

# Synthesis, Characterization and Application of Metal Oxide Nanoparticles from *Cressa Cretica* Whole Plant

<sup>[1]</sup> Kalaiarasi.S, <sup>[2]</sup> Gurulakshmi.P, <sup>[3]</sup> Yokeswari Nithya.P

<sup>[1][2][3]</sup> Department of Chemistry, A.P.C.Mahalaxmi College for Women, Thoothukudi, Tamilnadu

**Abstract:--** Zinc oxide nanoparticles were synthesized by using *cressa cutica* whole plant extract. The synthesized metal oxide nanoparticles were characterized by using FTIR, SEM, EDAX, XRD and AFM techniques and found to be in the nm range. Photocatalytic activity of the metal oxide nanoparticles were examined and found to have a good degradation property.

**Keywords:--** SEM, EDAX, AFM, Photocatalyst

## INTRODUCTION

Nanotechnology is an important field of modern research dealing with synthesis, strategy and manipulation of particle's structure ranging from approximately 1 to 100 nm in size. Within this size range all the properties (chemical, physical and biological) changes in fundamental ways of both individual atoms/molecules and their corresponding bulk. Novel applications of nanoparticles and nanomaterials are growing rapidly on various fronts due to their completely new or enhanced properties based on size, their distribution and morphology. It is swiftly gaining renovation in a large number of fields such as health care, cosmetics, biomedical, food and feed, drug-gene delivery, environment, health, mechanics, optics, chemical industries, electronics, space industries, energy science, catalysis, light emitters, single electron transistors, nonlinear optical devices and photo-electrochemical applications.

Biosynthesis of metal nanoparticles from plant systems is an emerging as a new and recent development technique [1]. The nanoparticles are of great interest due to their extremely small size and large surface to volume ratio, and they exhibited utterly novel characteristics compared to the large particles of bulk material[2][3].

Some of the distinct advantages that biological synthesis protocols have over the conventionally used physical and chemical methods are

- (a) clean and eco-friendly method, as toxic chemicals are not used [4].
- (b) the active biological component like enzyme itself acts as a reducing and capping agent, thereby reducing the overall cost of the synthesis process [4];

(c) small nanoparticles can be produced even during large-scale production [5]

(d) external experimental conditions like high energy and high pressure are not required, causing significant energy saving [6].

Most of the medicinal halophyte plants are herbs and forbs and were perennial, and their biological types were therophyte and chameophyte. There is a need for systematic study of all plants used in native medicine or folk medicine as no pharmaceutical and chemical research has yet been done on these species, among which *Cressa cretica* is one.[7] *C. cretica* L., belonging to the family Convolvulaceae, is a perennial plant with a lifecycle that continues in the summer period when the salt marsh area drains. *C. cretica* is a thermo cosmopolitan halophilous species. *C. cretica* usually grows in sandy or muddy saline habitats along the sea coast along with the species *Suaeda maritima*, *Salicornia europaea*, *Salsola soda*, *Limonium vulgaresubsp. Serotinum*, and *Crypsis aculeate*. [8]

## 2.EXPERIMENTAL METHODS

### *2.1.Preparation of plant sample for experimental studies*

The collected whole plants were cut into small fragments and shade dried until the fracture is uniform and smooth. The dried plant materials were granulated or powdered by using a blender and sieved to get uniform particles by using sieve No. 60. The final uniform powder of the plant was used for various experimental studies.

### *2.2.Preparation of zno nanoparticles*

ZnO nanoparticles were prepared by green synthesis. In this synthesis, 0.02M aqueous zinc nitrate is prepared in 50ml of distilled water under constant stirring. Then 10ml of plant extract were introduced in to the above solution after 10 min

stirring .In this solution, 2.0M NaoH was added and resulted in a pale white solution. This solution was then placed in a magnetic stirrer for 2hour. The pale white precipitate is obtained and the precipitate was taken out and washed over and over again with distilled water. Then a pale white powder of zno nanoparticles was obtained after drying at room temperature.

### 2.3. Photocatalytic measurement :

The photocatalytic activity of Zinc oxide nanoparticles were examined by studying the degradation of MB dye [C<sub>16</sub>H<sub>18</sub>ClN<sub>3</sub>S.2H<sub>2</sub>O] aqueous solution under laboratory made Visible spectrophotometer[9]. For a typical photocatalytic experiment, 0.12g of the prepared sample was added to 100 ml of 3.5 g of methylene blue aqueous solution. The aqueous suspension was put under constant stirring in dark for 1hr, so that the MB dye atoms are adsorbed on the surface of nanocrystals. The stable suspension was then exposed to the UV- radiation with continuous magnetic stirring. About 3ml of suspension solution was taken out after every 10 min of UV light exposure. The photo degradation of MB dye mixed with each synthesized samples were examined using Visible absorption values.

