

Editorial

Environmental Photocatalysis 2013

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Semiconductor photocatalysis has caused enormous attention in recent year and has been demonstrated to be one of the "green" and effective methods for water and air purification, water disinfection, hazardous waste remediation, antibacterial, and self-cleaning. However, owing to low photocatalytic efficiency, the environmental applications of various photocatalytic materials and technologies are still very limited. Thus, more improvement and investigations are highly required from the viewpoint of practical use.

This special issue contains 20 papers, which are mainly related to pollutant degradation and environmental purification. Among them, 10 papers are related to composite of two semiconductors including TiO₂ and other semiconductors, 4 papers deal with fabrication of new photocatalytic materials, 2 papers are about doping of TiO₂, and 4 papers are devoted to immobilization of TiO₂. Furthermore, there are 13 papers devoting degradation of pollutant in water, 4 papers on air purification including decomposition of formaldehyde, NO and benzene, 2 papers related to hydrogen production, and 1 paper dealing with bactericidal activity of TiO₂. We would like to express our sincere thanks to all the authors for submitting their interesting works to this special issue. A brief summary of all 20 accepted papers is provided as follows.

In "A cost-effective solid-state approach to synthesize g-C₃N₄ coated TiO₂ nanocomposites with enhanced visible light photocatalytic activity," the authors describe the

fabrication and photocatalytic performance of g-C₃N₄/TiO₂ nanocomposites by a facile solid-state method using urea and commercial TiO₂ as precursors. The prepared nanocomposites exhibited enhanced absorption and photocatalytic performance for degradation of aqueous MB in visible light region.

The paper "Synthesis and characterization of pyrochlore Bi₂Sn₂O₇ doping with praseodymium by hydrothermal method and its photocatalytic activity study" reports preparation of Pr-doped Bi₂Sn₂O₇ (BSO) by a hydrothermal method. The photocatalytic activity of the prepared samples was evaluated by the degradation of rhodamine Bextra (RhB) and 2,4-dichlorophenol (2,4-DCP) in aqueous solution under visible light. Pr-doped BSO samples exhibited enhanced visible-light photocatalytic activity and the optimal dopant amount of Pr was determined to be 1.0 mol%.

The paper "Single step formation of C-TiO₂ nanotubes: influence of applied voltage and their photocatalytic activity under solar illumination" presents fabrication of self-aligned and high-uniformity carbon (C)-titania (TiO₂) nanotube arrays by single step anodization of titanium (Ti) foil at 30 V for 1 h. The photocatalytic activity evaluation of C-TiO₂ samples was performed by degradation of methyl orange (MO) solution. The results revealed that controlled nanoarchitecture C-TiO₂ photocatalyst led to a significant enhancement in photocatalytic activity.

The paper "Removal of formaldehyde using highly active Pt/TiO₂ catalysts without irradiation" describes preparation of TiO₂ supported Pt catalysts by sol-gel method and their application for eliminating formaldehyde (HCHO) at room temperature without irradiation. More than 96% of the conversion of HCHO was obtained over 0.5 wt% Pt/TiO₂-H₂ sample, on which highly dispersed metallic Pt nanoparticles with ~2 nm were identified.

The paper "CTAB-assisted hydrothermal synthesis of Bi₂Sn₂O₇ photocatalyst and its highly efficient degradation of organic dye under visible-light irradiation" reported preparation of Pyrochlore-type Bi₂Sn₂O₇ (BSO) nanoparticles by a hydrothermal method assisted with cetyltrimethylammonium bromide (CTAB). The photocatalytic activity of the BSO assisted with CTAB was two times that of the reference BSO.

The paper "H₂ fuels from photocatalytic splitting of seawater affected by nano-TiO₂ promoted with CuO and NiO" described preparation and photocatalytic performance of nanostructured TiO₂ loaded with NiO (2.5%) and CuO (2.5%). The accumulated H₂ yielded from the photocatalytic splitting of seawater containing oxalic acid (50 mM) as the sacrificial reagents on CuO/nano-TiO₂ was 8.53 μmol/g_{cat} after the 5 h radiation. On the NiO/nano-TiO₂ photocatalyst, the H₂ yield was relatively low (i.e., 1.46 μmol/g_{cat}).

In "Dynamic hydrogen production from methanol/water photo-splitting using Core@Shell-structured CuS@TiO₂ catalyst wrapped by high concentrated TiO₂ particles," core@shell-structured CuS@TiO₂ catalysts were prepared and the prepared samples exhibited a wide absorption range above 700 nm comparing with pure TiO₂. Hydrogen evolution rate from methanol/water photo-splitting over the core@shell-structured CuS@TiO₂ photocatalyst was about 10-fold higher than pure CuS.

In "Enhanced visible light photocatalytic activity for TiO₂ nanotube array films by codoping with tungsten and nitrogen," a series of W, N codoped TiO₂ nanotube arrays (TNAs) with different dopant contents, were fabricated by anodizing, followed with hydrothermal treatment. W and N codoping successfully extended the absorption of TNAs into the whole visible light region and resulted in remarkably enhanced photocatalytic activity under visible light irradiation.

The paper "Kinetics study of photocatalytic activity of flame-made unloaded and Fe-loaded CeO₂ nanoparticles" reported preparation and enhanced photocatalytic activity of Fe-doped and undoped CeO₂ by flame spray pyrolysis method. Photocatalytic studies showed that Fe-doped CeO₂ sample exhibited higher activity than un-doped CeO₂ sample, with optimal 2.00 mol% of iron loading concentration.

