International Journal of Science, Strategic Management and Technology
Volume **02** Issue **03** March-**2026** | ISSN: **3108-1762 (Online)** | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

Green Synthesis and Characterization of TiO_2 nano particles by SCM

Dr.A.Anitha Kumari 1, A.Umesh Chandra2, G.Sai Krishna2, Barmavath Naresh2

1Assistant Professor, Department of Mechanical Eng. SITS, Hyderabad.

2 Students of III B Tech I semster, Department of Mechanical Eng. SITS, Hyderabad.

https://doi.org/10.55041/ijsmt.v2i3.037

Cite this Article: Chandra, A., Krishna, G. & Naresh, B. (2026). Green Synthesis and Characterization of TiO2 nano particles by SCM. International Journal of Science, Strategic Management and Technology, *02*(03), 1-7. https://doi.org/10.55041/ijsmt.v2i3.037

Nowadays, steel has become an important part of our life due to its extensive applications in automotive, household appliances, business machine and heavy construction such as marine and chemical industries. Mild steel is selected for construction because of its mechanical properties and machine-ability at a low price, while at the same time; they have to be resisted against corrosion phenomena. Nano TiO2 can be used for high lubrication, high conductivity, and high adsorption rate as well as catalytic performance, chemical industry, aerospace, and other fields. Characterization of this TiO2 are made by X-ray diffraction, Particle size analysis, Scanning electron microscopy, Energy dispersive X-ray spectroscopy, Thermo gravimetric and differential thermal analysis techniques.

Keywords: XRD, SEM and EDX

Introduction:

In materials science, nanoparticles allow for the making of products with mech In biology and medicine, a greater understanding of the functioning of molecules and of the origin of diseases on the nanometre scale has lead to improvements in drug design and targeting. Nanomaterials are also being developed for analytical and instrumental applications, including tissue engineering and imaging.

A wide variety of nanoscale materials and coatings are already in use in consumer products such as cosmetics and sunscreens, fibres and textiles, dyes, and paints. The constant drive towards miniaturization in electronic engineering has led to devices that are well within the nanometre range. Data storage devices based on nanostructures provide smaller, faster, and lower consumption systems.

Optical devices have also benefited from this trend and new types of microscopes have been invented, that can produce images of atomic and molecular processes at surfaces. Mechanical properties very different from those of conventional materials and can also improve surfaces by adding new friction, wear or adhesion properties.

The applications of nanotechnology, commonly incorporate industrial, medicinal, and energy uses. These include more durable construction materials, therapeutic drug delivery, and higher density hydrogen fuel cells that are environmentally friendly. Being that nanoparticles and nanodevices are highly versatile through modification of their physiochemical properties, they have found uses in nanoscale electronics, cancer treatments, vaccines, hydrogen fuel cells, and nanographene batteries.

Experimental Details:

Materials Used:

- Drum Strike Plant Leafs
- Titanium tetra isopropoxide ($C_{12}H_{28}O_4Ti$)
- Ethanol (C_2H_6O) 50 ml
- H_2O 200 ml

Green Synthesis of TiO_2 nano particles:

Initially the leafs of drum stick plant were collected and washed to remove dust. The leaves were dried at room temperature for about 7 days in atmospheric condition. Dried leaves were grinded to get the finest powder. 10 grams of finest powder were mixed with 50 ml of ethanol and extracted under normal condition at 100 ˚C. After few minutes, the ethanol leaf extract was obtained by filtered the mixture through what man filter paper.

Figure 1. Extracting nano particles from Drum stick plant leafs

For the preparation of TiO_2 nano particles, initially the flask containing 5 ml of titanium tetra isopropoxide in ethanolic leaf extract was reacted under magnetic stirrer at 100 ˚C. After three hours of continuous stirring, the formed titanium dioxide nanoprticles was acquired by centrifugation at 5000 rpm for 15 minutes. Then the centrifuged nano particles were removed with ethanol and again subjected to centrifugation at 3000 rpm for 10 minutes. Separated TiO_2 nano particles were dried and grinded to calcinated at 600 ˚C in muffle furnace for about 4 hours. Then the calcinated TiO_2 nano particles were used for further analysis.

