

Abstract

Access to clean water has become a major problem in the last decades. This is due to the exponential growth of human population and industrialization. Because of this, the need for reuse of treated waste waters has arisen. A lot of methods for waste water treatment have been developed, but they can be inefficient for the degradation of persistent organic pollutants. A major environmental problem are textile industry effluents since conventional treatment methods are not able to remove textile dyes from waste waters. Because of that, waste waters remain colored, which can alter biological cycles of water organisms, by blocking access of sunlight and consequentially blocking photosynthesis. There is therefore a need for the development of a method, which could efficiently degrade pollutants present in textile industry waste waters. Because of its ability to completely oxidize organic pollutants to CO_2 and H_2O , photocatalysis has emerged as a promising technique for waste water treatment. The term photocatalysis is used to describe a process during which light of a certain wavelength excites an electron from the valence band onto the conductive band of a photocatalyst. The resulting charge carriers (electron and hole) then travel to the surface of the photocatalyst, where they can catalyze the degradation of adsorbed organic pollutants. Because of its advantageous properties, titanium dioxide (TiO_2) has been one of the most widely used photocatalysts. One of the main drawbacks of TiO_2 is the width of its band gap (3.2 eV for anatase), which means that an electron can only be excited onto the conduction band when illuminated with UV light with a wavelength lower than 390 nm. A lot of studies have focused on narrowing the width of the band gap of TiO_2 , which would increase its photocatalytic activity under visible light illumination.

In my research work, I focused on preparing TiO_2 with high photocatalytic activity under visible light illumination. This was achieved by non-metal and metal doping. Samples were synthesized using a sol-gel synthesis with titanium tetrachloride as a precursor (inorganic path). During the synthesis, solutions were acidified with two different acids (HCl and H_2SO_4). To increase the activity of TiO_2 under visible light illumination, different dopants, acting as a source of doped nitrogen (NH_4NO_3 , urea), sulfur (thiourea) and platinum (H_2PtCl_6), were added. Afterward, the prepared sols were deposited onto object glasses using dip-coating and thermally treated in a muffle furnace to promote crystallization. Corresponding powders were prepared by drying the prepared sols, followed by thermal treatment in a muffle furnace. Photocatalytic activity of the prepared thin films was tested by observing the degradation rate of *Plasmocorinth B* textile dye. The photocatalytic activity of powders was determined by observing the rate of isopropanol to acetone oxidation. Thin films and corresponding powders were characterized by various techniques. Moreover, the degradation mechanism of *Plasmocorinth B* was determined using various techniques (chromatography, pH and conductivity). Results of these characterization techniques have shown that the type and amount of acid and dopant used and also the temperature of thermal treatment have a large effect on the structural, surface and morphological properties and consequentially the photocatalytic activity of thin films and corresponding powders. Results have shown a significant increase in activity in samples, doped and co-doped with metals and non-metals, under UV and visible light illumination. The highest activity was observed in samples, co-doped with nitrogen and sulfur and modified with platinum.