ZnO under direct sun light, replaced CdS@TiO_2 particles in photo-degradation of phenazopyridine

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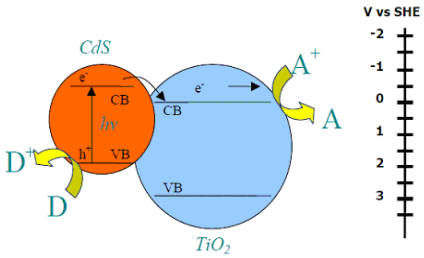
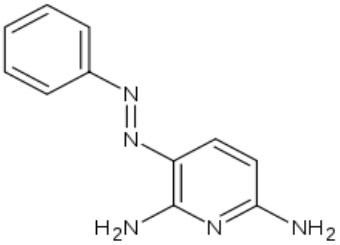
Abstract:

TiO_2 nano- and micro-particles have been extensively studied as photo-ctalysts in complete mineralization of many toxic organic pollutants. However, modification of TiO_2 is necessary to enhance the efficiency of TiO_2 photocatalysis and to improve the photocatalytic activity of TiO_2 under solar visible light. To enhance efficiency in visible region, surfaces of Rutile TiO_2 particles have been modified with CdS particles. The TiO_2/CdS system was used to catalyze photo-degradation of phenazopyridine (a medically active compound), Scheme 1. Both UV and visible ranges were investigated.

CdS sensitization of TiO_2 to visible region was observed (Scheme 2), as the TiO_2/CdS system showed much higher catalytic efficiency than the naked TiO_2 system in the visible region. Unfortunately, the TiO_2/CdS system was unstable under neutral, acidic and basic conditions. Degradation of CdS into hazardous aqueous Cd^{2+} ions occurred. This imposes limitations on future usage of CdS-sensitized TiO_2 photo-catalytic systems in water purification processes.



Scheme 2:
Sensitization in a TiO_2/CdS system



Scheme 1:
phenazopyridine structural formula

Solar-driven photo-degradation of phenazopyridine contaminant was investigated in aqueous media using different ZnO-based catalyst systems, naked ZnO, and activated carbon-supported ZnO (AC/ZnO). Both naked ZnO and AC/ZnO were highly efficient in degrading phenazopyridine, reaching complete removal in reasonable time, with AC/ZnO having a higher edge. In both ZnO and AC/ZnO systems.Effects of catalyst concentration, catalyst recovery, contaminant concentration, temperature and pH, on catalyst efficiency, have also been studied.

Keywords: Photo-degradation, TiO_2, ZnO, Cadmium Sulfide, phenazopyridine