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A Simple Chemical Precipitation Method of Titanium Dioxide Nanoparticles Using Polyvinyl Pyrrolidone as a Capping Agent and Their Characterization

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Abstract : In this paper, a simple chemical precipitation route for the preparation of titanium dioxide nanoparticles, synthesized by using titanium tetra isopropoxide as a precursor and polyvinyl pyrrolidone (PVP) as a capping agent, is reported. The Differential Scanning Calorimetry (DSC) and Thermo Gravimetric Analysis (TGA) of the samples were recorded and the phase transformation temperature of titanium hydroxide, Ti(OH)₄ to titanium oxide, TiO₂ was investigated. The as-prepared Ti(OH)₄ precipitate was annealed at 800°C to obtain TiO₂ nanoparticles. The thermal, structural, morphological and textural characterizations of the TiO₂ nanoparticle samples were carried out by different techniques such as DSC-TGA, X-Ray Diffraction (XRD), Fourier Transform Infra-Red spectroscopy (FTIR), Micro Raman spectroscopy, UV-Visible absorption spectroscopy (UV-Vis), Photoluminescence spectroscopy (PL) and Field Effect Scanning Electron Microscopy (FESEM) techniques. The as-prepared precipitate was characterized using DSC-TGA and confirmed the mass loss of around 30%. XRD results exhibited no diffraction peaks attributable to anatase phase, for the reaction products, after the solvent removal. The results indicate that the product is purely rutile. The vibrational frequencies of two main absorption bands of prepared samples are discussed from the results of the FTIR analysis. The formation of nanosphere of diameter of the order of 10 nm, has been confirmed by FESEM. The optical band gap was found by using UV-Visible spectrum. From photoluminescence spectra, a strong emission was observed. The obtained results suggest that this method provides a simple, efficient and versatile technique for preparing TiO₂ nanoparticles and it has the potential to be applied to other systems for photocatalytic activity.

Keywords : TiO2 nanoparticles, chemical precipitation route, phase transition, Fourier Transform Infra-Red spectroscopy (FTIR), micro-Raman spectroscopy, UV-Visible absorption spectroscopy (UV-Vis), Photoluminescence Spectroscopy (PL) and Field Effect Scanning electron microscopy (FESEM)
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