The paper "Solar photocatalytic degradation of bisphenol A on immobilized ZnO or TiO₂" reported the removal of bisphenol A (BPA) under simulated solar irradiation in the presence of either TiO₂ or ZnO catalysts immobilized onto glass plates. BPA degradation followed first-order reaction kinetics.

In "Supported zinc oxide photocatalyst for decolorization and mineralization of orange G dye wastewater under UV365 irradiation," a photocatalytic system by utilizing both cold cathode fluorescent light (CCFL) UV irradiation and steel

mesh supported ZnO nanoparticles in a closed reactor for the degradation of azo dye C.I. Orange G (OG) was reported. The ZnO-coated steel mesh can be repeatedly used over 10 cycles without significant loss of catalyst mass.

In "The multiple effects of precursors on the properties of polymeric carbon nitride," polymeric graphitic carbon nitride (g-C₃N₄) materials were prepared by direct pyrolysis of thiourea, dicyandiamide, melamine, and urea under the same conditions, respectively. The photocatalytic activity of the samples was evaluated by the removal of NO in gas phase under visible light irradiation. Considering the cost, toxicity, and yield of the precursors and the properties of g-C₃N₄, the best precursor for preparation of g-C₃N₄ was melamine.

In "One-step synthesis of TiO₂/perlite composites by flame spray pyrolysis and their photocatalytic behavior," TiO₂/perlite composites were prepared by facile one-step flame spray pyrolysis (FSP) route using titanium alkoxide (TIPO) and expanded perlite as Ti source and substrate, respectively. The porosity and the light absorbance of the TiO₂/perlite composites were examined and their photocatalytic activity in NO oxidation was evaluated. The best photocatalytic activity of the composites was connected to almost equal anatase-rutile ratio and possible synergetic effect of the two TiO₂ phases.

The paper "Au/TiO₂ reusable photocatalysts for dye degradation" reported preparation of Nanogold-doped TiO₂ catalysts and their application in the photodegradation of dye pollutants. Au-doped systems showed very good photoactivity in the degradation of dye pollutants under UV irradiation as well as in sunlight.

The paper "Fabrication, modification, and emerging applications of TiO₂ nanotube arrays (TNAs) by electrochemical synthesis: a review" reviewed the recent progress of the new research achievements of TNAs on the preparation processes, forming mechanism, and modification. In addition, the authors also reviewed potential and significant applications in the photocatalytic degradation of pollutants, solar cells, water splitting, and other aspects. Finally, the existing problems and further prospects of this renescent and rapidly developing field were also briefly addressed and discussed.

In "Photocatalytic degradation of organic dyes by H₄SiW₆Mo₆O₄₀/SiO₂ sensitized by H₂O₂," H₄SiW₆Mo₆O₄₀/SiO₂ was sensitized by H₂O₂ solution that significantly improved its catalytic activity under simulated natural light. The photodegradation of malachite green, methyl orange, methylene blue, and Rhodamine B were also tested, and the degradation rate of dyes reached 90%–98%.

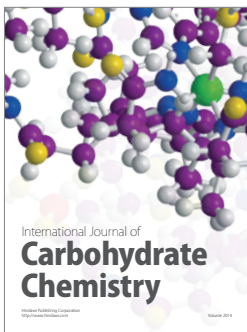
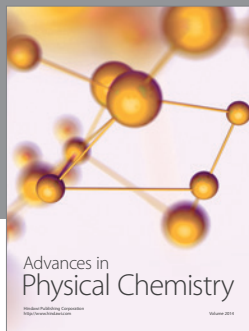
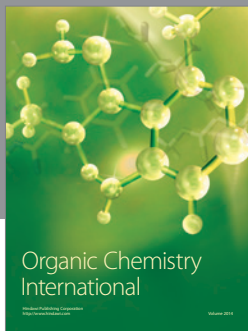
In "Enhancement of photocatalytic activity on TiO₂-nitrogen-doped carbon nanotubes nanocomposites," TiO₂-nitrogen-doped carbon nanotubes (TiO₂-CNx) nanocomposites were successfully synthesized by a facile hydrothermal method. TiO₂-CNx nanocomposites exhibited much higher photocatalytic activity than neat TiO₂ and TiO₂-CNTs mechanical nanocomposites. The improved photodegradation performances were attributed to the suppressed recombination of electrons and holes caused by the effective transfer of photogenerated electrons from TiO₂ to CNx.

In “Effect of different calcination temperatures on the structural and photocatalytic performance of Bi-TiO₂/SBA-15,” the Bi-TiO₂/SBA-15 composite was synthesized by an easy wet impregnation method. It was found that SBA-15 retained the ordered hexagonal mesostructure after incorporation of TiO₂ and Bi. The Bi-TiO₂/SBA-15 composite exhibited higher photocatalytic activities than pure TiO₂ and Bi₂O₃.

The paper “Photocatalytic oxidation of gaseous benzene under 185 nm UV irradiation” reported that benzene removal efficiency of Photocatalytic oxidation (PCO) with 254 nm UV irradiation (denoted as 254-PCO) was only 2.1%, while it was greatly increased to 51.5% in 185-PCO. 185-PCO exhibited superior capacity for benzene oxidation. In the 185-PCO process, much ozone was left in case of TiO₂ as photocatalysts while it could be nearly eliminated by 1% Co-TiO₂.

The paper “Bactericidal activity of TiO₂ on cells of pseudomonas aeruginosa ATCC 27853” presented the antibacterial effects of TiO₂ and light exposure (at 365 nm) on Pseudomonas aeruginosa ATCC 27853. Following 90 minutes exposure to TiO₂ and UV light, logarithm of cell density was reduced from 6 to 3.

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