



Faculty of Science

Chemistry Department

Photocatalytic Degradation of Various Toxic Pollutants on the Surface of Nanoparticles

A Thesis

Submitted By

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B.Sc., Chemistry, Ain Shams University, ٢٠١٢

Submitted for the degree of master in science
(Inorganic and Analytical Chemistry)

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رسالة مقدمة من

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Abstract

In recent years, photocatalysis has been a promising solution for environmental remediation, titanium dioxide (TiO_2) is usually the choice for photocatalytic applications due to the best activity as well as the stability when compared to other photocatalysts. Meanwhile TiO_2 has many advantages such as high reactivity, low toxicity and low cost. However, there are two major drawbacks have hindered its usage in practical applications, the first one is the large band gap of TiO_2 (3-3.2 eV) that has limited its effective use of solar energy; the second is the rapid recombination of photogenerated electron/hole pairs that decrease its activity. In this context, platinum (Pt) is one of the most active noble metals for photocatalytic enhancement of TiO_2 , which exhibits effective Schottky barrier height, which can act as stronger electron traps to facilitate electron-hole separation. Additionally, Pt has a unique property of the surface plasmon resonances phenomena, therefore this property can help in extending light absorbance towards the visible light region.

As of late, the widespread presence of chemicals, for example, dyes, heavy metals, herbicides, pesticides, aliphatic and aromatic detergents, arsenic compounds, solvents,

degreasing agents, volatile organics, and chlorophenols show a serious risk to the environment. When such chemicals pollute water sources, they become dangerous to environment. For instance, 15% of the total dye is lost during the dying process and discharged in waste waters. Degradation of these pollutants at the surface of TiO_2 photocatalyst is an important photocatalysis application.

In the present study, a modified titania was prepared using sol-gel method then doped with platinum through incipient wetness method to attain its application in photocatalytic degradation of cationic Rhodamine B and anionic Methyl orange dyes in visible light region. The prepared titania showed good physicochemical property owing to the role of chitosan as template, the crystalline size of the prepared samples are in the nano sized particles within the range of 11.4-14.6 nm, spherical particles of the prepared photocatalysts reveals the role of chitosan in tailoring the shape. Platinum has a great role in enhancing the photodegradation process through electron hole separation of TiO_2 and increasing the absorbance in visible region. The effects of parameters including dopant concentration, photocatalyst dosage, initial dye concentration and initial pH

on the process performance were investigated. Furthermore chemical oxygen demand (COD) confirmed the degradation of the dyes. The degradation processes in both dyes followed a pseudo-first-order kinetics.

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