Green Synthesis of TiO_2 nano particles:

Initially the leafs of drum stick plant were collected and washed to remove dust. The leaves were dried at room temperature for about 7 days in atmospheric condition. Dried leaves were grinded to get the finest powder. 5 grams of finest powder were mixed with 50 ml of ethanol and extracted under normal condition at 100 ˚C. After few minutes, the ethanol leaf extract was obtained by filtered the mixture through what man filter paper.

Figure . Extracting nano particles from Drum stick plant leafs

For the preparation of TiO_2 nano particles, initially the flask containing 5 ml of titanium tetra isopropoxide collected in a beaker with 50 ml of ethanol and stirring it for 30 minutes. Then mix the extracted liquid (drum stick powder) through burette drop wise drop in the beaker. After three hours of continuous stirring, the formed titanium dioxide nanoprticles was acquired by centrifugation at 1500 rpm for 15 minutes. Separated TiO_2 nano particles were dried and grinded to calcinated at 600 ˚C in muffle furnace for about 4 hours. Then the calcinated TiO_2 nano particles were used for further analysis.

Results and Discussions:

X-Ray Diffraction:

In the XRD pattern of the TiO_2nano particles, the peaks are observed at 23.567, 25.577, 37.851, 49.354, 57.501 and 63.211 (h k l) values of the peaks are (1 2 1), (1 1 0), (1 0 4), (1 1 0), (1 0 4) and (2 0 1) respectively. These results are coincided with JCPDS card number 86-1156, and it shows that the TiO_2 nano particle consists of tetragonal body-centred structure. The average crystalline size is measured using Debye-Scherer's formula [5].

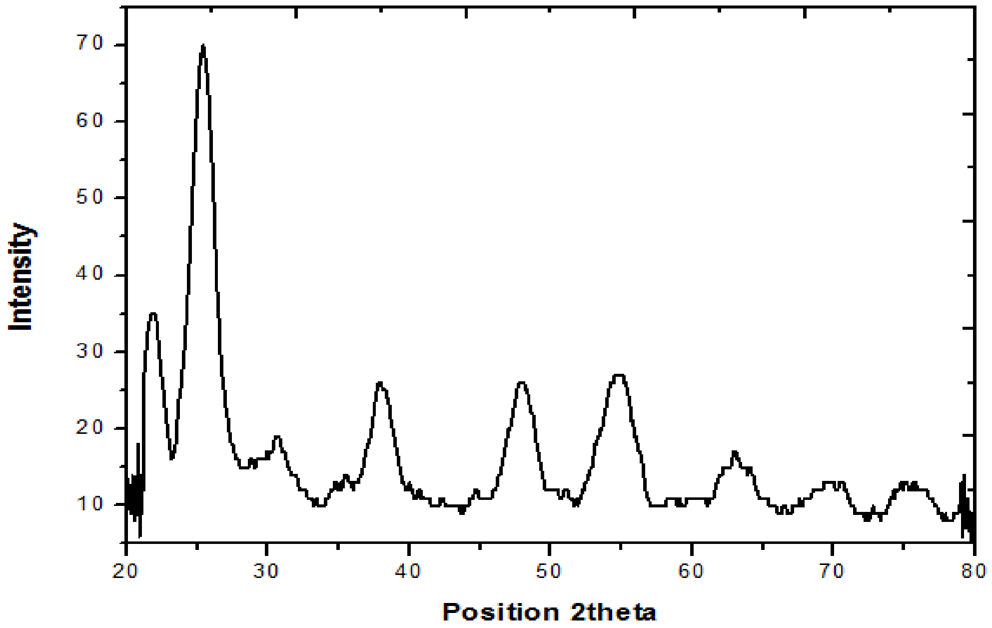

Figure 3: XRD Pattern of $GTiO_2$ nano particles

According to the Debye-Scherer's equation:

$$D = \frac{0.9\lambda}{\beta\cos\theta}\,\text{nm}$$

Where D – Average size of the particle [nm]

λ --Wavelength of the radiation [A°]

θ –Diffraction angle [degree]

B – Full width half maximum (FWHM) of the peak [radians]

From the above formula obtained average crystalline size is 25 nm. The lattice parameter a = b = 4.7589 A°, c = 12.9919 A°.

