Hindawi Publishing Corporation
International Journal of Photoenergy
Volume 2013, Article ID 786806, 3 pages
http://dx.doi.org/10.1155/2013/786806

Hindawi

Editorial

Environmental Photocatalysis 2013

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Received 16 December 2013; Accepted 16 December 2013

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 TiO_2 and other semiconductors, 4 papers deal with fabrication of new photocatalytic materials, 2 papers are about doping of TiO_2, and 4 papers are devoted to immobilization of TiO_2. 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 TiO_2. 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-C_3N_4 coated TiO_2 nanocomposites with enhanced visible light photocatalytic activity," the authors describe the fabrication and photocatalytic performance of g-C_3N_4/TiO_2 nanocomposites by a facile solid-state method using urea and commercial TiO_2 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 $Bi_2Sn_2O_7$ doping with praseodymium by hydrothermal method and its photocatalytic activity study" reports preparation of Pr-doped $Bi_2Sn_2O_7$ (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-TiO_2 nanotubes: influence of applied voltage and their photocatalytic activity under solar illumination" presents fabrication of self-aligned and high-uniformity carbon (C)-titania (TiO_2) nanotube arrays by single step anodization of titanium (Ti) foil at 30 V for 1 h. The photocatalytic activity evaluation of C-TiO_2 samples was performed by degradation of methyl orange (MO) solution. The results revealed that controlled nanoarchitecture C-TiO_2 photocatalyst led to a significant enhancement in photocatalytic activity.

The paper "Removal of formaldehyde using highly active Pt/TiO_2 catalysts without irradiation" describes preparation of TiO_2 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/TiO_2-H_2 sample, on which highly dispersed metallic Pt nanoparticles with ~2 nm were identified.

The paper "CTAB-assisted hydrothermal synthesis of $Bi_2Sn_2O_7$ photocatalyst and its highly efficient degradation of organic dye under visible-light irradiation" reported preparation of Pyrochlore-type $Bi_2Sn_2O_7$ (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 "H_2 fuels from photocatalytic splitting of seawater affected by nano-TiO_2 promoted with CuO and NiO" described preparation and photocatalytic performance of nanostructured TiO_2 loaded with NiO (2.5%) and CuO (2.5%). The accumulated H_2 yielded from the photocatalytic splitting of seawater containing oxalic acid (50 mM) as the sacrificial reagents on CuO/nano-TiO_2 was 8.53 μmol/g_{cat} after the 5 h radiation. On the NiO/nano-TiO_2 photocatalyst, the H_2 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@TiO_2 catalyst wrapped by high concentrated TiO_2 particles," core@shell-structured CuS@TiO_2 catalysts were prepared and the prepared samples exhibited a wide absorption range above 700 nm comparing with pure TiO_2. Hydrogen evolution rate from methanol/water photo-splitting over the core@shell-structured CuS@TiO_2 photocatalyst was about 10-fold higher than pure CuS.

In "Enhanced visible light photocatalytic activity for TiO_2 nanotube array films by codoping with tungsten and nitrogen," a series of W, N codoped TiO_2 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 CeO_2 nanoparticles" reported preparation and enhanced photocatalytic activity of Fe-doped and undoped CeO_2 by flame spray pyrolysis method. Photocatalytic studies showed that Fe-doped CeO_2 sample exhibited higher activity than un-doped CeO_2 sample, with optimal 2.00 mol% of iron loading concentration.

The paper "Solar photocatalytic degradation of bisphenol A on immobilized ZnO or TiO_2" reported the removal of bisphenol A (BPA) under simulated solar irradiation in the presence of either TiO_2 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-C_3N_4) 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-C_3N_4, the best precursor for preparation of g-C_3N_4 was melamine.

In "One-step synthesis of TiO_2/perlite composites by flame spray pyrolysis and their photocatalytic behavior," TiO_2/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 TiO_2/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 TiO_2 phases.

The paper "Au/TiO_2 reusable photocatalysts for dye degradation" reported preparation of Nanogold-doped TiO_2 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 TiO_2 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 renascent and rapidly developing field were also briefly addressed and discussed.

In "Photocatalytic degradation of organic dyes by $H_4SiW_6Mo_6O_{40}/SiO_2$ sensitized by H_2O_2," $H_4SiW_6Mo_6O_{40}/SiO_2$ was sensitized by H_2O_2 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 TiO_2-nitrogen-doped carbon nanotubes nanocomposites," TiO_2-nitrogen-doped carbon nanotubes (TiO_2-CNx) nanocomposites were successfully synthesized by a facile hydrothermal method. TiO_2-CNx nanocomposites exhibited much higher photocatalytic activity than neat TiO_2 and TiO_2-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 TiO_2 to CNx.

In "Effect of different calcination temperatures on the structural and photocatalytic performance of Bi-TiO_2/SBA-15," the Bi-TiO_2/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 TiO_2 and Bi. The Bi-TiO_2/SBA-15 composite exhibited higher photocatalytic activities than pure TiO_2 and Bi_2O_3.

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 TiO_2 as photocatalysts while it could be nearly eliminated by 1% Co-TiO_2.

The paper "Bactericidal activity of TiO_2 on cells of pseudomonas aeruginosa ATCC 27853" presented the antibacterial effects of TiO_2 and light exposure (at 365 nm) on Pseudomonas aeruginosa ATCC 27853. Following 90 minutes exposure to TiO_2 and UV light, logarithm of cell density was reduced from 6 to 3.

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