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Research note

TiO_2 nanoparticles prepared without harmful organics: A biosafe and economical approach

M.A. Shah [a,b,*], **F.M. Al-Marzouki** [a]

[a] *Department of Physics, Faculty of Science, King Abdul Aziz University, Jeddah 21589, Saudi Arabia*

[b] *Electron Microscopy Centre, Department of Physics, Faculty of Science, National Institute of Technology, Srinagar, 190006, India*

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Abstract Growth of titanium oxide (TiO_2) nanoparticles of varying size, ranging from 20–60 nms through a versatile and an economic route, is being reported. The approach is based on a simple reaction of titanium powder and De-Ionized (DI) water at ∼180 °C, without use of any harmful additives. Field Emission Scanning Electron Microscopy (FESEM) reveals the well defined morphology of nanoparticles, whereas X-ray Diffraction (XRD) studies reveal that the, as prepared, nanoparticles are in a mixed phase, with a dominance of a stable rutile phase. Since only water, which is regarded as a benign solvent, is used during the preparation of nanoparticles, we believe that the products so produced are biocompatible and bio-safe and can be readily used for medical applications. The biocompatibility tests are yet to be carried out and shall be reported in forthcoming publications.

1. Introduction

Titanium oxide (TiO_2) has many applications in the fields of sensors, new types of solar cells, electrochromic devices, antifogging and self cleaning surfaces [1]. In nanodimensions, it has been shown to be useful for the destruction of micro-organisms such as bacteria and viruses, the inactivation of cancer cells, the control of odors, cosmetics, the fixation of nitrogen and the clean up of oil spills [2–4]. It also bears a tremendous hope in helping to ease the energy crises through effective utilization of solar energy, based on photovoltaic and water splitting devices. As a photocatalyst, it is used for the decomposition of various organic pollutants [5]. It has also been used in many industrial areas, including environmental purification and pigments for plastic industries. It has a higher refractive index than any other pigment and has good chemical stability. In view of its tremendous applications in various sectors, this versatile material has been extensively studied in the recent decade.

The morphology of nanomaterials has prominent effects on the properties and applications of nanomaterials and therefore developing safe methods to control morphology has been, and still is, a challenge in nanotechnology. It has been reported that the different methods for synthesis of titanium dioxide results in products with different structures (amorphous, anatase or rutile), crystallinity and contaminants [6–10]. Studies have revealed that all reported methods involve multistep processes and frequent use of harmful additives and organics. In addition, the pathways suggested involve environmentally malignant chemicals that are toxic and cannot be used for medical and other applications.

Water is regarded as a benign solvent and is attractive because it is inexpensive, environmentally safe and bestowed with many virtues. In this report, we present a cost-effective, biocompatible and reproducible approach for the preparation of TiO_2 nanoparticles at ∼180 °C, without using organics/amines, having well defined morphology. The pure water is used as a solvent, as well as a source of oxygen during the synthesis. To the best of our knowledge, the synthesis of nanoparticles without organics, catalysts and toxic solvents has not been reported so far in the literature. The prospects of the processes are promising.

* Corresponding author at: Department of Physics, Faculty of Science, King Abdul Aziz University, Jeddah 21589, Saudi Arabia.
E-mail address: sashraf@kau.edu.sa (M.A. Shah).

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