## 3. CHARACTERIZATION

The X-ray diffraction (XRD) patterns were recorded for the powdered materials using a BRUKER AXS (D8 ADVANCE) X-ray diffractometer. TEM images were recorded using Philips CM 200 model with the operating voltage range of 20-200. The FT-IR spectra were recorded using a Nicolet iS5 instrument. FTIR spectrophotometer, using Kbr pellet method. Atomic Force Microscope (AFM) images were recorded using particle size and shape of the nanoparticles.

## 4. RESULT AND DISCUSSION

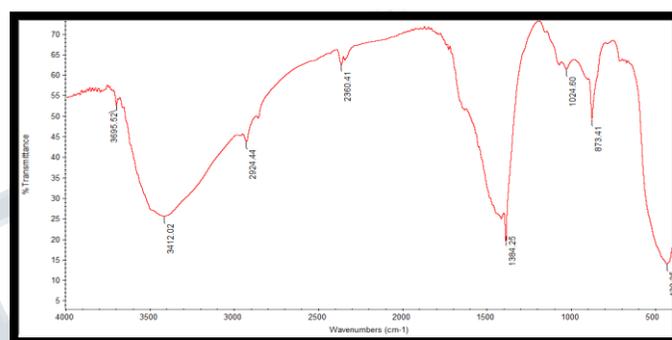
### Characterization of ZnO Nanoparticles

The characterization results of the synthesized ZnO nanoparticles are described below by various techniques. The results obtained are discussed in detail as follows.

#### 4.1. FTIR Studies:

The IR spectrum was taken using a Nicolet iS5 FT-IR instrument operating at a resolution of 4000-400cm<sup>-1</sup> in the percent transmittance mode. The FTIR spectrum of synthesized ZnO nanoparticles synthesized using plant extract was shown in the Fig.1. The broad peak located at 3412.02 cm<sup>-1</sup> can be assigned to the O-H stretching vibrations, indicating the presence of hydroxyl groups [10].

Few less intense peaks centered at 2924.88 cm<sup>-1</sup> and 2360.41cm<sup>-1</sup> are probably due to presence of aliphatic asymmetric C-H stretching vibration and O-H stretching in carboxylic acid respectively [11]. Moreover, the peaks at 1384.25 cm<sup>-1</sup> are mainly attributed to the -C=N- stretching vibrations as well as amide bands of proteins [12]. The band at 1024.60cm<sup>-1</sup> corresponds to the presence of water molecule. The peak at 873.41 cm<sup>-1</sup> was due to the formation of tetrahedral coordination of Zn ion [13]. The characteristic peak appeared at 460.06cm<sup>-1</sup> could be attributed to the metal oxygen (Zn-O) bond [11].



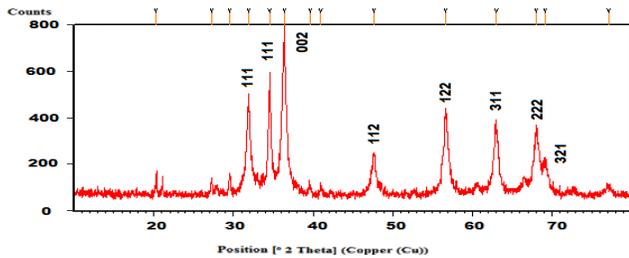
**Fig:1 FT-IR Spectrum of ZnO nanoparticle**

#### 4.2. XRD Analysis:

Structural parameters of ZnO nanoparticles synthesized using plant extract was calculated from the XRD pattern. The prominent peaks obtained for doped and undoped samples corresponding to the diffraction planes {100}, {002}, {101}, {102}, {110}, {103} and {112} agree well with the JCPDS Card No. 36-1451 [14]. Presence of several peaks indicates random orientation of the crystallites, confirming the hexagonal wurtzite structure of the ZnO nanoparticles. The average crystallite size (D) was calculated using the well-known Scherer's formula.

$$D = k\lambda / \beta \cos\theta$$

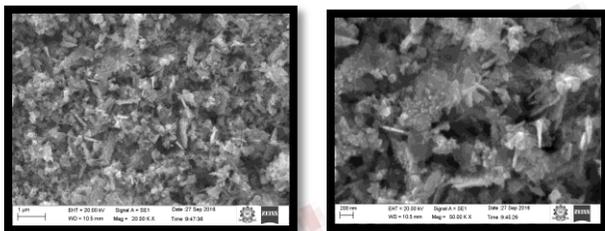
The X-ray diffraction pattern of ZnO nanoparticles synthesized using plant extract was shown in Fig.2. The spectrum of ZnO nanoparticles exhibits sharp peaks at 2θ equal to 31.930, 34.540, 36.380, 47.700, 56.690, 63.010, 68.050 and 69.21 [158]. These peaks are identified to originate from {111}, {111}, {002}, {112}, {122}, {311}, {222} and {321} planes of the hexagonal ZnO phase respectively. This XRD pattern was well matched with standard JCPDS Card No. 36-1451 [14]. The average crystallite size (D) of synthesized nanoparticles was found to be 25.95 nm.



