Synthesis of gold nanoparticles supported on TiO_2 for the photocatalytic degradation of 4-clorophenol

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Introduction

In the latest years the use and application of gold nanoparticles has been extensively studied [1-5], especially for catalytic purposes since this metal presents good catalytic activity even at room temperature. In this project, we are studying the effect of gold nanoparticles supported on the surface of TiO_2 on the photocatalytic degradation of 4-chlorophenol. Since, different preparation method leads to the formation of metallic nanoparticles of different size distribution and different contact angle and morphology structure between the particles and the support [6]. Therefore, the catalysts have been prepared by three different method of synthesis in order to evaluate their photocatalytic activity for the degradation of an organic model compound.

Photocatalysis is an economic alternative to remove organic pollutants from aqueous effluents. In this process the semiconductor absorbs light and generates active species (HO• radicals) that promotes an oxidation of the organic compounds. Most of the studies report that commercial TiO2 has a good photocatalytic activity for the degradation of organic compounds. But, It has a high-energy band gap (Eg>3.2 eV); it is activated with ultraviolet light (λ<388nm). Therefore is important to develop novel catalysts that can be activated by visible radiation in order to use solar energy fro the photocatalytic processes.

Modified semiconductors with nanoparticles of noble metal have been of great importance to improve the photocatalytic efficiency of this process. Noble metal nanoparticles can reduce the recombination effect hole-electron by acting as a sink at the surface of electrons, and the may displace the band gap to the visible region of the spectrum [7].

Methodology

Three sets of photocatalysts were deposited on the surface of the TiO_2 support by photo reduction, deposition-precipitation and colloidal synthesis in order to control the particle shape and particle size distribution, which in turn affect the photocatalytic activity of titania. The photocatalytc degradation experiments of a 4chlorophenol aqueous solution (100 ppm) were carried out in a reactor illuminated with UV light lamps (λ_{max}=365 nm). These materials were characterized by DRX, BET area, DR-UV-VIS, Atomic Absorption, TPR, TEM and SEM.

Results

The UV-vis spectroscopy has shown that gold nanoparticles displace the absorption band to the 410 nm region. The spectra also show presence of the plasmon in the visible region.

It was shown that gold nanoparticles of d_p around 6nm improves the photocatalytic activity of TiO_2. On the other hand, when the size of the gold nanoparticle increases up to 12 nm the activity decreases.

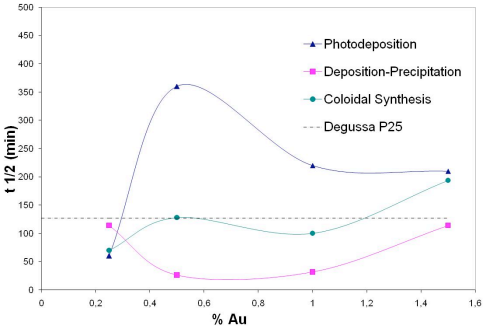

Fig 1. Half-life time of photocatalitic degradation reaction of 4-chlorophenol with Au/TiO_2 catalysts.

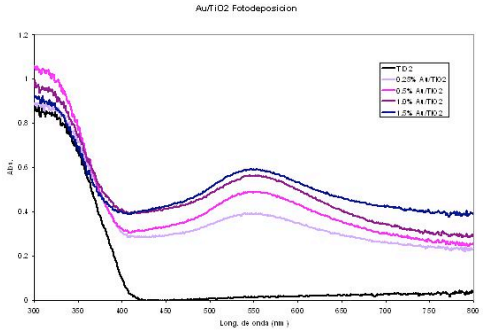

Fig 2. UV-Vis SDR of materials with plasmon resonance at 550nm.

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