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Titanium Dioxide Versatile Solid Crystalline: An Overview

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Abstract

Among the several choices, titanium dioxide (TiO_2) is the most efficient material and has attracted great attention because of its certain specific properties like high permittivity, refractive index, efficiency, low cost, chemical inertness, non-toxicity, photocatalytic activity, photostability and capability of decomposing a wide variety of organic compounds. In the field of dental, orthopedic and osteosynthesis applications, the titanium and its native oxide (titanium dioxide) are used as an implant material. TiO_2 is used in an extremely wide range of commercial applications and research areas including: (i) TiO_2 powder: as a white pigment in paint, plastic, inks, paper and cosmetics; in washing powder, toothpaste, sunscreen, foodstuffs, pharmaceuticals, photographic plates, for creating synthetic gemstones; and as a catalyst. (ii) TiO_2 thin films: for ultra-thin capacitors and MOSFETs due to its extremely high dielectric constant; as humidity and oxygen sensor due to the dependence of its electrical conductance on the gases present; as an optical coating and a material for waveguides due to its high refractive index; as a protective coating and corrosion-resistant barrier; and as a photoanode in solar cells due its photoelectric activity.

Keywords: nanoparticles, titania, sol-gel, spin coating, thin films, electronic, optical, solar cells

1. Introduction

Research in the development of efficient materials has seen significant progress in the last two decades with a large number of research works carried out every year. Improvements in the performance of materials have been largely correlated with advances in nanotechnology. In recent years, the metal oxide nanoparticles are increasingly receiving attention for their wide range of applications in almost each and every field. Concerns regarding metal oxide nanoparticles exist in their chemistry and size and for being non-biodegradable. This poses the rapid distribution of nanoparticles in the environment with potentially harmful consequences.

2. Titanium dioxide semiconducting material

Titanium dioxide (TiO_2) is an n-type metal oxide semiconducting material used in a wide range of common and high-tech applications. It is cheap, chemically stable, non-toxic and bio-compatible. Titania is successfully used as implant material in dental, orthopedic and osteosynthesis applications and its native oxide mostly constitutes titanium dioxide [1]. TiO_2 in the form of nanopowder is used as