Abstract

The main objective of this thesis was to investigate the application of photocatalysis for the degradation of organics, dyes, polymers, reduction of metal ions, decomposition of NO, etc. In this context, extensive work was done both theoretically and experimentally, the kinetic scheme differs for each substrate under consideration. For example, organics and dyes undergo oxidative degradation by OH• radicals, metal ions undergo photo catalytic reduction by the photo generated electrons; polymers in solution undergo random scission by the radicals; NO decomposition or reduction to N2 and N2O in presence of CO occurs by getting adsorbed on oxide ion vacant sites available on Pd Substituted titania followed by dissociation by the photo generated electrons. The kinetics of these systems was studied in detail in this study.

Chapter 2 presents the systematic development of kinetics of photocatalytic degradation of dyes/organics. The individual role of holes and electrons is quantified using the validation of the model with the experimental results where the electrons alone were scavenged by the metal cations.

Chapter 3 presents the photocatalytic reduction of metal ions in presence of solution combustion synthesized titania. Also, the emerging need of development of new photocatalyst is also considered. In this context, the newly developed photocatalysts namely GdCoO3 and metal substituted/impregnated titania were explored extensively in terms of their characteristics and photocatalytic efficiencies.

Chapter 4 and 5 deals with the photocatalytic efficiencies and characteristics of GdCoO3 and metal substituted/impregnated titania, respectively. The dependence of photocatalytic efficiency on the size of nano GdCoO3 is also explored. The efficiency of these new materials is compared with that of the commercial catalyst Degussa P25.

Chapter 6 deals with the modeling and experimental investigations on polymer degradation under simultaneous ultraviolet and ultrasound irradiation.
Chapter 7 deals with the modeling of photocatalytic reduction of NO on Pd substituted titania.