UV-Vis Spectroscopy:

The visual absorption of TiO_2 nano particles using Drum stick leafs as shown in the figure 4. It shows the peaks at different intervals. The spectral image displays the absorption peaks of TiO_2 nano particles at a wavelength of 280 nm.

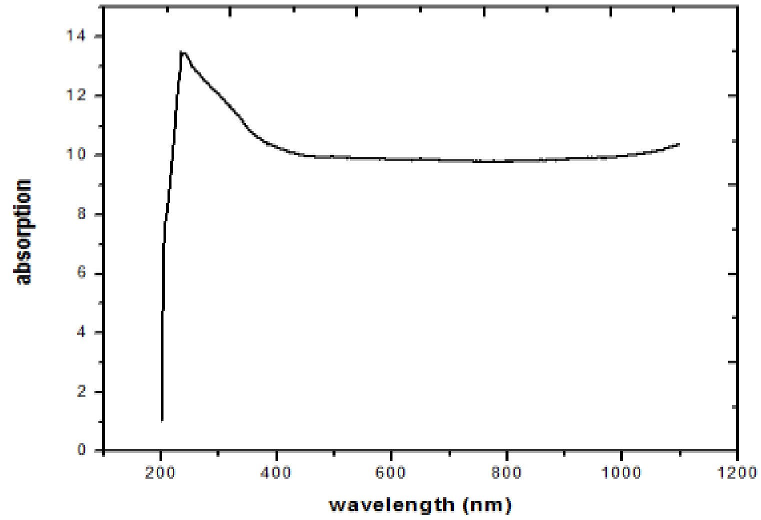

Figure 4: UV-Vis Spectroscopy of synthesized GTiO2 nano particles

Scanning Electron Microscopy:

The SEM images of $GTiO_2$nano particles as shown in the figure 5. It is clearly shows that the green nano particles consist of agglomerated and nearly spherical in shape. It shows respectable morphology and grain size of $GTiO_2$nano particles were nearly 120.2 nm.

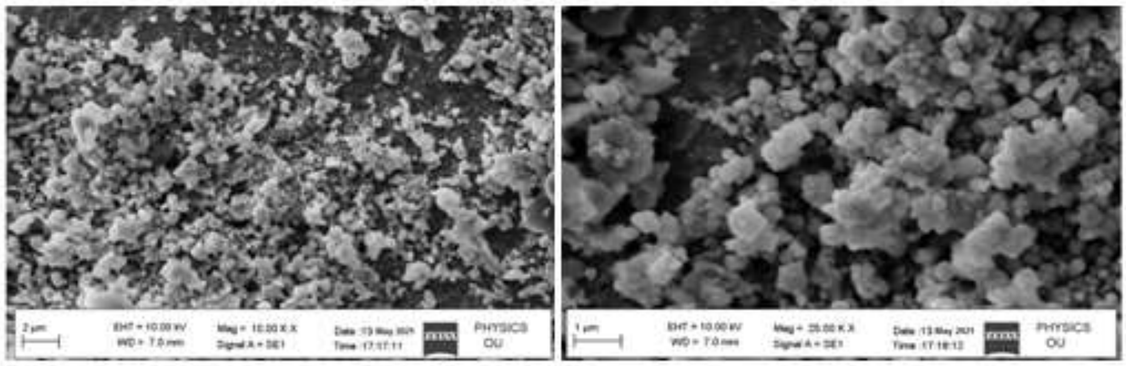

Figure 5: SEM Images of synthesized GTiO2 nano particles

EDX of $GTiO_2$ nano particles:

