Characterization and application of Nano-TiO_2 in bio-physics

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Abstract

Nanotechnology has become a dynamically developing industry with a multiplication of applications in materials sciences and also in biophysics. The present study is aimed at investing the effect of Nano-TiO_2 on in Biophysics. TiO_2 was prepared by sol- gel method and calcinated at different temperatures 600 ^{0}C. The crystalline phase formation of TiO_2 was investigated by the X-ray diffraction analysis.

Key Words: Nano-TiO_2, sol- gel method, X-ray diffraction

1. Introduction

The element Titanium was discovered in 1791 by William Gregor, in England. Titanium dioxide has two phases' rutile and anatase. More than a few decades, TiO_2 has been widely studied due to its exciting electrical, catalytic and electrochemical properties. Based upon these properties verities of scientific application are possible. TiO_2 has been widely used in catalysis, in electrochromism and as sensors [1, 2]. The general scheme for the photocatalytic destruction of organics begins with its excitation by suprabandgap photons, and continues through redox reactions where OH radicals, formed on the photocatalyst surface, play a major role. Titanium dioxide is non-toxic hence it is used in cosmetic products like sunscreens, lipsticks, body powder, soap, pearl essence pigments and tooth pastes. Titanium dioxide is even used in food stuffs, for instance in the wrapping of salami. Small amounts added to cigar tobacco are the cause of the white ash cigar smokers so cherish. TiO_2 is also a potent photocatalyst that can break down almost any organic compound when exposed to sunlight. Nanotechnology has become a dynamically developing industry with a multiplication of applications in materials manufacturing, computer chips, medical diagnosis, energy and health care. Products based on nanotechnologies was estimated that there are more than thousand products and expected to raise more in the market within the next few years. It was estimated that more than 15% of all products on the global market will have some kind of nanotechnology incorporated into their manufacturing process [3-6], photocatalysis, and solar cells. Metal oxide nanoparticles, is of great technological importance in the field of heterogeneous catalysis for catalytic support of a wide variety of metals [7] and also find extensive applications in sunscreen industry due to their ultraviolet blocking ability and visible transparency of nanoparticulate. There is considerable concern about the potentially harmful effects of those ENPs due to their unique properties, such as high specific surface area, catalytic efficiency, surface energy, abundant reactive sites and strong adsorption, they may have significant effects on many organisms [8], especially plants which are essential base component of all ecosystem. This paper is concentrated about use of TiO_2 nano particle in biophysics [9].

2. Synthesis of TiO_2 by Sol Gel Technique

Ethanol was added drop by drop in titanium tetra-iso propoxide during stirring, white color solution was obtained, we code it as solution 1. On the other hand ethanol was added first in distilled water and afterward HCL was added drop wise during stirring, we call it as solution 2. In the next step, we add solution 1 in solution 2 together drop by drop while stirring process at a fixed temperature of 15 ^{0}C. This process from a white gel, which was further dried in the microwave oven. To convert gel to powder we optimize the parameters like time and powder during microwave heating. After microwave heating, white powder was obtained. Further, this white powder was calcinate at different temperature viz.: 500 ^{0}C and 600 ^{0}C for fixed soaking time of 10 hr in conventional furnace. Powder X-ray diffraction (XRD) was used for crystal phase identification and estimation of the crystalline size of each phase present. XRD measurements were carried out with a D-8 apparatus at room temperature using Cu Kα radiation.

3. X-Ray Diffraction Studies

Calcination is a common treatment that can be used to improve the crystallinity and photocatalytic activities of TiO_2 powder. When calcinated at high temperatures, TiO_2 powder experiences phase transformation from amorphous to anatase or from anatase to rutile. Figure 1 shows XRD patterns of TiO_2 powders calcinated at temperatures from 500 ^{0}C to 600 ^{0}C. The XRD peaks of the TiO_2 powders calcinated at low temperatures are weaker than those calcinated at higher temperatures. The high intensity peak corresponding to the angle 25.3 for (101) plane indicates the formation of anatase phase. In addition, the presence of rutile phase is confirmed by 110-diffraction peak only for sample calcinated at 600 ^{0}C for 10 hr. XRD patterns were measured at room temperature with a diffractometer using CuK_α radiation. The XRD patterns of anatase phases prepared by sol-gel method and calcinate at different temperatures of 500 ^{0}C and 600 ^{0}C. The high intensity peak corresponding to the angle 25.3 for (101) plane indicates the formation of anatase phase. In addition, the presence of rutile phase is confirmed by 110-diffraction peak only for sample calcinated at 600 ^{0}C for 10 hr. Low calcination temperatures show broad peaks that indicate the amorphous nature of the powder with the presence of very small size crystals. When the calcinations temperature increases, the diffraction peaks become narrower and sharper this indicates the increase of the grain size as shown in the

Figure 1: The crystallite size has been determined by the broadening of the corresponding x-ray spectral peaks using the Scherrer formula.

