Chapter 4
Novel Synthesis of 4nm Anatase Nanoparticles at Room Temperature Obtained from TiO_2 Nanotube Structures by Anodizing Ti

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ABSTRACT

The scope of the chapter is showing novel experimental findings on preparing anatase TiO_2 nanoparticles, first anodizing titanium into an organic media for obtaining TiO_2 nanotubes, and these used as a photo catalytic active electrode in treating water polluted with organic contaminants. The substrates were grit blasted in order to obtain mechanical fixation of the generated nanotubular TiO_2 structure. This was successfully achieved without diminishment of the nanotubes order and

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with a self-leveling of the outer surface. A new phenomenon is investigated consisting in the process of oxidation of the nanotubes in water after anodizing. Along this process, methyl orange added to the aqueous solution was discolored as part of the redox reaction involved. The final state of the modified layer was composed of conglomerates of crystalline TiO_2 nanoparticles, around 4 nm in size, consisting of anatase. This was obtained under room conditions.

INTRODUCTION

Nowadays, many materials with different properties have been investigated, between them, the nanomaterials, which have the potential to influence modern society in many aspects. These kinds of materials are now so interesting and both nanoscience and nanotechnology, result so attractive and exciting fields because nano-systems may not behave like their bulk counterparts. The era of dealing with tiny objects has been gaining momentum in the past few years because of the industrial progress, the scientific ability to fabricate, model and manipulate things with a small number of atoms, and the almost daily discovery of novel size-induced phenomena.

The origin of the size-induced properties in nanomaterials depends on the surface phenomena (extrinsic contribution) and quantum confinement effects (intrinsic contribution). The surface to volume ratio increases rapidly when particle size decreases (Fagan & Solange, 2011).

There are many techniques for synthesizing nanoparticles, but in this work is presented the investigation about obtaining them through the synthesis of TiO_2 nanotubes through an electrochemical method. Their analysis cover different aspects, such as morphology layer surfaces, their shape and size, chemical composition, crystalline size, study about catalytic and photocatalytic activity, morphology before and after catalytic and photocatalytic tests. These analyses allow finding and observing a complete transformation of the structure to 4nm anatase nanoparticles.

There are so many works in the nanomaterials area, but those directly related to photocatalysis are mostly associated to TiO_2 or ZnO (Chen & Mao, 2007). TiO_2 is used for many applications, such as: sunscreens, antibacterial, chemical sensors, pollutant filters, toner photoconductor, and in optoelectronics (Chen, Wang, Wei, & Zhu 2012; Chen, Liu, Zhang, & Jin, 2003; Cui, Ghao, Qi, Liu, & Sun 2012; Liang, Luo, Tsang, Zheng, Cheng, & Li, 2012; Macak, Tsuchiya, Ghicov, Yasuda, Hahn, Bauer, & Schmuki, 2007; Xie, 2006). The main use of TiO_2 is like a white dye in many products. In some cases, it is possible to find several industries spread around the world that are producing different kinds of nano-structured titanium dioxide on a large scale (Khvan, Kim, Hong, & Lee, 2011; Yam, Beh, & Hassan, 2011).

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Shiv Shankar Kumar, Pradeep Acharya, Pradeep Kumar Dammalaand Murali Krishna Adapa (2020). *International Journal of Geotechnical Earthquake Engineering (pp. 1-25).*

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(2014). *Computational Intelligence in Remanufacturing (pp. 171-185).*

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