

Nanoparticle CdS-Sensitized TiO₂ Catalyst for Photo-Degradation of Water Organic Contaminants: Feasibility Assessment and Natural-Dye Alternatives

Ahed Zyoud, Nidal Zatar, Iyad Saadeddin & HiKmat Hilal
Department of Chemistry, Graduate Studies, An-Najah N. University,
Nablus, West Bank, Palestine

Abstract:

The photocatalytic degradation of organic contaminants (such as industrial dyes, insecticides, pesticides, ... etc) in water, using TiO₂ under UV are commonly used procedures. Modifying TiO₂ with CdS is also a common technique used for water purification under visible light.

In this work both commercial and prepared TiO₂ were used for photo-degradation of two model contaminants, methyl orange (MO) and phenazopyridine (PhPy). In order to sensitize TiO₂ to visible light, a chemical path deposition method (CBD) was used to precipitate non-scale (~20 nm) CdS particles on TiO₂ particle surfaces. Sand was used as a supporting surface for the TiO₂/CdS catalyst. UV-visible spectra, photoluminescence emission spectra, XRD and SEM imaging were measured to characterize the prepared catalyst systems. Effects of catalyst concentration, initial contaminant concentration and pH on photo-degradation rate were studied. Turnover number and quantum yield were also calculated for comparison study.

Despite the high efficiency of TiO₂/CdS catalyst system in degrading water contaminants, voltametric analysis confirmed complete CdS decomposition during the photo-degradation process. Due to hazardous nature of resulting Cd²⁺ in the treated water, an alternative sensitizer has been suggested based on natural nontoxic dyes. Anthocyanin was used here for the first time as a sensitizer for the rutile TiO₂ system. Activated Carbon (AC) was also used as a supporting substrate. Electronic absorption spectra, FT-IR spectra, and TGA analysis were used to characterize the prepared TiO₂/Anthocyanine catalyst systems. The efficiency of the new catalyst system, in photo-degradation of MO and PhPY was assessed. An observable efficiency was noted specially when using AC/TiO₂/Anthocyanin at low pH in photo-degradation of MO.

Details of results, discussions and suggested mechanisms will be presented in this presentation

Keywords: TiO₂, CdS, anthocyanin, contaminants, photo-degradation.

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Email addresses:

ahedzyoud@najah.edu