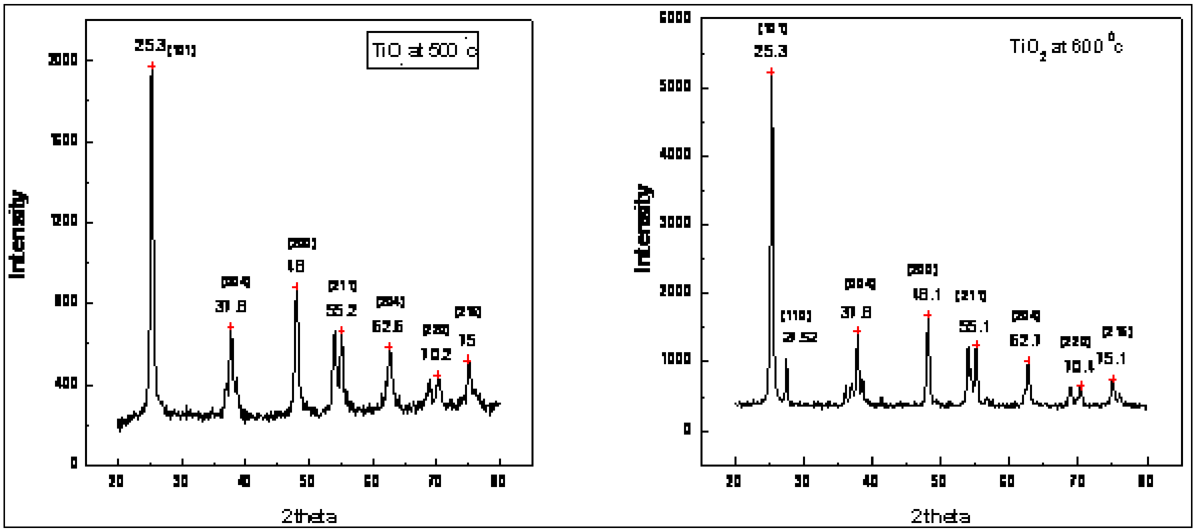

Fig 1: Shows XRD patterns of TiO_2 powders calcinated at different temperatures.

4. Scanning Electron Microscopy Studies

SEM micrographs of TiO_2 powder treated at different temperatures are shown in Figure-2 from the SEM results the particle size can be calculated by measuring average size of particle. From SEM the particle sizes were 4.85 µm and 3.94 µm respectively. In addition, particle size increases due to increase in temperature. Anatase phase particle size increases due to increasing the temperature.

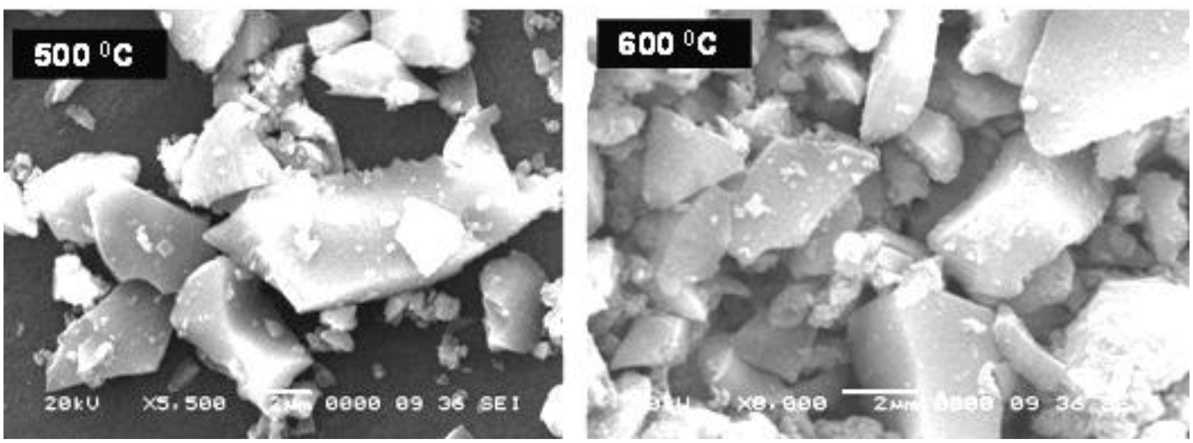

Fig 2: SEM micrographs of TiO_2 powder treated at different temperatures

5. Result

We have successfully synthesized TiO_2 in anatase phase. From the XRD it is clear that values corresponding to 2θ is exactly matches with JCPDS data. The high intensity peak corresponding to the angle 25.3 for (101) plane which indicates the formation of anatase phase TiO_2. The optimum calcination temperature for the best photocatalytic activity of TiO_2 was determined to be 500 ^{0}C and 600 ^{0}C for biophysics uses such as purification of toxic material.

6. Reference

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