Editorial

Photocatalysis in Environment, Energy, and Sustainability

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Received 28 April 2016; Accepted 3 May 2016

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Photocatalysis has attracted enormous attention in solar energy conversion to provide renewable and sustainable energy source, thus solving the serious environmental and energy-related problems. Those applications include hydrogen evolution by water splitting, CO₂ conversion to hydrocarbon fuels, photocatalytic pollutants degradation, and water disinfection. In the past few decades, TiO₂ has been the most commonly used photocatalyst because of its low-cost, nontoxicity, and high efficiency with UV-irradiation. Meanwhile, in recent years, researchers have turned their focus to novel materials and advanced technology that may bring photocatalysis into practical use. In this regard, to move this field forward, we invited investigators to contribute original research articles on recent development of photocatalysis in environment, energy, and sustainability. This special issue consists of 9 papers, mainly related to environmental purification by using various advanced photocatalysts. A brief summary of all accepted papers is provided below.

In “Adsorption and Photocatalytic Kinetics of Visible-Light Response N-Doped TiO₂ Nanocatalyst for Indoor Acetaldehyde Removal under Dark and Light Conditions,” the paper investigated the removal of indoor acetaldehyde using N-doped TiO₂ photocatalyst under visible light irradiation. It was found that the mesoporous N-TiO₂ had a high ability to absorb acetaldehyde, which was subsequently photooxidized under visible-light irradiation. The increase in temperature would result in the decrease in the adsorption rate of indoor acetaldehyde.

The paper “Evaluation of the Antimicrobial Activity of Nanostructured Materials of Titanium Dioxide Doped with Silver and/or Copper and Their Effects in *Arabidopsis thaliana*” reported the sol-gel synthesis of Cu²⁺-TiO₂ and Ag@TiO₂ as nanostructured photocatalysts for microbial disinfection. The Ag@TiO₂ was more active than Cu²⁺-TiO₂, while *E. coli* was more sensitive to Ag@TiO₂ than *S. cerevisiae*. The impact of the as-prepared photocatalysts in plants was evaluated by exposing *Arabidopsis thaliana* Col-0 strain to these materials at different conditions and concentrations. Deleterious effects on *A. thaliana* due to exposition of silver base materials were observed at longer times of exposures and higher concentrations of photocatalysts.

The paper “Synthesis of CdS Sensitized TiO₂ Photocatalysts: Methylene Blue Adsorption and Enhanced Photocatalytic Activities” reported the microwave-assisted hydrothermal synthesis of a series of CdS/TiO₂ nanocomposite with different Cd to Ti molar ratio by using P25-TiO₂ nanopowder as the raw materials. Results showed that CdS/TiO₂ photocatalysts with low Cd to Ti molar ratios exhibited much higher activities than P25-TiO₂, and the CdS/TiO₂ sample with 20% CdS/(TCd2) showed the highest activity among all these samples, which is attributed to the low rate of electron-hole recombination.

The paper “TiO₂/Halloysite Composites Codoped with Carbon and Nitrogen from Melamine and Their Enhanced Solar-Light-Driven Photocatalytic Performance” reported the fabrication of C and N codoped anatase TiO₂/amorphous

halloysite nanotubes (C,N-TiO₂/HNTs) using melamine as C and N source. The as-prepared C,N-TiO₂/HNTs showed higher photocatalytic activity for the degradation of methylene blue than that of TiO₂/HNTs.

In the paper "Synthesis of CuO/Co₃O₄ Coaxial Heterostructures for Efficient and Recycling Photodegradation," a highly efficient CuO/Co₃O₄ composite was synthesized on Cu wire mesh by a simple hydrothermal method. These CuO/Co₃O₄ coaxial heterostructures were easy to recycle and exhibited enhanced photocatalytic activity for the degradation of methylene blue than that of single CuO nanorod arrays.

The paper "Evaluation of La-Doped Mesoporous Bioactive Glass as Adsorbent and Photocatalyst for Removal of Methylene Blue from Aqueous Solution" reported a series of La-doped mesoporous bioactive glasses (BG-La) with excellent biosafety and hypotoxicity. The BG-La showed higher photocatalytic activity than undoped mesoporous bioactive glasses (BG). The MB loaded on BG-La could be easily desorbed with acid solution due to its electronegativity and mesoporous structure.

In the paper "New TiO₂/DSAT Immobilization System for Photodegradation of Anionic and Cationic Dyes," a new technique to immobilize TiO₂ was developed by coating TiO₂ solution onto double-sided adhesive tape (DSAT) as a thin layer binder without adding any organic additives. The immobilized TiO₂/DSAT showed lower and higher photocatalytic activity for the degradation of reactive red 4 and methylene blue than that of TiO₂ powders in suspension mode, respectively. The DSAT provided a very strong interaction between glass and TiO₂ layers, and therefore the reusability of immobilized TiO₂/DSAT could be up to 30 cycles.

In the paper "Hydrophobic ZnO-TiO₂ Nanocomposite with Photocatalytic Promoting Self-Cleaning Surface," ZnO nanorod array film on quartz crystal microbalance is modified by β -CD in hydrothermal process and then decorated by P25-TiO₂ after impregnating in its suspension. The as-prepared films exhibited excellent hydrophobicity as well as self-cleaning property for organics under UV-irradiation.

The paper "Enhanced Photocatalytic Property of Cu Doped Sodium Niobate" reported the synthesis of Cu doped NaNbO₃ by modified polymer complex method. Compared with pristine NaNbO₃, the as-prepared Cu-NaNbO₃ showed enhanced photocatalytic activity for H₂ evolution from methanol aqueous solution as well as degradation of rhodamine B (RhB) under visible light irradiation. The Cu doping was found to improve the adsorption property of NaNbO₃ and accelerate the mineralization process.

Acknowledgments

We would like to express our sincere thanks to all the authors for submitting their articles to this special issue.

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