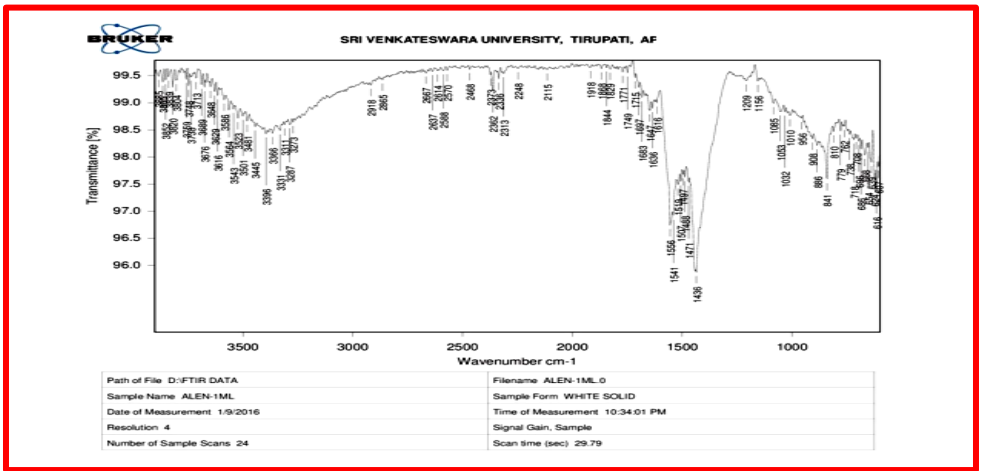

Fig 4:- FTIR graph of ZnO nanoparticles of Alternanthera Sessile leaves.

Conclusions:-

The Green synthesis of zinc oxide nanoparticles using leaf extract of Alternanthera Sessile provides anenvironmental friendly, easy and effective route for synthesis of nanoparticles.From the use of plant extracts eliminates bad effects from the usage of harmful and toxic reducing and stabilizing agents. The nano crystallites of ZnO are in the range of 18-30nm. The operating temperature and P^H of the solution will affect thestability of nano particle and agglomerates are formed.The Green synthesis of ZnO nano particles is still in its Research progress for focusing in the fields of pharma,optical energy conversion and spintronics by tuning its size over few nanometers.

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