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Water Pollution

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Short Communication

Environmental problem caused by toxic organic pollutants from the domestic and industrial output is now the subject of considerable concern from environmental remediation point of view. In the past decades, great efforts have been made using widely called "Advanced Oxidation Technologies (AOTs)" for treatment of these recalcitrant pollutants to more biodegradable compounds or their mineralization into CO_2 and other inorganics. It has been estimated that the amount of solar energy reaching on the Earth every day is more than that mankind could use for three decades. In whole energy of incoming solar spectrum, ultraviolet radiation (400 nm) accounts to only less that 4%. Hence, effective utilization of the visible light of solar radiation, (as in the photosynthesis of plants), is a long dream of any photo chemist.

The most important aspect of photo catalysis is a focus probably on metal oxide semiconductor for degradation of organic pollutants in water at ambient conditions using inexpensive and clean solar light and hole as the energy source and oxidant, respectively. The main advantage of this method is that almost all organic pollutants can be mineralized completely into CO_2, H_2O and inorganic ions. Activated charcoal adsorption was used for color removal in minor amounts but it is an expensive method and had high regeneration cost. Photocatalysis is a promising technology for degradation of water pollutants. Many semiconductors like TiO_2, ZnO, Fe_2O_3, CdS, Sb_2S_3 etc. have already been used as photocatalysts for degradation of many dyes molecules into harmless or less harmful products. Various researchers have used different semiconductors as photocatalyst for degradation of dyes.

Photocatalysis

Photocatalysis includes such reactions, which utilize light to activate a substance (particularly a semiconductor), which modifies the rate of a chemical reaction without being involved itself. The definition of 'Photocatalysis' accepted by IUPAC after long debate is a catalytic reaction involving light absorption by a substrate. Similarly, the substrate, which is a semiconductor, absorbs light and acts as a catalyst for that chemical reaction, is known as photocatalyst.

Photocatalytic Reactions

The photocatalytic reactions can be classified into two categories on the basis of physical state/appearance of reactants.

Homogeneous Photocatalysis

When the catalyst and reactant; both are in the same phases, i.e., gas, solid or liquid, then the photocatalytic reaction is called homogeneous photocatalysis. Different dyes/organic substances and coloured coordination compounds are best example of homogeneous photocatalysts.

Heterogeneous Photocatalysis

When the catalyst and reactant; both are in different phases, then the photocatalytic reaction is called heterogeneous photocatalysis. The common example of this kind is a solid photocatalyst in contact with either liquid or a gas phase.

Photocatalysts

All the photocatalysts are normally semiconductors, but all semiconductors are not necessarily photocatalysts. Semiconductor is a substance, where the energy gap between conduction band (lowest unoccupied molecular orbital, LUMO) and valence band (highest occupied molecular orbital, HOMO), ranges from 1.5 to 3.0 eV. The energy difference between the valence band and the conduction band is known as the band gap (Eg). On the basis of this band gap, the materials are classified in three categories

a) Eg < 1.0 eV, metal or conductor,

b) Eg > 5.0 eV, insulator or non-conductor and

c) Eg ~ 1.5 to 3.0 eV, semiconductor.

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