

Characterization of Green Mediated Synthesis of Titanium Dioxide Nanoparticles using Vigna Radiata

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Abstract— Recently eco-friendly green mediated route is of growing interest in synthesis of metal oxide nanoparticles. The present work is to synthesis titanium dioxide nanoparticles using Vigna radiata(green gram) extracts by green synthesis method. This biosynthesized titanium nanoparticles were characterized with the help of X-ray diffraction (XRD), Surface morphological analysis (SEM), Elemental Analysis (EDX) and Fourier transform infrared spectroscopy (FTIR).

Key words: XRD, SEM, EDX, Vigna Radiata

I. INTRODUCTION

Nanotechnology is a standout amongst the most dynamic area of research in present day material science. This field which is creating step by step is having an effect in circles of people's life and making a developing passion in the life science, particularly biotechnology and biomedical science [1]. Nanoparticles display totally new properties in light of particular qualities, for example, shape, size and dispersion. Nanocrystalline particles have discovered enormous application in the field of high sensitivity bimolecular discovery and diagnostics, therapeutics and antimicrobials [2] catalysis and microelectronics [3]. However there is still requirement for financially feasible too naturally clean organic route to synthesised nanoparticles [4]. Green synthesis gives advancement over physical and chemical method as it is cost effective eco friendly technique [5] since in this method high pressure, high temperature and toxic chemicals are not used. The utilization of plant extracts such as from leaves, blossom, bark, seed, peels and so on, in synthesis of nanoparticles offers numerous benefits of biomedical applications [6].

II. MATERIAL & METHODS

About 0.2 M of titanium dioxide was mixed with 100 ml distilled water and it was stirred for 30 minutes. Then 10 g of Mung dal was dried and grained. The powdered mung dal was boiled in 100 ml of distilled water and it was filtered. About 25 ml of prepared mung dal extract was added to the titanium dioxide solution and the mixture was stirred with magnetic stirrer for 3 hours at room temperature. The precipitate produced was filtered and it was dried in an oven at 100°C for 8 hours. The dried powder was grinded using agate mortar and pestle. The grinded powder calcinated at 400°C temperature for 3 hours using electrically heated muffle furnace as a result the formation of titanium nanoparticles are prepared.

III. RESULT & DISCUSSION

A. XRD Analysis

The crystallography analysis was carried out by X-ray diffraction method. X-ray diffraction pattern of the prepared Titanium dioxide nanoparticles is shown in the Fig. 1. The straight line and sharp peaks shows that the synthesized nanoparticles are crystalline in nature. The average crystalline size is determined using Scherer formula,

$$D = K\lambda / \beta \cos\theta \quad [9,10]$$

The characteristics peaks of apatite can be identified in the range of 2θ , using the Scherer formula. The micro strain can be calculated from the following equation

$$E_{\text{Strian}} = \beta/4 \tan\theta$$

The dislocation density can be calculated by $\delta = 1/D^2$

The average crystalline size of Titanium dioxide nanoparticles is found to be 51.8981 nm for two strong preaks and those values are listed in table 1.

2θ (deg)	d (Å)	FWHM (deg)	Crysalline Size(nm)	Micro Strain 10^{-3}	Dislocation Density $\times 10^{15} m^{-2}$
25.22	3.53	0.2955	53.8316	2.8801	34.509
37.72	2.38	0.3181	49.9646	2.0305	40.0567

Table 1:

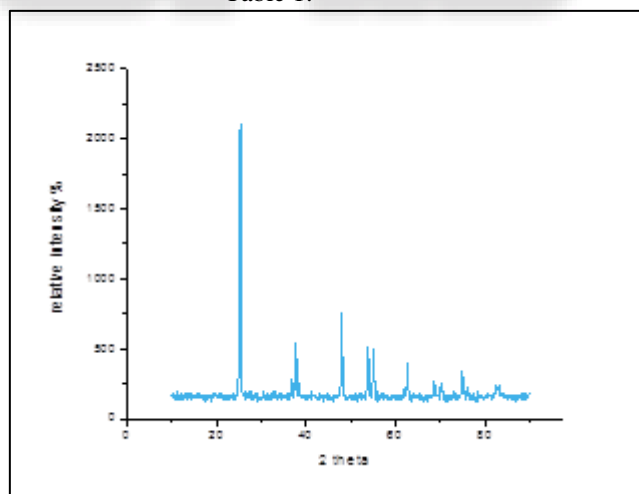


Fig. 1: XRD Spectrum of Titanium dioxide nanoparticles

B. SEM Analysis

The surface morphology of Titanium dioxide nanoparticles synthesized by green synthesis method was examined using scanning electron microscope. The SEM image of titanium dioxide nanoparticles is shown in the Fig. 2 shows that the synthesized nanoparticles exhibit nearly spherical shape and clustered as bunches.

