# Green Synthesis of Zinc-Oxide and Titanium Dioxide Nanoparticles

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***Abstract***

*Nanotechnology is one of the latest and fastest spreading research in all walks of life. The present work describes synthesis of a Zinc oxide and Titanium dioxide nanoparticles by biological (green) method. Of all the other methods, biological (green) methods are the most preferred and the easiest method. This is because of their non toxic, cost effective, easily and abundantly available feature. Titanium dioxide ($TiO_2$) and Zinc-oxide (ZnO) nanoparticles are synthesized from the leaf extracts of Nerium Oleander (Oleander) and Azadirachta indica (Neem) by the methods of co-precipitation. Plant extracts may act both as stabilizing agents, capping agents and as reducing agents in the synthesis of nanoparticles. The synthesized $TiO_2$ and ZnO particles were analyzed by Fourier transform infra red spectroscopy to find the characteristic molecular groups and Particle size Analyzer was used for detecting the size of the nano-catalytic particles to confirm in the Nano-range.*

**Keywords** - *Biological (green) synthesis; Fourier transform infra red spectroscopy (FTIR);*

## I. INTRODUCTION

Nano biotechnology is used in different fields of science such as nanotechnology, biotechnology, materials science and chemistry.

The chemical reducing agents which used in the previous studies has caused the production of larger particles and consumes extra energy. So an alternate methodology is to be studied which should be environmental friendly and economical which will consume only less amount of energy.

Titanium dioxide ($TiO_2$) and Zinc oxide (ZnO) can be used in both alkaline and acidic media solutions. $TiO_2$ and ZnO nanoparticles are used in the process of photocatalysis. These nanoparticles will react with –OH and $O_2$ for obtaining oxygen and hydroxyl free radical. The area of interaction with pathogenic bacteria increases because of the high surface area of nano particles, resulting in making them suitable as antimicrobial agent. The small size of the particles enables them to easily enter bacterial surface and capable of harm.

Several researchers have described the usage of natural products from medicinal plants such as *Psidium guajava, Aloe barbadensis Miller, Vitex negundo, Psidium guajava, Curcuma longa, Vigna unguiculata, Eclipta prostrata* and *Moringa oleifera* for the formation of $TiO_2$ nanoparticles and *Plectranthus amboinicus, Moringa oleifera, Nephelium lappaceum,* and *Calatropis gigantean* for the formation of ZnO nanoparticles. Huge amount of nanoparticles can be effortlessly made from the plants and majority of synthesized products are nontoxic. In this work, titanium and zinc-oxide nanoparticles are synthesized by using leaf extract of *Nerium Oleander* and *Azadirachta indica*.

## II. MATERIALS AND METHODS

All the materials chosen for this work are of analytical reagent grade.

- *Nerium Oleander*
- *Titanium tetra isopropoxide*
- *Azadirachta indica*
- *Zinc sulphate*

### A. *Preparation of extract derived from leaves of Nerium oleander and Azadirachta indica*

The leaves were washed thoroughly in running tap water to remove soil particles and adhered debris and finally washed with sterile distilled water. After that the leaves are dried in 15 days at room temperature (32 °C) and then the leaves grained into a fine powder using mortar. The *Nerium oleander* leaf powder of 5g was taken for synthesis purpose and 25g of Azadirachta indica leaf powder was taken for synthesis purpose. The weighed 5g *Nerium oleander* leaf powder were boiled with 500 ml of distilled water for 3 hour at 80°C until the color of the aqueous solution changes from watery to green and the weighed 25g of Azadirachta indica leaf powder was boiled in 500 ml of distilled water with magnetic stirring at 70°C. After 30 min, the color of water turns into green. Then the extracts were cooled at room temperature and filtered by Whatman No.1 filter paper and stored at room temperature.

### B. *Synthesis of Titanium dioxide and Zinc oxide nanoparticles*

For the synthesis of $TiO_2$ nanoparticles, 500ml of *Nerium Oleander* leaves extract was taken and boiled at 80°C with a magnetic stirrer. When the temperature of the solution was reached at 80°C, 5 ml titanium tetra-isopropoxide solution was added. The mixture was boiled until color changed to a green color paste. Then the paste was collected in a ceramic crucible and heated using muffle furnace at 500 °C for 3 hrs. Thereafter we obtained white color powder; it was stored in properly labelled containers.

And for the synthesis of ZnO nanoparticles, 500ml extract of *Azadirachta indica* leaves was taken and boiled. After the extract attained 70°C, 20ml of Zinc sulphate solution was added very slowly with constant heating. The leaf extract turns into yellow and forms a precipitate. The precipitate was collected and dried for 2 hrs then it was calcinated at 450°C in muffle furnace.

## III. RESULTS AND DISCUSSIONS

### *C. Particle size analysis*

The particle size distribution of the titanium dioxide and Zinc oxide Nanoparticles were found out using the Particle Size Analyzer. The fig.3.1 shows the histogram of $TiO_2$ nanoparticles, in which about 20% of the particles are in the range of 65nm and the 80% of the particles are in the range of 75nm. The Fig. 3.2 shows that the average particle size of ZnO nanoparticles was found to be 55.58nm.

