Green synthesis of Titanium dioxide nanoparticle using catharanthus roseus leaf extract

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***Abstract*: Nanotechnology is a new star in the science horizon with many valuable applications.It includes the synthesis and utilization of nanostructure ranging from 1 to 100 nm.TiO2 nanoparticles were synthesized from titanium dioxide and extract of root of catharuthus roseus. In recent years, the biosynthetic method using plant extracts has received more attention than chemical and physical methods and even than the use of microbes, for the nano-scale metal synthesis due to the absence of any requirement to maintain an aseptic environment. New strategies are therefore needed to identify and develop the next generation of drugs or agents to control bacterial infections. The obtained TiO2 nanoparticles have been characterized by scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD). The obtained results show that the green treated TiO2 nanoparticles can act as a better photocatalytic material.**

***Keywords*: Green synthesis, Nanoparticles, TiO2 nanoparticles, Catharanthus roseus leaf extract, UV, SEM, FTIR.**

1. Introduction

There has been a rapid increase in interest in nanotechnology and the use of nanoparticles in commercial applications.The prefix comes from the ancient Greek through the latin nanus meaning literally dwarf and by extension very small.Along with its size, structure ,and physicochemical and biological characteristics, nanotechnology has a diverse set of applications in a multitude of fields such as industries, notably mechanical, electronic,imaging specific targeting, and molecular diagnosis .Nanoparticles (NPs) are being used in more and more purposes every day, covering medical, cosmetology, pharmaceuticals,and power.TiO2 NPs are largely employed as a semiconductor material .The transition metal oxide, mainly TiO_2, is widely used in cosmetics, photocatalysts, medicines, sensors, and solar cell applications because of its peculiar properties like interconnected pores and large surface area .TiO2 has a high catalytic activity due to its large surface area, high molecular oxygen adsorption capacity, and low rate of electron-hole pair recombination. This is the work to use a precipitation approach with extract catharuthus roseus as a stabilizing agent to synthesize TiO2 nanoparticles, and no findings on photocatalytic or antibacterial activity have been reported.

2. Experimental

2.1 Materials

Titanium TiO2 was purchased from Madras scientific shop,which was directly used for the experiment .All the chemicals were of analytical grade and they were used t further purification.Deionized water was used throughout the experiment.All Glassware used for the preparation of TiO2 nanoparticles were properly washed with distilled water and dried in a hot air oven.The fresh and desease free leaves of catharuthus roseus were collected from the campus.All the aqueous solutions were prepared by using double distilled water.

2.2 Preparation of leaf extract

Fresh and healthy Catharuthus roseus leaves were collected from the garden. One of the selected leaves was cut and washed twice with tap water followed by distilled water to remove dust particles and other contaminants. 20g of the leaves was weighted using Analytical balance and transferred into a 500ml beaker containing 200ml distilled water. The contents were boiled for 30 minutes at 70°C in the beaker. The extracts were filtered by using Whatman filter paper. The filtrate was stored for the synthesis of nanoparticles.

2.3 Synthesis of titanium dioxide nanoparticles

The TiO2 nanoparticles were synthesized by using 1.0 M of titanium dioxide in 100 ml of double distilled water. Then the solution was stirred at 200 rpm/sec for about 1 hour without heating. Then the solution was precipitated by adding drop wise 50 ml catharuthus roseus leaf extract as a precipitating agent. The beaker containing the mixture was stirred at 220 rmp/sec for about 2 hours without heating. Then the prepared mixture has kept freely without any disturbance for 24 hours. Then, the formed TiO2 nanoparticles mixture was dried in a hot air oven at 80˚C.After complete drying the TiO2 nanoparticles obtained were scraped and stored in a beaker for further characterization.

3. Results and discussion

3.1 UV- VIS Analysis:

The UV visible light at wavelength ranging from 200-1000 nm was used to evaluate the light absorption chracteristics of Tio2 nanoparticles.The UV visible spectra of Tio2 and catharuthus roseus leaf extract in an aqueous solution at room temperature. The absorption peaks obtained for the samples in the range of 261.25 nm for titanium dioxide. For the peak 261.25 nm the corresponding absorption range is 6.4270 AU.

The conduction band energy is calculated from the Einsteins photon energy equations.

$$E=hc/\lambda \ max$$

Where,

λ max- maximum absorbance wavelength

H-Planks constant ($6.6x10^{-34}$ Js)

C-speed of light ($3x10^{8}$ m/s^{2})

The band gap energy of titanium dioxide has been calculated to be 3.0807 eV.

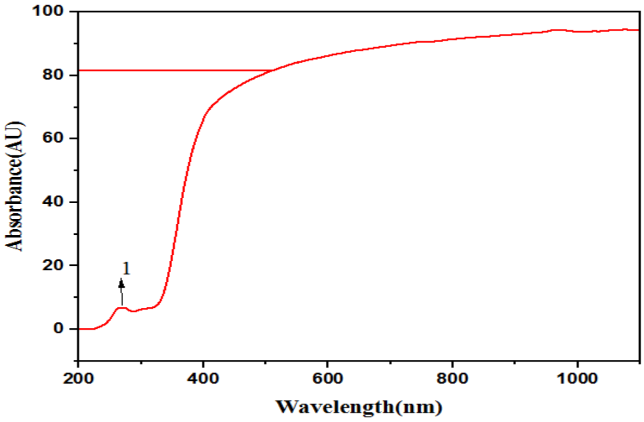

Figure 1 UV-Vis analysis of Titanium dioxide nanoparticles using catharanthus roseus extract

3.2 FTIR Analysis:

Fourier-transform infrared (FT-IR) spectra were recorded using an FT-IR spectrophotometer. FTIR spectroscopy is used to study the change in chemical composition, impurity content and interaction between different species. FTIR spectrum is used to calculate various functional groups which present in the TiO2 nanoparticles and also used to determine the absorption range. The FTR spectra of the TiO2 nanoparticles which were synthesized by precipitation method.The wavenumber at 3427 cm^{-1} represent the stretching vibration of O-H (strong).The wavenumber at 2056 cm^{-1} represents stretching vibration of N=C=S (Strong) .The wavenumber at 1629 cm^{-1} represents stretching vibration of C=C (Medium).The wavenumber at 638 cm^{-1} represents stretching vibration of C-Br (strong).