**Fig:2 XRD Spectrum of ZnO nanoparticle**

**4.3.SEM ANALYSIS:**

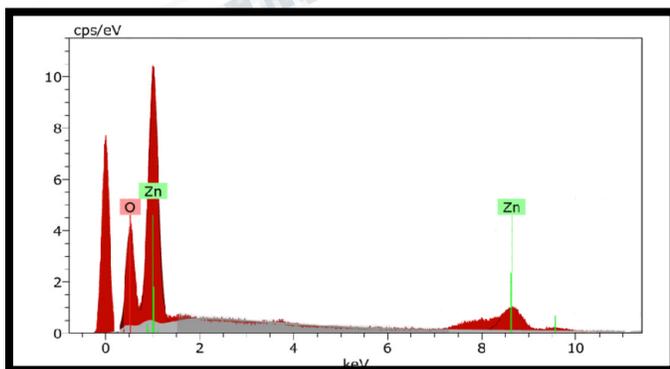
Scanning Electron Microscopy was employed to analyze the morphology and the growth features of the as prepared nanoFig.3 represents the SEM image of ZnO nanoparticles synthesized using plant extract. This picture substantiates the needle shape to the ZnO nanoparticles with granular nature. From SEM images the crystallite size of ZnO nanoparticles synthesized using plant extract was found to be in the nanometer range.



**Fig:3-4. SEM image of ZnO nanoparticle**

**4.4. ENERGY DISPERSIVE X-RAY ANALYSIS:**

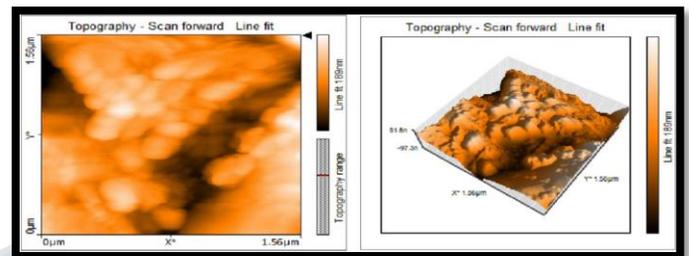
The elemental composition of the ZnO nanoparticles was carried out by EDAX spectroscopy. Fig.5 shows the EDAX spectrum of Zinc oxide nanoparticles synthesized using plant extract. Zinc oxide nanoparticles were found to have atomic percentage 79.42 of Zn, 20.58 of O, as shown in Table 2. This confirmed the presence of Zn and O.



**Fig:5 EDAX Spectrum of nano ZnO nanoparticles**

**4.5. AFM ANALYSIS**

The shape and particle size of synthesized ZnO nanoparticle using plant extract are studied by AFM analysis. AFM spectra were recorded for the ZnO nanoparticles deposited on glass plate. Fig.5 shows the AFM image synthesized ZnO nanoparticle using plant extract with a scanning area to 0m to 1.56 μm, we found spongy shape distributed over the surface [15]. These particles are between 0mY 1.56μm in length and size is in the range of 100-200nm.



**Fig:5 AFM image of ZnO nanoparticles**

**5.PHOTOCATALYTIC ACTIVITY:**

The photocatalytic activity of Zinc oxide nanoparticles was examined by studying the degradation of MB dye (C<sub>16</sub>H<sub>18</sub>ClN<sub>3</sub>S.2H<sub>2</sub>O) aqueous solution under laboratory made Visible spectrophotometer. Present measurements reported that the photocatalytic activity of mixed metal oxide nanoparticles by degradation of MB dye under UV light exposure. The UV-Vis absorbance values of MB solution shows absorption wavelength at 664 nm. Absorption values of pure MB dye with and without UV radiation exposure is shown in Table-3. It can be clearly noticed from the recorded values that no significant changes of the concentration of MB after 3 hr irradiation, which indicated that pure MB solution cannot be easily degraded by UV light. The absorption values of MB dye solution mixed with ZnO nanoparticles under different duration(80min) of UV-radiation is shown in Table-4. The results clearly indicates that the prepared ZnO nanoparticles shows a good photocatalytic activity, thus it can be used as a photocatalyst [16].

**Table-3**

Time in hours	Absorbance
1 hour	0.1139
2 hour	0.9912
3 hour	0.9313

**Table-4**

Time in minutes	Absorbance
10	0.2091
20	0.1527
30	0.1470
40	0.1291
50	0.0111
60	0.0829
70	0.0585
80	0.0231

### CONCLUSION

*Cressa cretica* belongs to the family Convolvulaceae is known Uppu marikozhunthu in tamil. The present investigation was carried out to determine the nanoparticles synthesis. FTIR,XRD,SEM,EDAX and AFM analysis proved that the prepared ZnO nanoparticle is in the nm range.FT-IR spectral results revealed that the presence of Zn-O bond of nano oxide.XRD behaviour also suggested oxide nano particles are in the nano scale range.The surface morphology of the synthesized oxide nano particles exhibited different structures. The crystallite size of the synthesized nano Zn-O is determined to be nm range.EDAX spectroscopy confirmed the presence of Zn and O metal oxides.Photocatalytic degradation was also investigated with Methylene Blue dye under UV- radiation source.Synthesized nanoparticles possess photocatalytic activity.

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