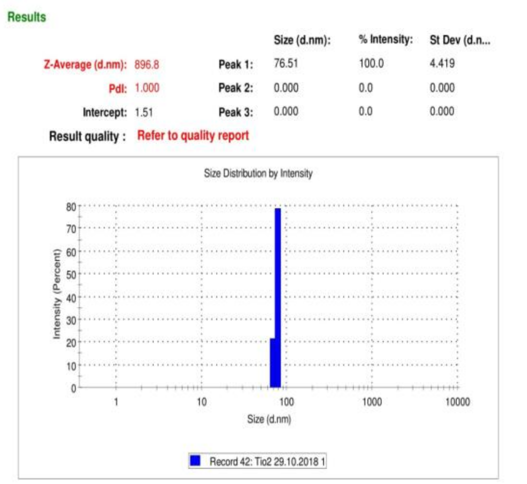


**Fig.3.1 Shows the particle size of range for $TiO_2$ nanoparticles**

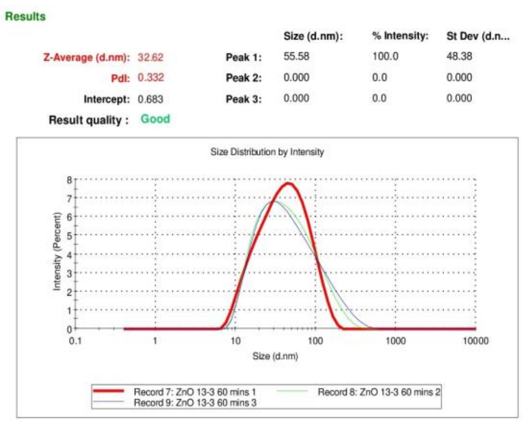


**Fig 3.2 shows that the average particle size of ZnO nanoparticles**

### *D. Fourier transform infrared spectroscopy (FTIR)*

FTIR analysis was carried out using the Perkin Elmer FTIR analyzer.

The FTIR spectra were recorded between the wave number of 400 to 4000cm$^{-1}$ for the sample ($TiO_2$) as shown in fig 3.3. The spectral peaks at 2352.30cm$^{-1}$ indicating OH bonds and 1504.73 cm$^{-1}$ corresponds to H-O-H bonding vibration of absorbed water. The $TiO_2$ stretching peaks at 511.04 cm$^{-1}$ clearly indicate.

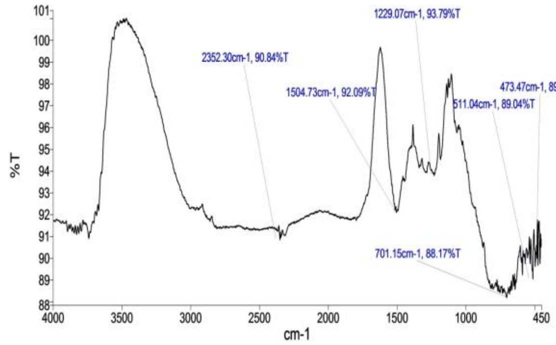


**Fig 3.3 Shows that the FTIR spectrum of $TiO_2$**

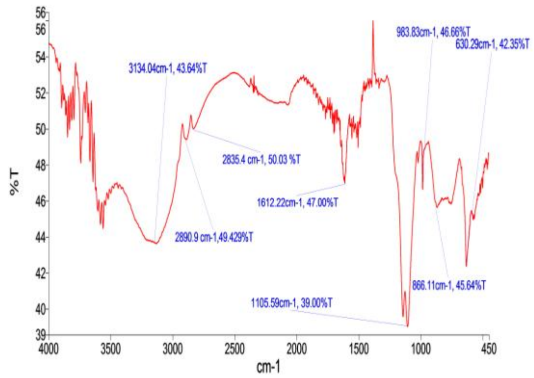


**Fig 3.4 Shows that the FTIR spectrum of ZnO**

For ZnO nanoparticles, an FTIR spectrum occurs between 3000cm$^{-1}$ to 450cm$^{-1}$ as shown in fig 3.4. The spectral peak 3134.04cm$^{-1}$ indicates the OH bond and 2835.4cm$^{-1}$ indicates the CH=O. The final spectral peak 630.29cm$^{-1}$ clearly indicates the ZnO stretching.

## IV. CONCLUSION

The nanoparticles were synthesized by simple co precipitation method using *Nerium Oleander* leaves extract and *Azadirachta indica* leaves extract. The leaves extract acts as a reducing agent and also act as capping agent. The following conclusions were drawn from the obtained results.

Greener approach of $TiO_2$ and ZnO nanoparticle synthesis was rapid and involves less toxicity. Due to increasing awareness towards green chemistry and synthesis of nanoparticle results in sustainable, simple and economical.

$TiO_2$ nanoparticles and ZnO nanoparticles were in the range of 77 nm and 55.58 nm.

FTIR shows the presence of the spectral peak at 511.04 $cm^{-1}$ indicates the $TiO_2$ stretching and peak 603.29 $cm^{-1}$ indicates the presence of ZnO.

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