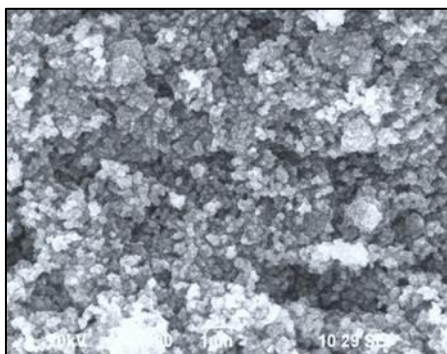


Fig. 2: SEM image of Titanium dioxide nanoparticles

C. FTIR Analysis

The FTIR spectra of Titanium dioxide nanoparticles synthesized by green synthesis method is shown in the Fig. 3. The band observed at 3432.84 cm^{-1} assigned to the presence of Alcohol group. The peaks observed at 2922.66 cm^{-1} were assigned to C-H (carbon) group. The peak observed at 1744.15 cm^{-1} indicates the presence of C=O (amides, carboxylic acid, aldehydes) group.[7,8]

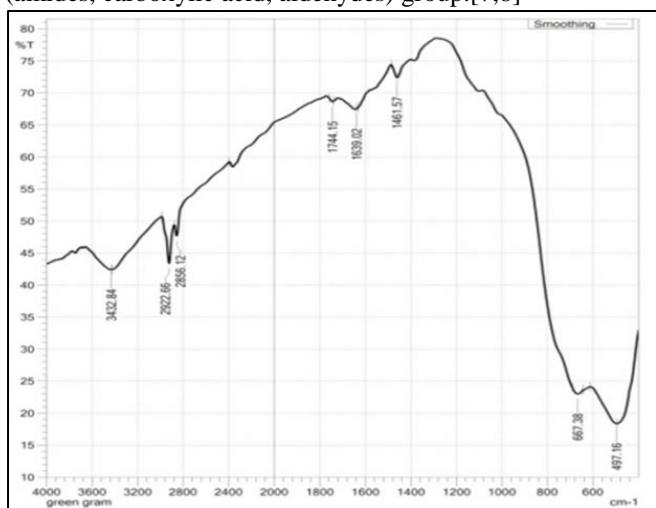


Fig. 3: FTIR spectrum of titanium dioxide nanoparticles

D. EDX Analysis:

The EDX spectrum of prepared nanoparticles is shown in the Fig. 4. The spectrum peak indicates the presence of titanium and oxygen. This Energy dispersive X-ray spectroscopy is an analytical technique used for the confirmation of elements present in the synthesised nanomaterial.

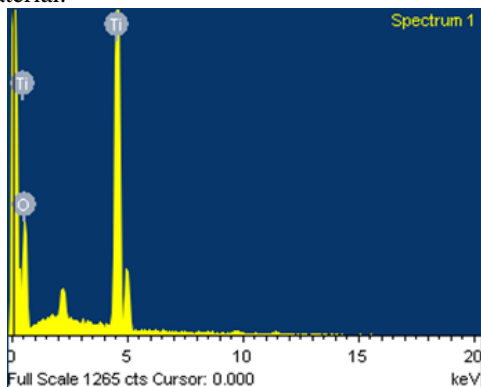


Fig. 4: EDX Spectrum of Titanium dioxide nanoparticles

IV. CONCLUSION

The Titanium nanoparticles were successfully prepared using Mung bean extract by green synthesis method. The FTIR spectra of Titanium nanoparticles synthesized by green synthesis method, the bands observed at 3432.84 cm^{-1} were assigned to presence of Alcohol group. The peaks observed at 2922.66 cm^{-1} were assigned to presence of C-H group. The peak observed at 1744.15 cm^{-1} were assigned to presence of C=O group. X-ray diffraction shows that the sharp peaks shows that the synthesized nanoparticles are crystalline in nature. The average crystalline size of Titanium nanoparticles is found to be 51.8981 nm . The surface morphology reveals that synthesized Titanium dioxide nanoparticles synthesized by green synthesis method, exhibit nearly spherical shape and clustered as bunches. The EDX spectrum peak confirms the presence of titanium and oxygen.

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