Seminar

Institute for Plasma Research

Title : Heterogeneous Photocatalytic dye degradation using Zinc Oxide (ZnO) Semiconductor nanoparticles prepared from its Laboratory grade powder

Speaker: Dr. Rajashree Sahoo
Kalinga Institute of Industrial Technology, Bhubaneshwar

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Venue : Online - Join the talk: https://meet.ipr.res.in/Dr.RajashreeSahoo_PDFtalk

Abstract :

Heterogeneous photocatalysis has been found to be very promising for applications like the generation of green fuel (H_2) by splitting of water, sterilization of medical instruments by bactericidal effect, purification of water by degradation of dyes and other waste products of industries, etc. Currently, the rapid industrialization has brought hazardous dye pollutants into the water. This is a serious threat to the environment. In few years, the metal oxide semiconductor materials were used as photocatalysts for the removal of dyes. Zinc oxide (ZnO) is an II-VI compound semiconductor, having properties like direct bandgap (Eg~3.3 eV) and large excitation binding energy (~60meV at room temperature). Many works have been reported on the use of commercial ZnO nanoparticles for photocatalysis reaction. However, in all these studies the ZnO nanoparticles used are generally of ACS or reagent grades which are quite expensive. For reduction of the cost, in this study ZnO nanoparticles are prepared from commercial laboratory grade ZnO powder and characterized by XRD, TEM, PL studies. UV photocatalytic dye degradation study was done using these ZnO nanoparticles. Particularly, the reaction kinetics and reaction rate are estimated by monitoring various dye degradation activity. The photocatalysis studies with scavengers are done to find the mechanism of the photocatalytic degradation process. The performance of these nanoparticles is compared with respect to benchmark commercial TiO2 nanoparticles (Degussa P25) and it is found that ZnO nanoparticles can exhibit 3 times more UV photocatalytic activity than that of P25. Artificial visible light and solar photocatalytic dye degradation have also been studied. In a comparative study, it is demonstrated that solar photocatalytic dye degradation activity can be 12 times higher than artificial visible light based photocatalytic dye degradation under same lumen level. Cause for this superior solar photocatalytic dye degradation activity is explored by comparing the spectrum of artificial visible and solar radiation. The solar photocatalytic activity of anionic dye like methyl orange and cationic dye like crystal violet dye is also studied. Probable explanation is given on the difference found in reaction rate constants for solar photocatalytic degradation of anionic and cationic dyes in similar conditions. The ZnO powder used by us is extremely low cost, so this material can be a suitable choice for mass scale industrial photocatalytic dye degradation applications.