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Use of Titanium dioxide as a Photocatalyst: A Review

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Abstract:
Even though heterogeneous photocatalysis appeared in many forms, photodegradation of organic pollutants has recently been the most widely investigated. By far, titania has played a much larger role in this scenario compared to other semiconductor photocatalysts due to its cost effectiveness, inert nature and photostability. Extensive literature analysis has shown many possibilities of improving the efficiency of photodecomposition over titania by combining the photoprocess with either physical or chemical operations. The present review paper seeks to offer an overview the use of the TiO_2 photocatalyst for remediation and decontamination of wastewater.

Keywords: Semiconductor, Titania, Degradation, Photocatalysis, Ecotoxicity

INTRODUCTION:

Titanium dioxide TiO_2 is a compound first synthesized by Martin H. Klaproth in 1791. The catalyst is in the heart of the photocatalytic process.Since photocatalysis is based on the excitation of a photocatalyst with irradiation of light energy at least equal to that of the band gap (BI). These photocatalysts are more commonly called semiconductors. There are many semiconductor metal oxides represent a large part of the semiconductors used for photocatalytic properties namely, TiO_2, ZnO, ZnS, WO_3, CdS, SnO_2, GaP etc...... Among the list of semiconductors reported in the literature, TiO_2 has proven most suitable for most common environmental applications. Because it is biologically and chemically inert, resistant to chemical corrosion and can work at ambient temperature and pressure, without addition of chemical species.

Fujishima and Honda[3] (1972) demonstrated the potential of titanium dioxide (TiO_2) semiconductor materials to split water into hydrogen and oxygen in a photo-electrochemical cell. Their work triggered the development of semiconductor photocatalysis for a wide range of environmental and energy applications.

Photocatalysis mechanism:

The catalytic activity of TiO_2 originates from its electronic structure and photoelectric characteristics. The band theory can be used to explain the photocatalytic reaction principle[2]. TiO_2 has a band gap which consists of valence band and conduction band, and the band gap energy is 3.2 eV. When the surface of TiO_2 is irradiated with light which is equal to or greater than the band gap energy of TiO_2, its surface will be stimulated and produce hole-electronic pair, which has the ability of oxidation and reduction[3]. Expression is as equation (1).

$TiO_2 + h\nu \; e^- + h^+ \Rightarrow$ (1)

The produced h^+ can oxidize OH^- and H_2O on the surface of TiO_2 to •OH, and •OH can almost oxidize all pollutants adsorbed on the surface of TiO_2[4].

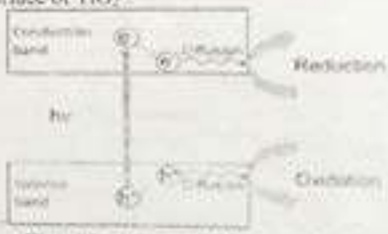

Fig. 1 The Process of Photocatalysis

Degradation of organic molecules

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