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TiO_2 Nanostructured materials: Synthesis and Characterization of new photocatalyst

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Abstract – TiO_2 photocatalysts were synthesized by sol-gel, homogeneous precipitation, and in emulsions templates. The production of only anatase phase depends on the critical nuclei particle formation. The obtained particles present spherical (Fig.1A) and tubular (Fig 1B) morphologies, with dimensions ranging from a few hundred nanometers to several microns. They were obtained by controlled evaporation of titanium tetraisopropoxide. The synthesized material presents a quantum yield of hydroxyl radical formation of 3.5 %, estimated in photocatalytic experiments using mercury (HPNL) lamps. The results suggest that this material can be improved for applications in advanced oxidative processes (AOP) mediated solar radiation.

Titanium dioxide has been synthesized by templates, precipitation, and hydrothermal methods. The TiO_2 particle formation from titanium tetraisopropoxide precursor can be affected by different approach in hydrothermal synthesis[1]. One of these cases is related with controlled drying of titanium tetraisopropoxide. The conditions of critical nuclei formation is fundamental to determinate the size and morphological aspects of these particles. In this case, the changes in concentration of organic part in organometallic precursor can favor the creation of bulk material with spherical shape[2].

On the other hand, the thermal treatment (450^{o}C during 300 minutes) has revealed in the XRD measurements that these particles are highly crystalline, and only the anatase phase is observed in these materials.

Great part of these structures is of spherical shape with near micrometric size. However, filled nanometric tubes can be observed together with these spherical particles. In Figure 1A, can be observed a rough surface for one of these particles. In Figure 1B, the agent of this effect is shown. The morphological behavior can be understood by the minimization of the surface energy. Nevertheless, these tubes are testimonial of the internal conditions of formation of the spherical particles, being ordered from the center. The band gap of this material was estimated by diffuse reflectance (Figure 2).

The excitation of these materials with energy equal or higher than the E_g, in presence of water, or other oxygenated species, results in the production of hydroxyl radicals. The quantum yield experiments were carried out using mercury (HPNL) lamps to estimate the formation hydroxyl radicals [3]. These radicals are very important, since they have high oxidative potential, and are used to degrade organic substrates in advanced oxidative processes (AOP). The azo dye New Coccine was used as model of organic substrate in our studies. A color removal is observed during the photocatalytic process (Figure 3). The synthesized materials are promising for the development of new photoactive materials based on a simple synthetic method with morphological and phase control.

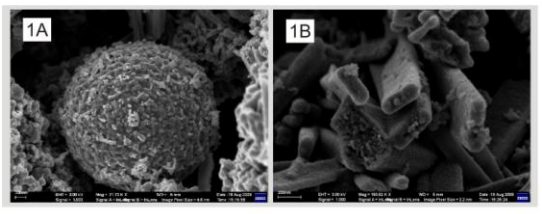

Figure 1: SEM image of a TiO_2 particle deposited. **a)** Spherical rough particle - beam image and **b)** Filled tubes inside the spheres.

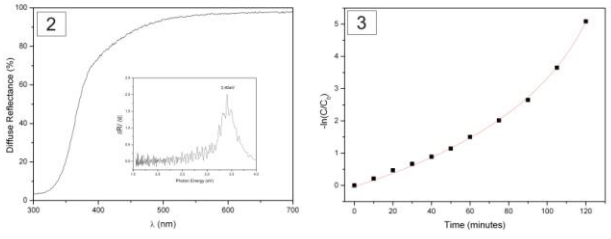

Figure 2 - Band gap determination.
Figure 3 - Decolorization of *New Coccine* at λ_{max}=507nm.

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