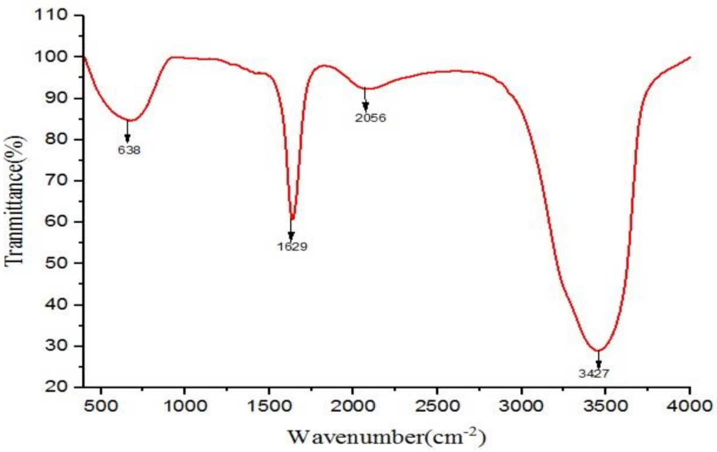

Figure 2 FT-IR analysis of Titanium dioxide nanoparticles using Catharanthus roseus leaf extract

3.3 SEM Analysis:

Scanning electron microscopy techniques provides information on the size, shape, location of the individual nanoparticles. Scanning electron microscopy analysis was employed to study the morphology of the nanoparticles.The SEM image shown in fig a and fig b .It can be seen that TiO2 nanoparticles were exclusively Rod shape.

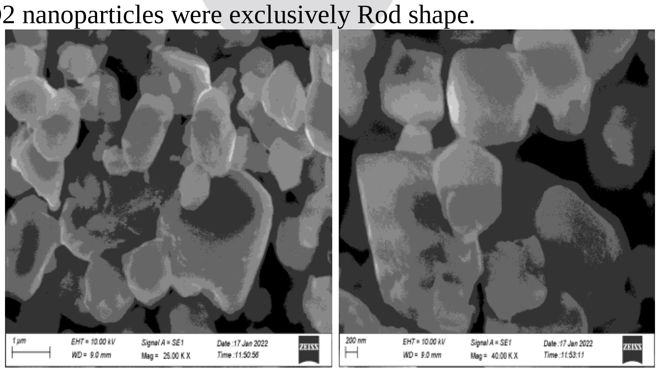

Fig 3 SEM Analysis of Titanium dioxide nanoparticles using catharanthus roseus extract

3.4 X-RD Analysis:

Using X-ray diffraction phase analysis was studied. The average crystalline sizes of the nanoparticle were calculated based on Debye's Scherer's equation.

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

Where,

D- Mean crystalline size

K- Shape factors taken as

λ- Wavelength of the incident beam

θ- Bragg's angle

The Titanium dioxide sample shows 2 major peaks 21.3113, 33.477 respectively. The below table shows that the interplanar distance and FWHM of corresponding values of TiO2 nanoparticles. The average or estimated crystalline size is about 27.39455 nm.

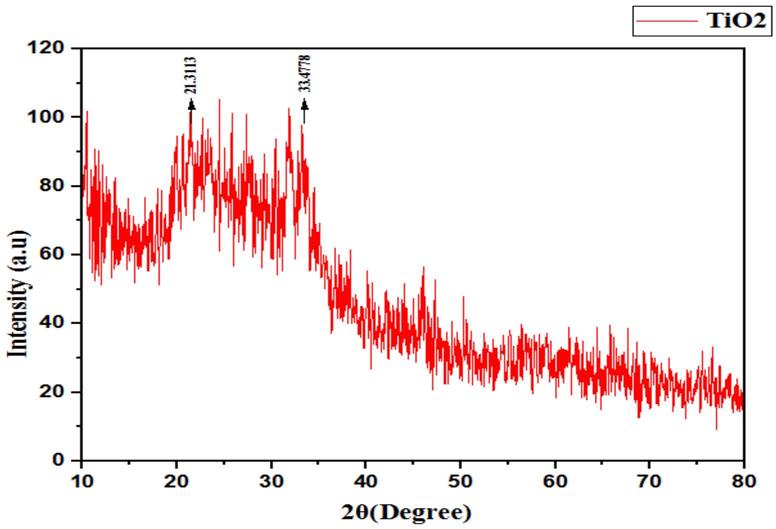

Fig 4 XRD-Analysis o of Titanium dioxide nanoparticles using catharanthus roseus extract

4. Conclusion

The synthesis of TiO2 nanoparticles by green approach and the obtained nanoparticles were chracterized to evaluate physical, chemical, structural and morphological behavior. Present method of green synthesis proved to be useful in controlling the size of TiO2 nanoparticles, thereby tuning their catalytic properties. The UV spectral results showed a peak range is 261.25 nm and the band gap energy of titanium dioxide have been found to be 3.0807 eV. FTIR analysis showed the absorption peaks at 3427 cm^{-1} respectively indicating the O-H group in TiO2 nanoparticles.The SEM of morphological structure is rod shape.The XRD analysis average are estimated crystalline size is about 27.39455 nm.

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