The EDX of the sample was done by the SEM (HITACHI S3400NS) machine. The Energy dispersive X-ray spectroscopy reveals that the required phase has present. Titanium (Ti) and oxygen (O) Elements are present in the sample as shown in the figure 6

International Journal of Science, Strategic Management and Technology
Volume **02** Issue **03** March-**2026** | ISSN: **3108-1762 (Online)** | Impact Factor: 3.8
An International, Peer-Reviewed, Open Access Scholarly Journal Indexed in recognized academic databases

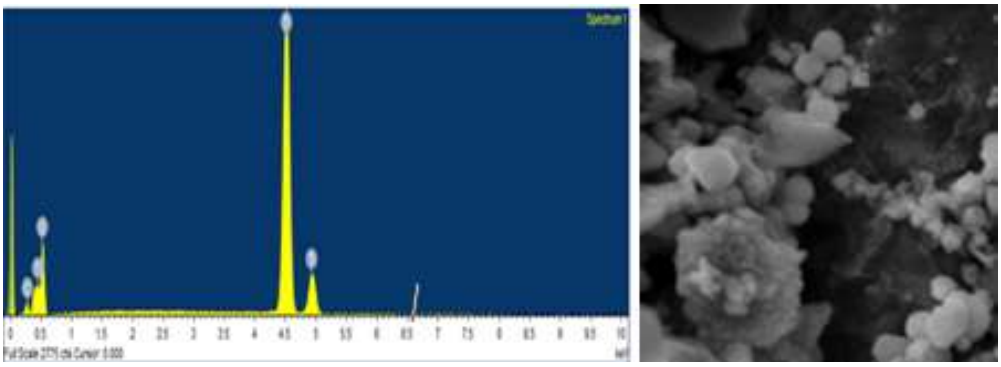

Figure 6: EDX of $GTiO_2$ nano particles

S.NO	Elements	Weight%
1	Ti	70.75
2	O	29.25

Table 1: Composition of $GTiO_2$nano particle

Conclusions:

$GTiO_2$ nano particles are synthesized by sol gel Process, the average crystal size were found be 25nm. The spectral image displays the absorption peaks of TiO_2 nano particles at a wavelength of 280 nm. UV-Vis shows that the energy band gap of TiO_2Nano particles are 3.34eV. Morphology of TiO_2 nano particles shows agglomeration structure because of the combustion was done in opened air. The Energy dispersive X-ray spectroscopy reveals that the required phase has been obtained.

V REFERENCES:

[1]T. Braun, A. Schubert, S. Zsindelv, Nano science and nanotechnology on the balance. Scientometrics 1997:8:321-325.

[2] K.J. Klabunde, etal. 1996. Nanocrystals as stoichiometric reagents with unique surface chemistrics 1997: 38 : 321 – 325.

[3] M.J. Neale, M.Gee, 2001. Guide to wear problems and testing for industry. New York, USA: Wiliiam Andrew Publishing.

[4] WalidNaous, Xiao-Yanyu, Qing-Xin Zhang, Kimiyoshinaito, Yutakakagawa, Journal of polymer science: Part B: Polymer Physics, 44 1466-1473(2006).

[5] M.R. Scanlon, R.C. Cammrata, 1994. Mechanical properties of nano composite granular metal thin films, J.Appl. Phys. 76(6): 3387-3393.

[6] D. Ratna, N. Manoj, R.Varely, R. Raman Singh, G. Simon, P. PolymInt 2003, 52, 1403-1407.

[7] Hutchings I.M., 1992. Tribology, Friction and Wear of Engineering Materials.CRC press, London.

[8] O.Becker, R. Varely, G. Simon, Polymer 2002, 43, 4365-4373.